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Citizen participation in the digital sphere

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SCOPUS

CITESCORE 2020 (2021-22): (7.30): Q1 in Cultural Studies (position 2nd from 1,037) (percentile 99). Q1 in Communication: position 14th from 426 (percentile 96). Q1 in Education (position 24th from 1,319) (percentile 98).
SCIMAGO JOURNAL RANK: SJR 2020 (2021-22): 1.217: Q1 in Cultural Studies, Communication and Education (first journal in Spanish language in Education and Cultural Studies and second journal in Communication).

RECYT (FECYT-MEC)

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2020: Top 100 of Google: Position 2nd (from 100) in the Spanish ranking of all research journals areas. H5: 39. Mediana H5: 54. En 2021-07-21: H: 91; H5: 76 (46,984 accumulated citations).
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DIALNET METRICS

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2021: 2nd position among 1,199 selected journals from all areas. Rating: 58.364.

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Level INT2 (2020).

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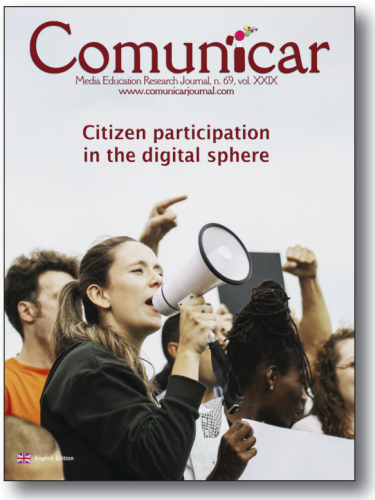

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Contents are peer reviewed, in accordance with publication standards established in the APA 7 (American Psychological Association) manual. Compliance with these requirements facilitates indexation in the main databases of international journals in this field, which increases the dissemination of published papers and therefore raises the profile of the authors and their centres.

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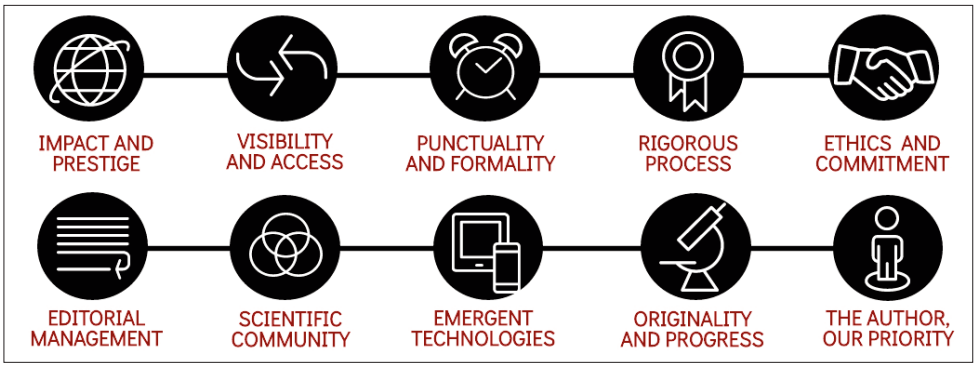

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- Received manuscripts internationalisation: 44 countries.
- Numbers of Reviews: 318 (112 internationals and 206 nationals) (update: www.comunicarjournal.com).
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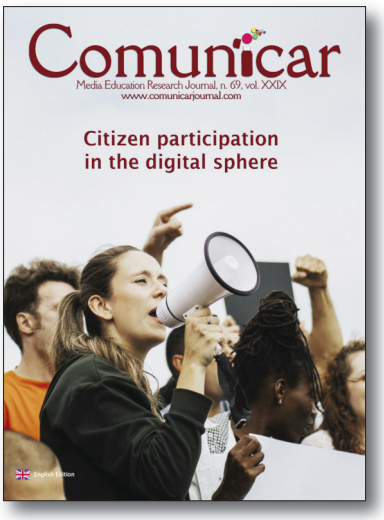

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Citizen participation in the digital sphere

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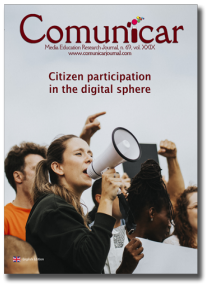

COVID-19 on YouTube: Debates and polarisation in the digital sphere

COVID-19 en YouTube: Debates y polarización en la esfera digital

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ABSTRACT

Social media has significantly transformed how political discussions and deliberations occur, mainly by providing a digital realm for the public sphere. This study aims to analyse the extent of polarised opinions across Spain, Italy and the United Kingdom regarding COVID-19 during 2020 within social media. To do this, we examined YouTube comments (n=111,808) using automatic analysis and machine-learning techniques based on algorithms. This methodological strategy denoted an innovative and unique quantitative approach for this field of study. In line with previous research, the hypothesis was that the degree of polarization does not crystallize in the same manner in different countries' digital spheres. Therefore, it could be said that higher levels of polarization occur amongst Southern European countries like Spain and Italy (both countries adhering to a polarised pluralism model), compared to other countries ascribing to the liberal model (the United Kingdom in our study), which provides evidence supporting previous research studies. The results confirmed the hypothesis that the polarization of digital deliberation between Spain and Italy is higher than in the United Kingdom. But, also, the findings based on more disaggregated analysis suggest that the most polarized attitudes are even rewarded by other users in Mediterranean countries.

RESUMEN

Las redes sociales han transformado de forma muy significativa la forma en la que se produce el diálogo político, impulsando una configuración digital de la esfera pública. El presente artículo tiene como objetivo el análisis de la deliberación producida en las redes sociales, con un especial énfasis en la polarización. Tomando como referencia los comentarios observados en YouTube sobre la COVID-19 durante 2020 en España, Italia y Reino Unido, lo cual arroja una muestra de 111.808 comentarios, se aplicaron una serie de técnicas automáticas de análisis basadas en algoritmos, lo que supone una metodología cuantitativa novedosa en este ámbito de estudio. En línea con lo señalado por trabajos previos, la hipótesis que se plantea en este artículo es que el grado de polarización no se da con la misma intensidad en las esferas digitales de distintos casos. De esta manera, cabe esperar unos mayores registros de polarización en la esfera digital de los países del sur de Europa, adscritos a un modelo de pluralismo polarizado, que en países de otros modelos como el liberal. Los resultados confirman la hipótesis, verificando que no solo se observa mayor polarización en España e Italia que en Reino Unido, sino que, a nivel desagregado, los hallazgos apuntan a que la actividad más polarizante obtiene mayor aprobación en los países mediterráneos de nuestra muestra.

KEYWORDS | PALABRAS CLAVE

Public sphere, YouTube, cyberpolitics, deep learning, polarisation, COVID-19.
Esfera pública, YouTube, ciberpolítica, aprendizaje profundo, polarización, COVID-19.

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1. Introduction and state of the art

The emergence and rapid development of digital technologies has ushered in a paradigm shift that affects both the media ecosystem and the configuration of the public sphere (López-García, 2005; Arias-Maldonado, 2016). Theorists have defined this concept as the communicative space in which issues of general interest are considered for discussion by concerned/affected citizens, fulfilling a series of admittedly ambiguous, normative criteria (Dahlberg, 2004). This process requires the mutual understanding of the participants, as well as a genuine, honest effort to reach a consensus (Serrano-Contreras et al., 2020).

The model shift, already identified by Jay Blumler (2018), has been linked to the concept of crisis (Davis, 2019). The connection seems even more evident during the pandemic, and has had a substantial impact on the transformation of the public sphere. In this sense, the theorisation of public spaces raises a new analytical perspective based on the concept of public horizons (Volkmer, 2014), which highlights the centrality of media in a constant process of evolution, in which the particular prominence of digital media is confirmed. The development of processes involving extreme fragmentation of the contemporary public sphere, accelerated by the environment imposed by digital communication, has led to a new definition of transition, such as the 'post-public sphere' (Davis, 2019; Schlesinger, 2020; Sorice, 2020).

The implications of the definitive expansion of social media are enormous. The consolidation of different forums such as Facebook, Twitter or YouTube is a good example (Dougan & Smith, 2016). The logic underpinning the functioning of social networks has also transformed the way in which political phenomena are received, perceived and discussed in the public sphere (Fung et al., 2013), which has now become a digital realm. However, the literature does not take for granted the positive effect on the deepening of political systems, and we can observe opposing views and arguments about the nature, dynamics and profile of this alteration (Gozálvez-Pérez, 2011).

On the one hand, the digital world has been consistently emphasised as the hope for promoting civic engagement, offering a wide array of democratic innovations that help make political discourse more pluralistic, facilitating greater involvement in public affairs, enabling citizens to monitor and control power, producing more information and providing new formats for the transmission of political content, and eventually culminating in participation in decision-making. So-called cyber-optimism (Bruns, 2008) suggests that ICTs could serve to articulate a more relaxed conversation among citizens, which does not happen in highly formalised, deliberative forums, helping to increase their nodal nature (Margetts, 2009). Through conversation, members of society clarify their own views, learn about the opinions of other interlocutors, and determine what problems citizens are facing (Stromer-Galley & Wichowski, 2011). Indeed, talking about issues of general interest with other citizens is considered necessary for a comprehensive understanding of democratic coexistence and thus for giving meaning to participation in political life (Rubio, 2000; Scheufele, 2001). To the extent that interaction is a vital component of democratic societies, these processes could lead to more inclusive and meaningful public deliberation (Bimber, 1998; Berry et al., 2010). In this sense, social networks show great potential in mobilising and empowering citizens, and in facilitating options for interacting with each other (and with their representatives), completely outside the more institutionalised, mainstream communication channels in the hands of large media corporations.

On the other hand, a more critical group of sceptical scholars (Fuchs, 2017) has argued that, far from the aforementioned optimism, the observed dynamics point to the fragmentation of this digital sphere and the consolidation of filter bubbles and echo chambers, phenomena whose scrutiny poses a number of significant methodological challenges, and which we have only recently begun to understand (Pariser, 2011)[1]. To the extent that there are different social networks and, within these, an almost infinite variety of distinct compartments, regular users end up choosing their interlocutors. In this sense, networks constitute echo chambers where we only hear the echo of our own voice (Sunstein, 2008), such that social empathy can be seriously damaged by identifying a drastic suppression of exposure to diversity (Prior, 2007) and a clear ideological homogeneity (Valera-Orgaz, 2017). Likewise, the high level of anonymity hidden in the network could constitute a means to exacerbate uninhibited communicative behaviour, moving in the direction of an increase in ill-mannered, disrespectful, uncivil, or aggressive political discussion (Rowe, 2014). In this vein, rather than facilitate rational and informed deliberation, networks function by

amplifying and modulating an atmosphere or public mood that is sometimes unreflective, manipulated and full of noise; this hinders calm reflection, underlining the notion of affective resonance (Fleig & von-Scheve, 2020). As Sunstein (2008) points out, given that the fragmentation of public opinion can reduce social cohesion, networks can make contact between different opinion groups more difficult, thus deepening the radicalisation of one's own opinions by never confronting their opposites (Reese et al., 2007).

At the same time, and perhaps related to the above, polarisation, or affective polarisation (Iyengar et al., 2019), has been incorporated as one of the main features of social and political phenomena in recent years, becoming an extremely important object of study in the field of political communication. Polarisation can be defined as the relative distance between two opposing political viewpoints. However, it is a concept in constant readjustment, although its primary meaning has to do with the growth of the space between poles, which is caused primarily by the influence of emotions and beliefs, rather than by reason and evidence (Mason, 2014; Olsson, 2013). These distinctions can lead to extreme positions (Fletcher & Jenkins, 2019; Gidron et al., 2019).

The aim of this proposal lies in the study of political deliberation from the angle of polarisation, which will be traced in a comparative way in relation to COVID-19, an issue that could be qualified as commonplace, as it is situated in the field of public health. Specifically, this article will explore the level of polarisation observed on the YouTube network during 2020 in relation to this matter in Spain, Italy and the UK, countries that represent differentiated models in political communication studies (Hallin & Mancini, 2004). To this end, the most relevant comments in connection to this episode will be examined using automatic analysis techniques based on algorithms, which is a novel, quantitative method in the field of study involved. Most of the research on political deliberation in recent years has focused on interactions observed on Twitter and Facebook (Bakshy et al., 2015; Conover et al., 2011; Gruzd & Roy, 2014; Jaidka et al., 2019; Oz et al., 2018). Underlying this is not only the projection of traditional leadership, but also a relatively simple collection of data in practical terms through its API. YouTube, on the other hand, has transitioned from a repository platform for audiovisual material to an environment that could be considered a social network several times the size of Twitter (with over 2 billion users versus Twitter's 340 million), and which offers similar interaction features with the inclusion of a recommendation system, the "likes", and data management (Allgaier, 2019).

2. Materials and methods

The hypothesis was formulated based on the following conditions: in countries with polarised pluralism models (Spain and Italy, in our case), a greater polarisation can be expected when analysing the political deliberation produced in the digital sphere compared to countries founded on the liberal model (United Kingdom). This hypothesis is supported by the differences revealed between these two systems where, moreover, in recent years, polarisation has been challenged by the profound transformations experienced due to both the unexpected electoral outcomes in some countries, and the impact of certain issues that abruptly burst onto the scene of public opinion (e.g. the Brexit referendum). If positive, it would confirm findings that affective polarisation is not the same in all countries (Boxell et al., 2020; Fletcher et al., 2020). In other words, polarisation may have a dependency relationship with regard to the society being examined, and not necessarily with respect to the media.

We extracted the sample for the analysis from YouTube with the following parameters: the 50 most viewed videos on the UK, Italian, and Spanish regional YouTube sites (".co.uk", ".it" and ".es") and with the search keywords "COVID" or "Coronavirus". We then extracted user comments for each of the 150 videos using the company's own API, for a total of 111,808 comments (15,933 from Spain, 27,468 from Italy, and 68,407 from the UK). Along with the comments, we downloaded other variables such as the number of "likes", the number of replies, the author's identity, and the video's identity. It is important to note that the data extraction, which took place on 29 December 2020, was based on popularity, so it does not represent the time period of the COVID-19 crisis, nor do the topics of the videos necessarily have to be similar (beyond dealing with the disease). To do otherwise would alter the results of the research by eliminating the selection made by citizens when approaching this social network. Once we acquired the corpus, we processed the text according to the standards of this type of study: the elimination of atypical

symbols, blank spaces, and tokenisation, among other aspects (see, for example, Meyer et al., 2008). As the number of extracted comments is massive, we did not consider a qualitative exploratory technique, so useful in other cases, to be appropriate. We deemed it necessary to apply an automatic technique for extracting and reducing the information contained in the sample for description. In this way, we were able to reduce the thematic complexity contained in the almost 112,000 comments to a few themes or ideas present in most of them (divided by country). In this regard, there are a multitude of existing techniques, from supervised algorithms (García-Marín & Calatrava, 2018) to unsupervised algorithms (such as LDA and LSI). Since the sample includes very varied texts, supervised algorithms do not seem advisable since the training should be based on all existing topics in very short texts. Therefore, we decided to apply an unsupervised technique, namely, a latent Dirichlet allocation (LDA) algorithm. This algorithm is a natural language processing (NLP) technique grounded in exploring the relationships between a set of documents and the terms they contain (so it is frequency-based) by producing concepts related to those documents and terms. The algorithm assumes that words with close meanings will co-occur in similar texts. The result is a set of topics present in each of the documents (a good explanation of its operation and usefulness can be found in Letsche and Berry, 1997), which shows that it is a fairly well-established technique.

However, the polarisation analysis is more complicated. First, we measured the polarisation of each unit of analysis (comment) through the development of its own index. We did this because the measurement of affective polarisation, defined as partisan identification, normally employs the survey as a reference methodology (Druckman & Levendusky, 2019). However, such an approach cannot be applied to anonymised data from social networks (i.e. to texts). To achieve this, we performed a classification by means of sentiment analysis, which allowed us to rate and classify the sample.

Since the sample is multilingual, we decided to use an identical analysis for the three languages (although adapted to the languages through a specific dictionary for each of them) and not to use three different analyses that could bias the results. We selected the tool Orange3 (Demsar et al., 2013) based on Python (which uses a multilingual dictionary for more than 50 languages). However, since this type of analysis does not provide more information than a statement about the positivity or negativity of words or phrases, we chose a way to measure polarisation in detail (Serrano-Contreras et al., 2020). To do so, we operationalised the polarisation of a comment as the distance between the sentiment analysis of that text and the median of the aggregate of the sentiment analysis of all comments from the same country (Spain, Italy, or the UK) in absolute number. In this way, we obtained a log that can take any value between 0 and 200, where 0 denotes no polarisation (although there can be both positive and negative sentiments) and 200 indicates maximum polarisation. That is, we defined polarisation not as the expression of the valence (negative or positive) of an expression, but as the difference between these valences. Thus, an isolated comment would not express any kind of polarisation on its own, but it would if its context was mostly opposed. For example, a negative comment was not polarising if the average comment was equally negative (such as condemnation of a criminal act). However, in the same environment, a positive comment would be considered polarising if it were outside the average.

Although the composition of the index may seem synthetic, the results provided are consistent with the perceived reality, as seen below. Naturally, the index is flexible enough to allow for changes in its composition; thus, we also extracted the polarisation per video or per author. Since the sample is very large, on the order of tens of thousands of comments, the polarisation will tend toward zero, as there will be many elements that will be cancelled or directly neutral. Therefore, small changes in the number will be quite significant.

Finally, the polarisation index has served as the basis for statistical analyses to model its dependence and to expose possible differences between these countries, which is the basis of our hypothesis.

3. Analysis and findings

Table 1, which summarises the sample captured from YouTube, serves as an initial source for our research proposal. From the angle of frequency analysis, we can see that the videos for Spain registered the fewest comments, slightly more than half of the comments for the Italian case, and less than a quarter of the comments for the British case. This could be a consequence of lower population figures, although

other factors may also be at play. Beyond these issues, the sample size is sufficiently large to consider the results of the statistical analysis meaningful.

Table 1. Summary of the sample by country

Country	Videos (n)	Comments	Authors	Comments / Author (DT)	"Likes"	"Likes" / Comments
Spain	50	15.933	7.291	2.18 (3.97)	49.102	3.08
Italy	50	27.468	9.578	2.87 (6.51)	83.972	4.69
United Kingdom	50	68.407	31.137	2.20 (5.05)	347.837	9.33

The rest of the variables included as possible explanatory factors follow a similar pattern: Spanish is the language with the fewest authors of comments and the fewest "likes". However, some differences can be perceived in the distribution of cases. On the one hand, the authors of comments in Spanish were less active (with an average of 2.18 comments) than those in English and Italian (with respective values of 2.20 and 2.87 comments). On the other hand, comments on videos about Spain also received fewer average "likes" (3.08) than those about Italy (4.69) and the UK (9.33). Naturally, this last fact is determined by the number of authors in each language.

If we go beyond a descriptive analysis, we can note relevant findings in relation to the content of the comments. As stated above, it is difficult to describe such a large sample. For this reason, we decided to use an unsupervised technique, LDA. We found of particular interest that after this process, we identified substantial differences between the three sets of text. Table 2 depicts the results of applying the algorithm.

In all three cases, the clusters of the algorithm show a rather pejorative use of language, although with substantial differences according to the language. For example, in the Spanish case, the first group is mostly composed of insults, but not in Italian or English, where words connected with public services ("scuola", "terapia") or government ("government") are found. Derogatory language is also present in the English and Italian samples, as are references to institutions in the Spanish sample, but not in the same order (which is hierarchical according to its importance in the sample) nor in the same quantity. Allusions to government policy are also frequent, but much more so in the Spanish and English comments, but not in the Italian comments. Another interesting element may be the appearance of conspiracy and denialist elements in the English ("Liverpool", "fake", "conspiracy") and Italian ("negazionisti", negationists) samples, but not in the Spanish sample.

Table 2. LDA results by country

Spain	Italy	United Kingdom
1: gracias, tonto, cojones, jajaja, ruina, jajajaja	1: grazie, grande, scuole, cervello, criminali, terapia	1: people, virus, like, covid, get, government, us, go, know
2: si, mas, virus, gente, solo, España, estan, gobierno, mundo, pais	2: virus, solo, persone, covid,	2: cant, false, british, pcr, bbc, millions, bollocks, hand, fool
3: dictadura, puedes, malo, historia, madre, siendo, politico, dimision, nivel, iglesias	3: chiudere, morire, natale, negazionisti, informazione, chiudono, funziona	3: getting, shit, comment, conspiracy, jesus, agree, happen, liverpool, thanks, evil
4: miguel, plan, jajajajajajaja, youtube, verano, gusto, corona, preveer	4: senso, colpa, bisogna, ridere, città, tampone	4: lies, test, fake, vaccine, corona, ever, lol, part, next, use
5: jose, che, don, ma, tontos	5: complimenti, azzimiei,	1: people, virus, like, covid, get, government, us, go, know

For the description of the polarisation variable, we decided to group the sample according to the language of the comments and the video or author. In other words, we measured the average polarisation of the videos and the authors of the comments, as seen in Table 3.

Table 3. Segmented polarisation

Polarisation	Spain	Italy	United Kingdom	Mean
By video				
Mean (DT)	6.91 (1.50)	6.24 (1.32)	2.57 (0.37)	5.26 (2.24)
Median [min, max]	6.57 [1.39, 11.9]	5.99 [1.39, 10.3]	2.56 [1.39, 4.28]	5.74 [1.39, 11.9]
By author				
Mean (DT)	7.78 (11.3)	7.08 (11.0)	2.68 (5.36)	4.33 (8.19)
Median [min, max]	3.85 [0.01, 103]	4.34 [0.06, 100]	0.48 [0.01,100]	1.70 [0.01, 103]

In the first case, the differences between each of the languages analysed are easily observable: the average polarisation is much higher in Spanish (6.91) and Italian (6.24) than in English (2.57). It is also

interesting to note that the standard deviation is much more pronounced for Spanish and Italian (1.50 and 1.32, respectively) than for English (0.37). In all cases, the average polarisation may be too low (after all, the index would theoretically move from 0 to 200). However, we should remember that this is a very large sample composed, for the most part, of non-computable terms (prepositions, articles, and emojis). This means that when the whole dataset is aggregated, even by language, it tends to zero. Similarly, we can state that even if we obtain quite small differences, they are still visible.

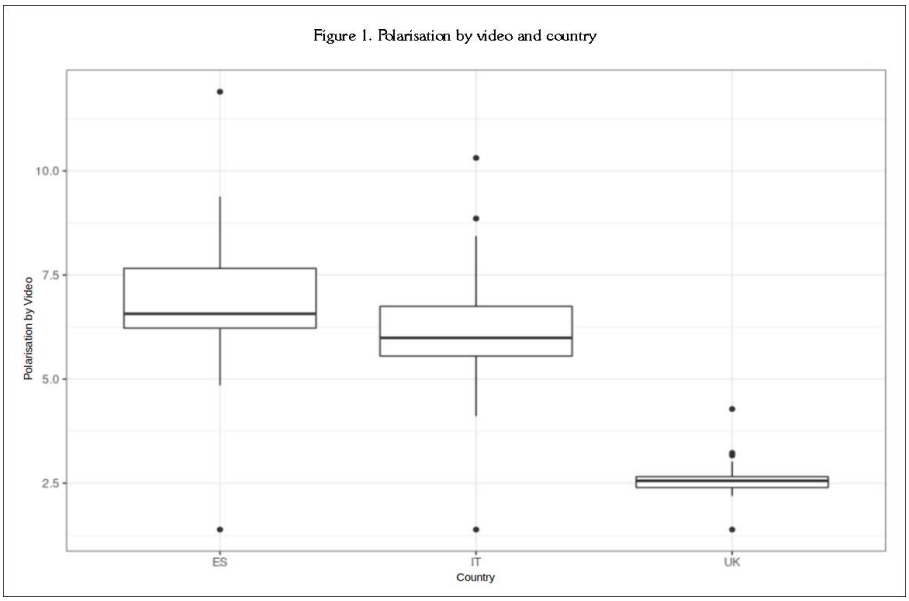
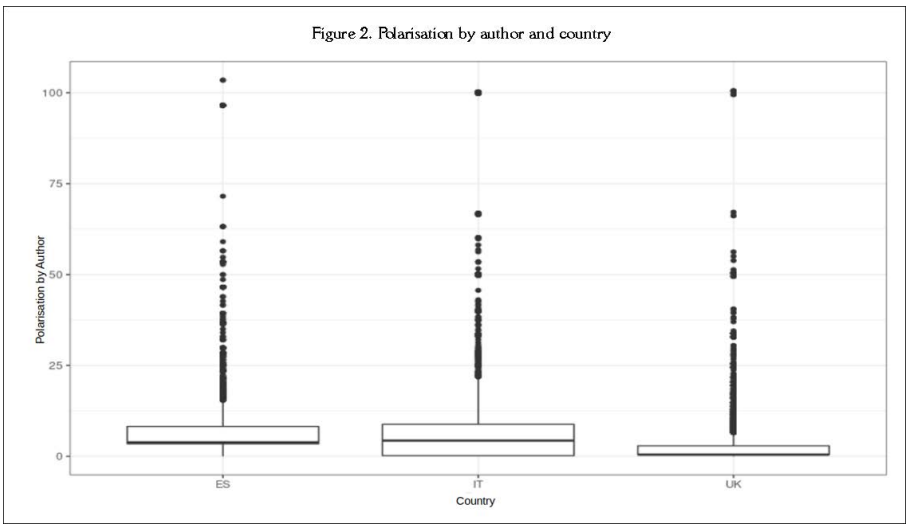


Figure 1 is a much more illustrative representation of the above. It is very clear that two different datasets are obtained: The Spanish and Italian comments, on the one hand, and the English case, on the other. Not only is the grouping of the segmented averages by case (country) striking, but also the wide dispersion for the first two cases: Spain and Italy.



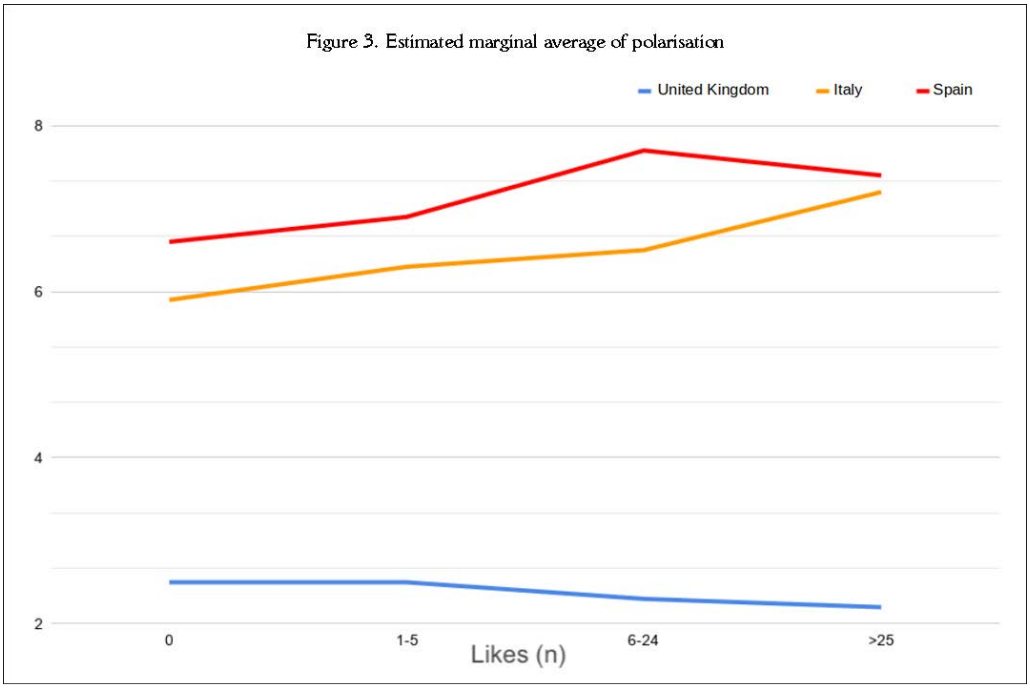
In the analysis of the comments disaggregated by author, the results reveal a similar pattern, as shown in Table 3: The average polarisation per author is highest in the comments in Spanish, followed by the comments in Italian and, at a great distance, the comments in English. It is equally interesting to see how the dispersion behaves in a different way: the minima and maxima in this case are very similar (from 0

to 100). This may mean that neither sample is free of highly polarising authors ("trolls", we could say), although these would be less numerous in the English case than in the Spanish and Italian cases. Again, Figure 2 portrays the results more clearly than the data included in the tables: although the English average is still lower than the Spanish and Italian averages, there are a multitude of equally polarising authors, but they tend to concentrate in the lower part of the graph.

Naturally, more complex statistical tests reflect a significant difference [2] between the variables "country" and "polarisation" ($F=3.521$, $gl=2$; $p<0.05$). The Tamhane, T3 Dunnett, and Games-Howell tests[3] indicate significant differences between the three countries and polarisation, although they are stronger between the UK-Spain sample (-4.22) and Italy (-3.54) than between the latter two (-0.67 Italy-Spain)[4]. The same happens if we add polarisation by video ($F=198.4$, $gl=2$, $p<0.05$; in this case, UK-ES -4.33, UK-IT -3.66 and IT-ES -0.67) or by the author of the comments ($F=1.969$, $gl=2$; $p<0.05$; UK-ES -5.10, UK-IT -4.40 and IT-ES -0.70).

Likewise, when crossing the variables "number of likes" and "country" in a univariate linear model, we found significant differences that explained a large part of the variability in polarisation (country*likes $F=9.259$, $gl=6$; $p<0.05$, $R^2=0.60$). These results are extremely interesting because they show a different pattern for the three countries, explaining the behaviour of polarisation in the sample. In this way, we can see a divergence between the behaviour of people who commented on the British videos and those who commented on the Italian or Spanish videos, as with the data presented above. As seen in Figure 3, in the British case, the number of 'likes' decreases along with the polarisation. The Italian case shows a completely opposite behaviour, with the most polarising comments having the most "likes". The Spanish case is similar to the Italian case, with the divergence that the most supportive comments are somewhat less polarising than the immediately preceding ones, but not by much (in any case, they are still more polarising than any comment in English or Italian).

Figure 3. Estimated marginal average of polarisation



Note. The "likes" per comment have been grouped into the four groups that can be seen on the x-axis.

It is important to note that "likes" always follow comments, so causal relationships could be established. Although the model is far from explaining the entire sample, we consider it very significant that in each segment (language), comments are rewarded or punished according to their polarisation. In this line, we assert that cultural—rather than situational—patterns could explain the differences. Hence, for the studied

sample, the variable "country" (language) is a good predictor of polarisation, and depending on it, the number of "likes" may also be a good variable to explain polarisation, either inversely (UK) or directly (Italy especially, but also Spain). However, we did not detect any significant relationships between the number of comments and polarisation by video or author or between the number of authors and polarisation, beyond the merely descriptive ones, as the sample is overrepresented in favour of comments in British videos.

4. Discussion and conclusions

Research on how deliberation takes place in the digital sphere has firmly established itself as a priority in disciplines such as political science, communication sciences, sociology and even computer science. We propose an innovative methodology to analyse political deliberation on social networks (YouTube) based on the use of algorithms to reach a standardised measure of polarisation.

After scrutinising the findings, we can confirm that the hypothesis underlying this proposal is verified. In countries with polarised pluralism models (Spain and Italy), treated as an independent variable, we observed a greater polarisation in political deliberation in the digital sphere in comparison with countries with the liberal model (United Kingdom). Similarly, the evidence shown specifies that in southern European countries polarising behaviour in the digital sphere is rewarded, which is not only not the case in the UK, but the opposite is true. Following Hallin and Mancini (2004), the first group of countries is characterised, among other things, by so-called political parallelism (political militancy of the media). Therefore, we interpreted this finding as a consequence of the extrapolation of the behaviour of traditional media to the digital communicative spaces that are formed in social networks. There would therefore be a process of feedback that would also infect the communicative dynamics in the digital sphere, which could be consolidated as a defining, confirmatory characteristic of the profiles that the aforementioned models propose for the political and media systems, functioning as an element of extension of the political parallelism, which is highly influenced by the political and media culture of each of the systems and is more intense in the models of southern Europe.

This happens, moreover, with an issue that can be considered commonplace, where a priori less polarisation is expected, although the role of some very active actors in the networks, such as the so-called negationists, make this a very interesting topic for discussion.

One of the most striking results of this research may help to elucidate the differences between theoretical and empirical studies on polarisation and social networks. Thus, analyses such as those by Spohr (2017), Parisier (2011), or Sunstein (2018) seem to indicate that polarisation could be a systemic effect of the functioning of information on the Internet and, more specifically, of social networks. However, empirical analyses have questioned these outcomes (Bakhsy et al., 2015; Dougan & Smith, 2016; Boxell et al., 2017; Allcott & Gentzkow, 2017). Our analysis may contribute some information to this debate by finding regional differences in the behaviour of affective polarisation in social networks, although it would not be the first contribution in this sense: Lee et al. (2014) already pointed out that polarisation could be linked to social networks but not with respect to all topics. Something similar is shown by Serrano-Contreras et al. (2020) when analysing polarisation with respect to three very different topics (elections in Spain, Catalan independence, and climate change). Above all, it seems to support the thesis of Boxell et al. (2020), who found very different behaviour across countries when examining affective polarisation from 1980 to 2015 in nine advanced democracies.

The dynamics of polarisation, described above, lead to a process of progressive fragmentation of the digital public sphere. The rupture of its unity is hence not replaced by a plural segmentation of interconnected public spheres (which seemed to occur in the initial phase of social networks, between 1997 and 2002), but by public spaces that often do not have reciprocal links or, in the best of cases, with weak links, and always under the condition of a strong polarisation process. The fragmentation of the public sphere, accelerated by digital communication ecosystems, produces a pulverisation of experiences and facilitates the emergence of resonance chambers, where the orientation action operated by algorithms does not play a secondary role in the information mechanisms. Our findings are in line with the results of previous research, pointing to the growth of filter bubbles, which play a role of ideological legitimation of

social networks themselves and, more generally, of what has recently been defined as the 'platform society' (van-Dijck et al., 2018), and to the processes of depoliticisation, from the post-representative tendencies of Western democracies, exacerbated by social networks, to the substantial transformation of the public sphere (Schlesinger, 2020; Sorice, 2020). Further, social networks help to form islands of information that constitute a sounding board for generating communicational linkage and saturation (Morlino & Sorice, 2021).

The results of this research raise additional questions, which could be a vein for future research. On the one hand, more countries could be included in the analysis to check whether this connection between polarisation and fragmentation is also recognisable in other countries with different political-institutional systems. On the other hand, the incorporation of other platforms, such as Twitter, Facebook or Instagram, into this same logic of analysis could verify whether the structure of polarisation occurs in the same way as on YouTube. In this line, checking the behaviour of deliberation on other topics would be an interesting anchor for comparison, and would contribute to a more precise discussion of this object of study. Finally, the inclusion of controls for other aspects (such as the structure of audiences in the different countries, which could function as intervening variables) could also represent a future advancement.

Author Contribution

Idea, O.L., J.G.M.; Literature review (state of the art), O.L., J.G.M., E.D.B.; Methodology, O.L., J.G.M.; Data analysis, O.L., J.G.M.; Results, O.L., J.G.M.; Discussion and conclusions, O.L., J.G.M.; Writing (original draft), O.L., J.G.M.; Final revisions, O.L., J.G.M., E.D.B.; Project design and sponsorship, O.L., J.G.M., E.D.B.

Notes

[1] The concept of a filter bubble refers to the dynamics of polarisation, determined by the use of algorithms that establish the creation of a digital sub-ecosystem. In other words, it is a property defined by the possibilities or structural qualities of the network; echo chambers, on the other hand, refer to homophilic mechanisms that are psychological in nature and play an important role in positional learning processes in the network.

[2] ANOVA with 1 factor and Welch's test confirmed that the data are not equal for all three countries, $p<0.05$.

[3] We used these statistics because we assumed that the variances were not equal.

[4] The differences portrayed are from the Tamhane test but are virtually identical in the other two tests. The results of the Tamhane test will also be shown in the rest of the article.

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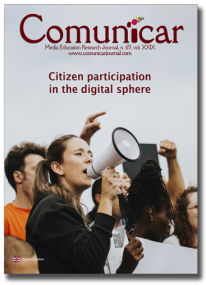

Citizen participation in Twitter: Anti-vaccine controversies in times of COVID-19

Participación ciudadana en Twitter: Polémicas anti-vacunas en tiempos de COVID-19

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ABSTRACT

Twitter has transformed into one of the main platforms for citizen engagement today. However, even though previous studies have focused on opinions about vaccines in general or about specific vaccines, opinions towards COVID-19 vaccines on Twitter have not been researched to date. The objective of this research is, by using social network analysis and language processing tools, to examine the degree to which the opinions and interactions present on Twitter are favorable or unfavorable towards the main COVID-19 vaccines. In addition, the relevance of each of the vaccines is studied, as well as their level of controversy. Likewise, the present study investigates, for the first time, the conversation from different perspectives including the content and also the participants, by analyzing in detail the verified accounts and using tools for the detection of bots. In global terms, the results from verified accounts show a moderate favorability towards the COVID-19 vaccines, the most accepted being those of Oxford-AstraZeneca, Pfizer, Moderna, and Sputnik V. On the other hand, the vaccine that attracts the most attention is the Russian Sputnik V, which is also the most controversial, behind those developed in China. Finally, verified users are shown to be relevant agents in the conversation due to their greater capacity for dissemination and reach, while the presence of bots is practically non-existent.

RESUMEN

Twitter se ha transformado en una de las principales plataformas de participación ciudadana hoy en día. Sin embargo, aun cuando estudios similares previos se han centrado en la opinión sobre las vacunas en general o sobre otras vacunas específicas, hasta la fecha no se han investigado las opiniones hacia las vacunas contra la COVID-19 en Twitter. El objetivo de esta investigación es, mediante el uso de herramientas de análisis de redes sociales y de herramientas de procesamiento del lenguaje, examinar el grado en el que las opiniones e interacciones presentes en Twitter son favorables o no hacia las principales vacunas de la COVID-19. Además, se estudia la relevancia de cada una de las principales vacunas, así como su nivel de controversia (polemicidad). Igualmente, el presente estudio investiga por primera vez la conversación no solo desde el punto de vista del contenido, sino también de los participantes que la integran, analizando en detalle las cuentas verificadas y empleando herramientas para la detección de bots. En términos globales, los resultados muestran una moderada favorabilidad hacia las vacunas de la COVID-19, siendo las más aceptadas las de Oxford-AstraZeneca, Pfizer y Moderna, y la de Sputnik V en el caso concreto de las cuentas verificadas. Por otro lado, la vacuna que más atención acapara es la rusa Sputnik V, que es además la más polémica por detrás de las de origen chino. Por último, los usuarios verificados se muestran como agentes relevantes de la conversación por su mayor capacidad de difusión y alcance, mientras que la presencia de bots es prácticamente inexistente.

KEYWORDS | PALABRAS CLAVE

Network analysis, quantitative analysis, misinformation, virtual communities, social media, critical thinking.
Análisis de redes, análisis cuantitativo, desinformación, comunidades virtuales, redes sociales, pensamiento crítico.

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1. Introduction and background

On March 11, 2020, the World Health Organization (WHO) attributed global pandemic status to COVID-19 in light of the alarming levels of disease transmission (World Health Organization, 2020a). Since then, the economic, social, and health consequences of COVID-19 have been, and continue to be, profound (United Nations, 2020; Yelin et al., 2020).

In a context in which the main containment strategies employed in most countries (social distance, confinement, restrictions on tourism, and other services...) have proven to be extremely costly from an economic point of view and insufficient to halt the advance of the virus, the main hopes for ending the pandemic lie in the development of specific drugs and, especially, vaccines (World Health Organization, 2020b). However, despite their proven efficacy in saving lives, as well as containing and eradicating diseases (Andre et al., 2008), vaccines have often been surrounded by controversy (Dubé et al., 2015) and have even suffered, in many cases, from direct opposition (Hornsey et al., 2018).

The reasons for this mistrust derive, among other reasons, from a postmodern cultural context that questions the legitimacy of science, the pharmaceutical industry, and medical authority (Bertin et al., 2020), and from a set of controversies about possible negative side effects associated with vaccines (e.g., Spier, 2001). Although studies have found no evidence to support such assumptions (Flaherty, 2011; François et al., 2005), doubt and suspicion have spread across the globe (Poland & Spier, 2010). All this has led the WHO to include distrust of vaccines in the list of the top ten global health threats (Friedrich, 2019).

In this regard, the COVID-19 vaccine is no exception, and one of the main reasons for distrust among those who speak out against receiving the vaccine is the fear of possible side effects, which is far ahead of other possible reasons, including the speed with which clinical trials have been conducted (Dror et al., 2020; World Economic Forum, 2021).

Much of this dialogue about the pandemic and the appropriateness of vaccines has moved from conventional media to social networks (Schmidt et al., 2018; Cuesta-Cambra et al., 2019) although not always with guarantees of reliability in the face of fake news (López-Rico et al., 2020). The debate is especially intense on Twitter (Himelboim et al., 2020; Meyer et al., 2019; Puri et al., 2020), which has become one of the main tools for channelling citizen participation (Auger, 2013). Among all social communication platforms, Twitter is unique in its ability to share and disseminate ideas in a fast and barrier-free manner due to its unique characteristics. For example, unless intentionally chosen otherwise, all tweets are immediately visible to everyone by default. In addition, it has mechanisms such as hashtags that facilitate dialogue on specific topics without the need to create delimited groups. Further, its retweet function makes it possible to disseminate information easily and immediately. Finally, unlike other networks such as Facebook, Twitter does not require reciprocal relationships between users which favours the emergence of central nodes for information dissemination (Colleoni et al., 2014).

As such, Twitter has become the worldwide platform that collects the opinions and information exchange of citizens regarding political (Manfredi-Sánchez et al., 2021), environmental (Vu et al., 2020), and social issues such as immigration (Gintova, 2019) and gender equality (Puente et al., 2021). Likewise, citizens have begun to use Twitter as a forum from which to claim civil rights (Yang et al., 2017), as a platform to denounce the violation of such rights (Xiong et al., 2019), and to carry out activist campaigns (Bosch, 2017).

Within the health domain, previous literature has analysed the debate that has arisen on Twitter about different specific vaccines and vaccines in general (Bello-Orgaz et al., 2017, Broniatowski et al., 2018; Himelboim et al., 2020; Milani et al., 2020; Tomeny et al., 2017). However, due to its recent nature, there has been no opportunity to analyse citizen dialogue regarding COVID-19 vaccines. Studying and monitoring the opinions and information shared on Twitter around a socially relevant topic such as vaccines against this coronavirus is important, first, because it can help the scientific-medical community to identify concerns, interpretations, and misconceptions, and to design specific messages that serve to clarify or disprove them. Secondly, because such opinions can be representative of the social climate of opinion in its entirety (Graells-Garrido et al., 2019); this allows predictions to be made regarding the subsequent behaviour of citizens (Burnap et al., 2016). Thirdly, the study of such opinions and content is relevant because, beyond its representativeness, it can be a key factor in shaping or influencing the attitudes of the

participants of the conversation being able to become, in this particularly sensitive area, a tool of information or disinformation that propagates unscientific theories and opinions that have real health, economic, and social consequences for the population as a whole (Kouzy et al., 2020) since an increasing number of people are turning to the Internet for information on whether or not to be vaccinated (Jolley & Douglas, 2014).

On the other hand, to date, most previous research on platforms such as Twitter does not differentiate between different audiences when analysing discussions and opinions. However, given that this network allows for the identity and specific data of its users (such as their professional careers, for example) to be recorded through verified accounts (i.e., those accounts identified by Twitter with a blue badge which confirm their authenticity), it is relevant to study the extent to which opinions on a medical and scientific topic such as these vaccines vary according to these characteristics. This approach is novel since, with some exceptions (Sued-Palmeiro & Cebral-Loureda, 2020), practically all research on Twitter has focused mainly on studying the content of messages, but with little attention paid to the individuals who generate and disseminate them. Specifically, identifying the presence and behaviour of different social sectors can be of great use to health professionals and institutions as it would allow not only to detect currents of opinion and specific needs but also to design and disseminate specific interventions for certain sectors (Tomeny et al., 2017).

At the same time, taking a closer look at the behaviour of those users who have verified accounts brings an additional advantage since the users of such accounts have differential qualities and requirements. Specifically, only those accounts that are qualified by Twitter as being of "public interest" can be verified, i.e., the account must belong to a socially relevant issuer and be active (Twitter, 2021). These accounts, therefore, are of special interest since, by their very definition, they can exert greater influence on the conversation inside and outside the platform.

Moreover, its use not only allows us to identify personal information that facilitates the social categorization of individuals participating in the dialogue, but also to avoid the presence of malicious agents such as bots, trolls, etc., that distort and adulterate the conversation (Subrahmanian et al., 2016). As such, previous research has already highlighted the existence of bots in vaccine debates where they play the role of disseminators of anti-vaccine messages (Broniatowski et al., 2018). Therefore, it is also of interest to shed light on their presence and role in the conversation about the COVID-19 vaccine currently taking place on Twitter.

In short, the present study is guided by the following research questions:

- Which are the most relevant vaccines? Which vaccine generates the most participation and dialogue?
- What is the sentiment or favourability towards the main COVID-19 vaccines?
- What is the specific activity carried out by the verified accounts? Are there differences in favourability of the different vaccines based on the different professional categories of these users?
- How often are bots present in the conversation? What is their activity?

2. Methods and materials

In order to study Twitter conversations, Social Network Analysis methodology (SNA) was used (Brand & Gómez, 2006). In the first phase, tweets related to the object of study were downloaded using NodeXL pro (Hansen et al., 2010), a program for obtaining social network data, and then processed through SNA. To obtain the data, all the tweets published and their respective interactions (replies, mentions, retweets, and mentions in retweets) that cited any vaccines that were in Phase 3 of their research were downloaded, these vaccines include, Moderna, Pfizer, three vaccines of Chinese origin (Cansino, Sinovac and Sinopharm), Sputnik V, and Oxford-AstraZeneca.

To select the days of greatest interest concerning vaccine discussions, data was obtained during the first four days after efficacy data were announced for each of the four vaccines that had made their results public before November 30, 2020 (Pfizer, November 9; Sputnik V, November 11; Moderna, November 16; Oxford-AstraZeneca, November 23) (AJMC, 2020; Callaway, 2020). On each of these four days,

tweets were downloaded that also alluded to, in addition to the four vaccines mentioned above, three others that were in Phase 3 (the Chinese CanSino, Simovac, and Sinopharm). The program downloaded a total of 49,776 interactions by 25,692 Twitter users, of which 2,970 were original tweets. Sometimes tweets referred to more than one vaccine, so after the number of tweets mentioning each vaccine was counted, those messages mentioning several vaccines were counted once for each vaccine mentioned. Additionally, the data collection tool did not count favourites as an interaction, so these favourites were later counted separately.

2.1. Study variables

Relevance: To identify the relevance of each vaccine, the number of users was counted as well as the number of tweets that mentioned each vaccine. Different indices were then generated to represent different relevance parameters:

- Total Activity Index is the proportion in which the users of each vaccine conversation participated in the conversation (no. of interactions/no. of users). This index makes it possible to determine which of the vaccines had the most activity on the network.
- Original Activity Index is the proportion of users in the conversation for each vaccine who participated in the conversation by issuing an original tweet (no. of tweets/no. of users). This index helps determine whether there was a greater initiative on the part of the users to start a discussion through original tweets.
- Reaction Index is the degree to which tweets about a particular vaccine were able to provoke interactions by the recipients (no. interactions/no. tweets in which the vaccine is mentioned).

Favourability: To establish the degree to which users were favourable to COVID-19 vaccines in general, as well as to each of them, a "Favourability Index" was created. This index is presented as the sum of those reactions that indicate acceptance or agreement with the content of a tweet (retweets and favourites) multiplied by the sentiment or polarity (either positive or negative) of that tweet. Higher values in this index reflect greater support for each of the vaccines, while lower values will imply greater rejection.

To calculate the sentiment or polarity index of each tweet, the TextBlob Sentiment Analysis tool (Loria, 2020) was used through Python (Oliphant, 2007). TextBlob is a library programmed in Python for processing textual data. It provides an API to perform natural language processing (NLP) tasks, such as part-of-speech tagging, noun phrase extraction, sentiment analysis, classification, and translation among other utilities. In this case, the polarity returned by the tool using a lexicon method for each tweet is a numerical value within the range [-1.0, 1.0] where -1 identifies a message with a very negative sentiment and 1 with a very positive one. The level of effectiveness of the program has been previously contrasted in published research (Fauziyyah, 2020; Micu et al., 2017).

Controversy: To establish the degree to which the conversation is or is not controversial (i.e., includes both favourable and unfavourable opinions), a "Polemic Index" was created (see Denia (2020) for a conceptually similar index). This index aims to capture the ratio between the number of reactions provoked by tweets mentioning a vaccine and the favourability of those reactions (reaction index/favourability index). Higher values in this index suggest a higher degree of controversy.

Verified accounts and professional sectors: The tweets that came from users whose accounts were verified by Twitter were identified and examined, as this was considered to be the only way to ensure that the person behind the user account was truly the one indicated. Once these users (973) were identified, they were grouped into the 16 most repeated categories, as well as an "other" category. These groups were then sorted into four major categories or sectors with their corresponding subcategories, as follows: Science and health (scientific journals, scientific associations, scientists, healthcare, and pharmaceuticals); Communicators and media (journalists, media, communicators); Politics and government (politicians and public institutions and administrations) and Civil society (athletes, lawyers, artists, economists, sports institutions, and others).

Diffusion: To measure the degree of diffusion of each user's messages. This index was established by multiplying the number of followers of each user by the number of retweets of their messages. Higher values indicate greater reach or viral capacity of the user.

Bots: To identify the degree to which bots were present in the conversation as well as their most common behaviours, the Python library, Botometer, (Botometer, 2020; Yang et al., 2017), was used. This detection system, which has been commonly used for the identification of bots in Twitter conversations (e.g., Broniatowski et al., 2018), analyses a user's characteristics to different variables and returns a value in an interval between 0 and 1 where 1 indicates that a user's characteristics match those of a bot 100%, and 0 when they do not. A user with a value of 0.3, for example, indicates that a user has the same characteristics as a bot 30% of the time. When analysing the differences between variables, statistical tests were used to show whether these differences were statistically significant. If the data did not show a normal distribution, non-parametric tests such as Kruskal-Wallis (Ostertagova et al., 2014), Mann-Whitney U (McKnight & Najab, 2010), or Chi-square (McKnight & Najab, 2010) were used.

3. Analysis and results

3.1. Relevance of vaccines in the network

As can be seen in the data collected in Table 1, the most relevant vaccine in terms of the number of users who talked about it, as well as the number of tweets that were published mentioning it, was the Russian vaccine (Sputnik V), followed by Pfizer, Moderna, Oxford-AstraZeneca. and those manufactured in China. Table 2 data shows that the vaccines with the most active interlocutors were Sputnik V (each user averaged 7.73 interactions), followed by Pfizer (5.39), Moderna (4.74), Oxford (4.37), and the Chinese vaccines (2.74). Similarly, the Russian vaccine provoked the most reactions (72.56 interactions per tweet posted), ahead of Oxford-AstraZeneca (66.73), Pfizer (61.41), Moderna (60.48), and the Chinese-produced vaccines (21.32).

3.2. Favourability towards vaccines in conversation

The polarity analysis tool used indicated that the average overall sentiment towards all COVID-19 vaccines was moderately favourable or positive ($M=0.11$; $SD=0.19$). When polarity or sentiment towards each vaccine was analysed, the results showed that polarity values could be grouped into three levels with Pfizer ($M=0.16$; $SD=0.198$) and Moderna ($M=0.16$; $SD=0.19$) as the vaccines with the highest positive values. A second group was found within the set of three vaccines of Chinese origin ($M=0.13$; $SD=0.17$) and the Oxford vaccine ($M=0.12$; $SD=0.18$) with lower mean relative positive sentiment values for the Russian Sputnik V vaccine ($M=0.098$; $SD=0.19$). The analysis revealed that these differences were statistically significant (Kruskal-Wallis $(4)=53.022$; $p<0.001$). On the other hand, when the favourability index was calculated (by taking into account not only the sentiment or polarity of each tweet, but also the number of favourites and retweets) for each of the vaccines (Table 2), the results showed that the Oxford-AstraZeneca vaccine received by far the highest acceptance ($M=21.58$; $SD=54.70$), followed by Pfizer ($M=13.85$; $SD=59.25$), Moderna ($M=10.23$; $SD=25.17$), Sputnik V ($M=7.88$; $SD=58.05$), and finally the three Chinese vaccines ($M=1.34$; $SD=5.23$) which, although they did not generate negative sentiment, was rather neutral. These differences between the vaccines were also identified as significant (Kruskal-Wallis $(4)=70.337$; $p<0.001$).

Table 1. Main indicators for each vaccine analysed

	Moderna	Pfizer	Cansino, Sinovac and Sinopharm	Sputnik V	Oxford-AstraZeneca	Total
Users	1.169	3.911	296	22.122	611	28.109
Interactions	5.546	21.083	810	170.954	2.669	201.987
Responses	40	216	97	2.236	49	2.638
Retweets	965	3.374	223	25.874	485	30.921
Favourites of the original tweets	4.367	16.927	465	133.267	2.091	157.117
Tweets	107	343	38	2.356	40	2.884
Mentions in retweets	113	251	4	7.575	24	7.967
Mentions	61	315	21	2.002	20	2.419

Finally, the vaccines with a significantly higher degree of controversy (Polemic Index) than the rest were the Chinese vaccines with an index of 15.82, followed by the Russian vaccine (9.21). The vaccines with the lowest level of controversy and discussion were Moderna (5.06), Pfizer (4.44), and Oxford (3.09). (Kruskal-Wallis $(4)=47.370$; $p<0.001$).

Table 2. Vaccine-specific indices					
	Moderna	Pfizer	Cansino, Sinovac and Sinopharm	Sputnik V	Oxford-AstraZeneca
Total activity index	4.744	5.391	2.736	7.728	4.368
Original activity index	0.092	0.088	0.128	0.107	0.065
Reaction index	51.832	61.466	21.316	72.561	66.725
Polarity index	0.16	0.16	0.13	0.10	0.12
Favourability index	10.23	13.85	1.34	7.88	21.58
Polemic index	5.06	4.44	15.82	9.21	3.09

3.3. Verified accounts

Of the total number of tweets (2,868), the authors were identified and tweets were catalogued according to whether their user account was verified or not, which made it possible to identify the person or institution behind each. The data showed that 22.7% of the tweets came from users with verified accounts.

Through the analysis of the type of activity carried out by this type of user, the data indicated that, as expected, 47.11% were focused on the publication of original tweets, while mentions in retweets occupied 20.55% of their activities. This was followed by replies to original tweets (16.14%), mentions to other users (9.55%), with retweeting messages from other participants (6.66%) being their least common activity. As can be seen in Table 3, since users of verified accounts are more prolific than other participants, they showed significantly more activity compared to users in the general sample.

In turn, when the main variables (relevance, favourability, and controversy) were analysed by examining only users with verified accounts (Table 3), the results showed that for these participants, the most relevant vaccine in terms of the number of users involved in the conversation as measured by their activity and the number of reactions generated continued to be the Russian Sputnik vaccine, followed by Pfizer's.

Regarding favourability, although Pfizer is the vaccine with the most positive polarity or sentiment index (0.19), this time it was the Russian Vaccine Sputnik V which, when considering the number of favourites and retweets, has a higher favourability index (19.71) among the verified users, although the differences were not significant (Kruskal-Wallis $p>0.05$).

The greatest controversy among verified users corresponds by far to the Chinese vaccines (13.18) followed by Sputnik V (4.99), Moderna (4.25), and Oxford-AstraZeneca (3.96), while Pfizer generated the least controversy (3.05). In this case, the differences were not statistically relevant (Kruskal-Wallis $p>0.05$).

Table 3. Main indicators analysing verified users only					
	Moderna	Pfizer	Cansino, Sinovac and Sinopharm	Sputnik V	Oxford-AstraZeneca
No. of verified users	69.00	196.00	26.00	656.00	26.00
Total activity index	11.72	19.06	10.31	79.50	3.77
Original activity rate	0.29	0.39	0.77	0.81	0.15
Reaction index	40.45	48.52	13.40	98.40	24.50
Polarity index	0.139	0.190	0.124	0.164	0.122
Favourability index	9.52	15.91	1.02	19.71	6.19
Polemic index	4.25	3.05	13.18	4.99	3.96

When the Mann-Whitney U test was performed to compare the sentiment or polarity of the messages according to whether the account of the author of the tweet was verified independent of any vaccine being mentioned, significant differences were found ($U=848.358$; $p<0.001$). Specifically, the mean sentiment of tweets from verified accounts was more positive ($M=0.16$; $SD=0.20$) than from unverified accounts ($M=0.099$; $SD=0.20$).

Consequently, it was relevant to analyse the diffusion of messages from verified accounts compared to unverified ones. To create this "diffusion index", the number of followers of each author's tweet was multiplied by the number of retweets it received. When the data were analysed, the results showed relevant differences (Mann-Whitney $U=1,280,576$; $p<0.001$). The average diffusion of the verified accounts was 30,567,660.99 ($SD=137,569,250.48$), while the unverified ones obtained a diffusion of 635,946.47 ($SD=4,757,267.29$). In other words, the tweets of verified users reached more users in the network than the tweets of unverified users.

In turn, the classification of the verified accounts that had published an original tweet according to their professional sector revealed a majority of participants belonging to the category of media and communicators (95.7%). The remainder was made up of users classified as civil society (1.84%), science and health (1.38%), and politics and government (1.08%). When the differences between the categories were analysed in terms of polarity and general favourability towards vaccines, the results were not significant (Kruskal-Wallis $p > .05$).

3.4. Presence and activity of bots in conversation

The bot index that the analysis tool generated for each user was categorized into three groups. First, users with a value below 20% as very likely human, those with a value above 80% as likely bot, and the rest an intermediate probability. The frequencies indicated that 63.9% of the users were very probably human and only 0.3% probably bots, indicating an exceptionally low presence of the latter.

This index was not equally distributed among the different vaccines ($x^2(8)=21.25$; $p<0.01$), however. The vaccines of Chinese origin presented significantly more users with a high probability of being bots (1.6%) compared to the others which ranged from 0.2% to 0.3%.

The most common activities presented by users identified as bots were those that might be expected: 58.25% of them were retweets and 13.11% are mentions with retweets. These were actions aimed at disseminating other users' messages, which is the main function of a bot. In turn, they allocate 12.14% of their actions to mentions, 8.74% to the publication of original tweets, and finally, 7.77% to replies.

4. Discussion and conclusions

In a context of where digital communication is gaining greater presence, Twitter has become one of the most relevant platforms for citizen participation and opinion today by hosting debates on topics as diverse as politics, the environment, social reform, and health (Auger, 2013). However, the conversation about a seemingly controversial topic as relevant from a social, economic, and health point of view as that of COVID-19 vaccines has not yet been analysed. For this reason, the present research has focused on the study of both the opinions and information expressed about the main COVID-19 vaccines and the behaviour of the participants who make up this conversation on Twitter.

The results obtained indicate that, despite the apparent media controversy, the general sentiment towards these vaccines was moderately positive. These data agree with the latest surveys conducted in 15 countries which showed a broad acceptance of COVID-19 vaccines by the majority of the population (World Economic Forum, 2021). They also coincide with Spain's results, for example, where surveys also showed greater favourability towards vaccines, especially as their arrival was confirmed (CIS, 2021). Although we should be cautious with the interpretation of the data since they only allow us to observe an image of a specific moment, these results can be relevant because they suggest that the analysis of citizen participation collected on Twitter can have a certain diagnostic capacity about the opinions of the general population by being both a faster and less costly method than traditional surveys. Although the methodology used does not allow us to examine the specific contents of these opinions and, therefore, does not allow us to identify misconceptions or imperceptions about COVID-19 vaccines, the study of their favourability does at least allow us to infer the dominant climate of opinion on the platform which can then provide an approximate view of the general climate of opinion. As noted in the introduction, this climate of opinion is relevant because it can be used to make predictions about the subsequent behaviour of citizens which, in this particular case, could translate into a large percentage of citizens willing to receive the vaccine. In addition, the climate of opinion on the platform may also have had consequences in shaping or influencing the attitudes of the participants in the conversation. This apparent majority acceptance towards vaccines is important news as the open existence of discrepancies can suggest that there is not enough scientific consensus on vaccines, thus reducing confidence in them (Dixon & Clarke, 2013).

In turn, when studying the differences in acceptance among the different vaccines, the research found that those receiving more favourable treatment were those of Oxford-AstraZeneca, Pfizer, and Moderna, indicating a greater confidence in vaccines of Western origin than those manufactured in countries such as China and Russia whose quality standards are less transparent.

On the other hand, and for the relevance of each of the vaccines, the Russian Sputnik V was by far the one that generated the most conversation, the one with the most active interlocutors, and the one that elicited the most reactions. It should be noted, therefore, that monopolizing much of the conversation, as it is with Sputnik V, does not improve the perception of the vaccine. In fact, after the Chinese vaccines, the Russian vaccine is the one that generated the most polemic and controversy, with a high proportion of positive and negative messages. However, the present research highlights the relevance of paying attention not only to the content of the conversation but also to the nature of its participants. Specifically, this research reveals the convenience of studying in detail those users with verified accounts, since, as the data indicated, these are users who, with respect to this topic, were not only more active but also demonstrated a diffusion power almost fifty times higher than non-verified users. In addition, half of their activity is devoted to publishing original tweets, i.e., generating their own content and much less replicating what others say, which demonstrates a greater commitment to the conversation than other participants. One possible explanation of this could lie in the fact, at least as far as the conversation about vaccines is concerned, that these are users who are in the communication sector. Finally, it is interesting to note that their messages, compared to the rest of the users, were significantly more positive towards vaccines, indicating greater support and acceptance of vaccines. Therefore, our research suggests that any health authority wishing to convince the population of the proven benefits of vaccines could have an effective ally in them. Furthermore, the analyses indicate that the presence of bots, which can distort the analysis of the conversation under study, was practically marginal. However, it is interesting to note that almost all the accounts that matched the profile of a bot were related to vaccines of Chinese origin. Finally, given that our study examines only tweets published in Spanish, future research would benefit from extending the analysis to all messages written in other languages, especially English, to gain a more global perspective of the conversation. It would also be desirable for future research to examine the temporal evolution of the debate, incorporate new emerging vaccines into the analysis, and include new study variables such as the objectivity and subjectivity of the messages.

Author Contribution

Idea, R.C, M.A., E.V.; Literature Review (state of the art), M.A., E.V.; Methodology, R.C., M.A.; Data analysis, R.C.; Results, R.C.; Discussion and conclusions, M.A., E.V.; Writing (original draft), R.C., M.A., E.V.; Final revisions, R.C.; Project design and sponsorships, M.A., R.C.

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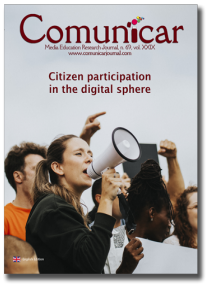

Children's participation, local policy and the digital environment: Visions and uses among Spanish municipalities

Participación infantil, política local y entorno digital: Visiones y usos en municipios españoles

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ABSTRACT

Children's policies at the local level stimulate initiatives in the municipalities to encourage child participation. In this article, we focus on the local political sphere as a space for the promotion of child participation and citizenship through digital mediation. It is in this immediate environment where the rights of children and adolescents are exercised and promoted. The study aims to analyse the contributions perceived by municipal leaders (elected officials and technical figures) of the digital environment and the uses they make of it to promote children's participation in the municipality. This study is part of a national project that includes as collaborating entities the International Association of Educating Cities (IACE) and Child Friendly Cities (CAI-Unicef). 279 subjects (191 technical figures and 88 elected officials) from 179 Spanish municipalities associated members of IACE and/or CAI. Data were collected in 2020. Two ad hoc designed questionnaires were applied. Two of the most significant results of the study are: (a) the finding of the variable that establishes differences between those technical figures that mediate children's participation with technological environments and those that do not; (b) the use made of the digital environment as an interactive space for informational purposes. It concludes on the need to rethink the digital environment as a participatory area and increasing the use of technology in support of children's citizenship.

RESUMEN

Las políticas de infancia a nivel local dinamizan en los municipios iniciativas para impulsar la participación infantil. En este artículo nos centramos en la política local como espacio promotor de participación y ciudadanía infantil a través de la mediación digital ya que es, en ese entorno inmediato, donde los derechos de la infancia y la adolescencia se ejercitan y se promueven. El estudio persigue analizar qué aportaciones perciben los referentes municipales (cargos electos y figuras técnicas) del entorno digital y qué usos hacen de él para impulsar la participación infantil en el municipio. Este estudio forma parte de un proyecto nacional que cuenta como entidades colaboradoras a la Asociación Internacional de Ciudades Educadoras (AICE) y Ciudades Amigas de la Infancia (CAI-Unicef). Han participado en él 279 sujetos (191 figuras técnicas y 88 cargos electos) procedentes de 179 municipios españoles asociados a AICE y/o CAI. Los datos fueron recabados en 2020. Se aplicaron dos cuestionarios diseñados ad hoc. Dos de los resultados más significativos del estudio son: a) el hallazgo de la variable que establece diferencias entre aquellas figuras técnicas que median la participación infantil con entornos tecnológicos y con las que no lo hacen; b) el uso que se hace del entorno digital como espacio interactivo con fines informativos. Se concluye en la necesidad de repensar el entorno digital como un espacio participativo e incrementar el uso de la tecnología al servicio de la ciudadanía infantil.

KEYWORDS | PALABRAS CLAVE

Participation, childhood, virtual environment, participatory culture, rights of the children, municipal government.
Participación, infancia, entorno virtual, cultura participativa, derechos del niño, gobierno municipal.

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1. Introduction

Citizen participation in public life plays an important role in democratic societies whose public policies seek to diminish the problems of citizen disaffection and governance, which characterize contemporary democracies (Díaz-Aldret, 2017; Innerarity, 2020). For the past three decades, child participation has been incorporated into international standards (Convention on the Rights of the Child, 1989 (Art.12); Council of Europe Recommendations on the participation of children under 18 (2012); goal 16.7 of the 2030 Agenda for Sustainable Development (UN General Assembly, 2015) and the UN Committee on the Rights of the Child (2016). This body of legislation has favoured various municipal initiatives to improve children's participation (children's participation bodies, participatory budgets, children's groups, etc.); for example: "The Children's City" (Tonucci, 1997), from which the initiative "My City with Children's Eyes", "Child Friendly Cities" (UNICEF) (https://bit.ly/3nQTJHG), Save the Children, Global Kids and Eurochild programmes, through children's councils targeting 8–17-year-old children.

Technologies have brought profound changes that affect the democratic culture and participatory practices of children and young people (De-la-Garza-Montemayor et al, 2019). What we do know is that children and adolescents use social media as a source of information on political and social issues, and that they perceive them as a quick and useful way to exercise their right to participation (give opinions, deliberate, make proposals, develop projects, support solidarity initiatives, and formulate protests) (Cho et al., 2020). Despite this, civic participation is scarce at this age and there is no clear awareness of digital media being seen as civic technology (Dias-Fonseca & Potter, 2016; Murden & Cadenasso, 2018).

1.1. Children's participation and the digital environment

From an inclusive citizenship approach, children's participation is understood as the process by which children, individually and/or collectively, express their opinions and decisions in matters that concern them directly on the basis of their age and maturity (Convention on the Rights of the Child, 1989). Unicef (2019) links child participation to a process of power transfer from adults to children, which transforms children from passive recipients to active, informed agents capable of influencing decisions that affect their lives.

Recent studies find that the digital environment can mobilise different levels and types of civic participation (Hart, 1992; White, 1996; Trilla & Novella, 2001; Tambouris et al., 2007; Guilló & Mancebo-Aracil, 2017; Unesco, 2019) and e-participation (Cáceres-Zapatero et al., 2015) which, as proposed by Lobera and Rubio (2015), ranges from information, communication, deliberation, and consultation/decision-making to creative action.

In relation to children's participatory processes, one of the challenges faced by the political sphere is the need to provide this citizenry with offline and online scenarios for exercising citizenship, so that they can assume active roles, with responsibility and autonomy in the local, national, and global spheres (Livingstone et al., 2020; Kamruzzaman, 2020).

Digital technologies enable new forms of political and citizen participation based on horizontality and connectivity (Claro et al., 2020), including children's participation (Council of Europe, 2016; UNICEF, 2016; Kaun & Uldam, 2017; Dennis, 2018; Boulianne, 2020). However, there is still a long way to go in terms of democratic innovation (Jenkins & Carpentier, 2013; Jennings et al., 2020), e-citizenship and children's empowerment.

1.2. A digital environment for children's participation

Recent studies have showcased the potential of technologies with children and young people in terms of citizen participation (Khalil, 2017; Roque et al., 2016). They are often thought of as socio-political innovations, rather than as consolidated realities in practice. As Save the Children Sweden (2020) demonstrates, the potential that policy makers see in technological devices to promote children's participation is high, but in practice their use is residual. At a discursive level, institutional narratives on children's e-participation oscillate between risk narratives (ICTs as potential threats) and empowering narratives (ICTs as transformative tools) (Livingstone et al., 2017). The EU Kids Online Network study (Smahel et al., 2020) reveals that digital practices among 9–16-year-olds are commonly recreational and relational, but not civic and political. It is known that the participatory potential of technology depends

on the civic and political uses made of it and that the more participatory experiences children have in the offline world, the more likely they are to engage in participatory processes online and vice versa (Boulianne & Theocharis, 2018). This study analyses municipal initiatives in the Spanish context aimed at promoting children's participation through digital environments. The research presented here is part of an emerging line of research on children's participation in local politics through the digital environment. Specifically, it aims to analyse the contributions perceived by municipal leaders (elected officials and technical figures) of the digital environment and the uses they make of it to promote children's participation in the municipality.

2. Materials and methods

In the research design (https://bit.ly/3nTqnIp) a descriptive study (phase 1) was carried out on the state of children's participation in Spanish municipalities that are members of the International Association of Educating Cities (IAEC) and Child Friendly Cities (CAI in Spanish). The study had an exploratory and diagnostic purpose covering the Spanish context and it integrated the design and application of a questionnaire in the framework of a self-administered online survey study (Díaz-de-Rada, 2021) to take a census of the forms of children's participation present in the municipalities, to learn about the elements and practices that characterise the forms of participation identified and to describe the exercise of citizenship by children. One of the elements explored was the digital environment.

2.1. Participants

The sample consists of 279 subjects: 88 elected officials, councillors with political leadership functions and 191 technical figures, civil servants with programme coordination and dynamisation functions. They come from 179 Spanish municipalities belonging to the universe of 386 municipalities associated to IAEC and/or CAI. A two-stage cluster sampling was chosen, with selection of the primary sampling units (municipalities) by accessibility, and of the final units (individuals) by non-random routes and also by accessibility. The selected sample has a sampling error of ±5.4%, considering a confidence interval of 95% and a p-q of 0.5 (considering probability sampling).

2.2. Instrument

Two questionnaires were designed: one for elected officials (EO) (https://bit.ly/2PYYG4t); another for technical figures (TF) (https://bit.ly/3f0r3aT). An initial design of the questionnaire was subject to a double validation process: logical, through judges, and empirical, applying it to 20 TFs and EOs in local administrations to assess the content of the questions (relevance and coherence) and their formulation (clarity and order). For both cases, three direct questions are asked to explore: whether or not participation is encouraged through digital environments; what digital tools they use; and what inputs they perceive. In the case of the TF questionnaire, it also seeks to explore the uses of digital environments in relation to three logics of citizen participation in the local sphere (Parés, 2017): 1) Representative; 2) Participatory; 3) Self-managed by children and adolescents. Specifically, we asked whether any digital environment was used; which digital environment; and how they use it.

The questionnaires received were filtered according to whether they had answered more than 50% of the questionnaire, eliminating 11 of the 99 EO questionnaires and 32 of the 223 TF questionnaires. The majority of respondents completed more than 80% of the questionnaire, which was validated with a Cronbach's Alpha of 0.93.

2.3. Procedure

The political and technical referents that both networks had as referents were invited to participate by e-mail. They were also informed about the issues of confidentiality and informed consent in accordance with the Organic Law on Data Protection, LOPD (Organic Law 3/2018, of 5 December), as well as the commitment of the research team as regards to the return of the data. This was followed by analysis and interpretation. At the end of October 2020, the research report was sent to the respondents (https://doi.org/10.6084/m9.figshare.13296335.v6).

2.4. Data analysis

Quantitative data were analysed using SPSS 25.0. Two databases were generated with labels and weighting factors for each record. The statistical analysis used was descriptive analysis, as well as inferential analyses. Specifically, the test used was the comparison of means Student Fisher's t-test to determine whether there are significant differences between the averages of the group of technicians who say that children's participation in the municipality is mediated by technological environments and of the group of technicians who do not use technological environments. The textual information was analysed by means of two types of analysis: one of a lexicometric-frequency nature for the identification of technological environments using the free software Iramuteq; the other, a thematic content analysis based on the constant comparison method (Corbin & Strauss, 1991; García, 2019) for understanding the contributions and uses of the environments. The content analysis took place in two phases. In the first, the inductive analysis aimed to find the emergent categories, based on which to generate the basic codes with which to code the content of the responses using the Atlas.ti 8 software. In the second, the deductive phase, the content of the responses was reduced to units of meaning (quotes) which were coded according to the codes developed in the previous phase as detailed in Table 1.

Table 1. Category system for the analysis of open questions

Topic Question	Code	Contents
What they contribute	Increase/facilitation	Open/facilitate participation beyond face-to-face attendance
	Speed/immediacy	Faster communication and contact
	Connection/proximity	To have access and proximity to the way children and adolescents relate and communicate
	Information	Disseminate, publicise, announce, make known what is being done and why
	Expression space	Making and gathering proposals, putting forward ideas, exchanging opinions
	Contact	Liaise, coordinate, send calls for proposals and internal information
	Digital skills development	Learning to make appropriate, safe and useful use of technologies
What uses	External communication	Sharing, publishing, transmitting, disseminating actions and information
	Internal communication	Internal information, for organisation and communication among members
	Gathering information/opinions	Gathering opinions, proposals, contributions from others

In order to reduce the content of the responses to units of meaning in the form of quotations, the general criterion was the search for the smallest unit of meaning that would allow unique coding, linking the quotation to a single code. Furthermore, when the same questionnaire response is separated into different quotations or units of meaning, these quotations are linked together. This makes it possible to make visible networks (https://bit.ly/RedesAportes and https://bit.ly/RedesUsos) between codes and quotations that show links of inclusion (the quotations of each code) and of relation (between the quotations of the same answer).

2.5. Results

2.5.1. Contributions of digital environments and children's participation: Elected officials and technical figures

Regarding the use of digital environments to mediate the participation of children and adolescents in the municipalities, 63.6% of the EOs and 64.9% of the TFs recognise their use.

Student's T-test was used to identify the variables that differentiated between municipalities that promoted children's participation with digital environments and those that did not. It was only significant in the group of TFs in relation to the variable reasons they claim to have for encouraging participation. In contrast, in the EO's sample, no significant differences have been found between the variables studied and mediating the participation of children and adolescents with digital environments.

Table 2 shows the contrast results of the differences between averages for independent samples on the variable reasons for participation. TFs that mediate participation with digital environments give a higher value due to perceiving participation as a fundamental right in comparison to those who say they do not use digital environments (M_{PET}=4.81 vs. M_p=4.52) with a standardisation of lower dispersion by the group of TFs who mediate participation with digital environments (SD_{PET}=.488 vs. SD_p=.948). The

Student's T-test confirms that there are differences between technicians who use digital environments and those who do not (t[179]=-2.751 and p<.05), with the former having placed greater value on participation as a right. Cronbach's alpha was calculated for this item, obtaining an adequate internal consistency (α=0.787).

Table 2. Differences between the reasons for encouraging participation and use of digital environments according to technical figures (n=181)

Dimensions/factors Scale Reasons for participation	Yes (n=121)		No (n=60)		t Mean difference	gl.	Sig. (bilateral)
	M	SD	M	SD			
Participation is a fundamental right	4.81	.488	4.52	.948	-2.751	179	.007*
Participation implies improvements in the areas where it occurs.	4.63	.660	4.48	.911	-1.219	179	.224
Participation enhances the development of citizenship competencies.	4.64	.632	4.63	.663	-.030	179	.976
Participation is a political exercise as a full citizen regardless of status.	4.55	.795	4.50	.893	-.411	179	.682

Note. The averages correspond to the sum values of the scale scores. Level of significance *p<.05.

As for the other reasons why participation can be promoted in municipalities, no statistically significant relationship was found between the group of technicians who use technology to mediate participation and those who do not. Both groups give remarkably similar values to promoting participation as an improvement, as an enhancement of competence development and as a political exercise, regardless of whether they incorporate a technological environment to mediate children and adolescents' civic participation.

Figure 1 represents the digital environments used in the municipalities to mediate children and adolescents' participation according to EO and TF. The lexicometric analysis shows that local council websites and social media are the most widely used. In particular, the term web appears 31 times in EO contributions and 78 times in TF contributions. The term network appears 32 times for EOs and 37 times for TFs, and the adjective social appears 27 times for EOs and 35 times for TFs. Among digital media, Facebook (16 EO and 47 TF) and Instagram (15 EO and 38 TF) are the most used. Blogs are mentioned less frequently by the two respondents (11 EO and 23 TF), as well as Twitter which is mentioned more by technical figures (5 EO and 23 TF). The messaging application WhatsApp is referenced 5 times by EOs and 13 times by TFs.

Figure 1. Words identified for referring to digital environments used by elected officials (left) and technical figures (right) to mediate the participation of children and adolescents

In the content analysis of the EO and TF responses on what contributions they attribute to these digital environments in relation to children and adolescents' participation, aspects related to seven cores have been gathered: they help to inform and disseminate (52 quotes); they open a space for expression (40 quotes); they facilitate participation (38 quotes); they generate proximity (33 quotes); they increase contact (31

quotes); greater speed (23 quotes); and they develop digital proficiency (7 quotes). The most referenced contribution by EO and FT is related to information. For the EOs (20 quotes), it is mainly valued as an environment to keep informed and facilitate access to certain information. The typical response was "a means of communication and dissemination" (EO,60). While, for the TFs (32 quotes), this information is mostly associated with giving visibility to the group and its actions, as well as disseminating its contributions to the rest of the children and adolescents, a typical response was "visibility in the campaigns and proposals for improving the city made by children" (TF,115).

From this point on, differences are already established between what is considered by one and the other group of respondents. The EOs cite proximity as often as information. Both categories are its main contributions. For them, digital environments provide proximity because they are a generation that relates more with these environments, they are tools that they handle and master, and they are attractive to them because they enable them to connect and bring them closer. This proximity is also associated with the augmentation/facilitation category, as well as with speed and immediacy. One response that exemplifies this category would be "reaching young people which we might not be able to reach in any other way. For them, digital environments sometimes provide comfort, a sense of security and confidence, and the agility they have developed in their generation" (EO,45). The next category mentioned by the EOs is to consider it as a space for expression, where they can express their ideas, proposals, complaints, and suggestions for improving the city. It is a medium through which they can make their contributions and where they can make it easier for other children and adolescents to do the same. Enabling immediacy is at this same level due to the fast and agile communication it provides. This contact becomes a channel for communicating, relating, and maintaining the relationship.

If we look into the categories that have emerged from the content analysis of TF contributions, after information at the same level we find providing a space for expression (27 quotes) and increasing participation (27 quotes). A space for expressing opinions that makes it possible to give children and adolescents a voice, present proposals or express their concerns. It increases and facilitates participation as it is more accessible from anywhere, more open, and it brings together a larger number of children and adolescents. An example would be the following contribution: "they facilitate the participation of children and adolescents, as they are part of their daily lives and they find it easy to use them, it is a way of adapting to the new social reality in which digital technologies are present in the personal, educational and social spheres of minors" (TF,74). TFs also see it as a contact, due to facilitating communication, convening and networking.

It is worth mentioning that a minority of EOs and TFs referred to the contribution of the digital environment to the development of digital skills. In both cases it is the contribution with the least amount of recurrence, but it is worth highlighting precisely for this reason.

Some of the TFs have revealed that during the pandemic period, digital environments have been a space that they have introduced for the first time, which they have tried out in order to be able to meet, stay connected, cohesive and communicate their concerns, as the following contribution states "we are still in an incipient process in such media... there is no clear project for children and adolescents to participate directly, but the lockdown period has helped us a lot to get children and adolescents to participate actively and allow us to keep in touch with them" (TF,64). It should also be noted that some respondents argued that digital environments are not usually used because they consider that they are not age-appropriate, as can be seen in the following response: "as I said before, we don't usually use them much, as we consider that these media should not be used by children because of their age" (CO,39).

2.5.2. Forms of participation and uses of digital environments: Technical figures

Considering the three logics of citizen participation (representative, participatory and self-managed), significant differences were found in the value they assign to the reasons for encouraging participation among the TFs that accompany the participatory logic of citizen participation with the mediation of technology and those that do not. No significant differences were found in the other two logics of citizen participation. The results, as reflected in Table 3, indicate that the TFs that mediate participation with digital environments give a higher value due to their perception of participation as a fundamental

right in comparison to those who say they do not use digital environments (M_{PET}=4.92 vs. M_p=4.15) with a standardisation of lower dispersion by the group of TFs who mediate participation with digital environments (SD_{PET}=.227 vs. SD_p=.1.144). The Student's T-test confirms that there are differences between technicians who use digital environments and those who do not (t[18]=-3.828 and p<.05), with the former having placed greater value on participation as a right.

In relation to the reason why participation is a citizen exercise, the TFs who mediate participatory practices with digital environments give it a higher value than those who do not (M_{PED}=4.70 vs. M_p=4.08) with a standardisation of lower dispersion by the group of technicians who mediate these practices with digital environments (SD_{PET}= vs. SD_p=1.256). The Student's T-test confirms that there are differences between the TFs who use digital environments and those who do not (t[48]=-2.353 and p<.05), with the former having placed greater value on participation as a political exercise. As regards the reasoning behind participation as an improvement, the results indicate a certain tendency towards statistical significance (p=.059), which we believe to be the case for participatory citizenship practices from a practical point of view. Finally, it should be noted that regarding the reason for participation as development of skills, it can be observed that there are no differences between TF of the two groups.

Table 3. Differences between the reasons for encouraging participation and use of digital environments according to technical figures (n=50)

Dimensions/factors Scale Reasons for participation	Yes (n=37)		No (n=13)		t Mean difference	gl.	Sig. (bilateral)
	M	SD	M	SD			
Participation is a fundamental right	4.92	.277	4.15	1.144	-3.828	48	.000*
Participation means improvements in the areas in which it occurs	4.68	.580	4.23	1.013	-1.935	48	.059
Participation helps to enhance the development of citizenship competences	4.76	.548	4.77	.439	.074	48	.941
Participation is a political exercise as a full citizen regardless of status	4.70	.618	4.08	1.256	-2.353	48	.023*

Note. *The averages correspond to the sum values of the scale scores. Level of significance *p<.05.

We will now move on to a content analysis of the TFs' responses in relation to each of the logics of citizen participation: Representative (R), Participatory (P) and Self-managed (A), a first general analysis from the coding reports that the type of uses made of digital environments is smaller than the perception of possible utilities of digital environments. The main use focuses on external or internal communication and opinion gathering. There is a predominance of the use of digital media to disseminate information as opposed to other possible uses in terms of the number of quotes.

Looking at the meanings provided by the responses for each of these categories, there are strong similarities in the uses of digital environments in each of the practices, with little or no differences. Thus, when TFs talk about the use of digital environments for external communication, they refer to disseminating information. "Dissemination and information" (A_TF,77) are the most repeated words in all three practices. Communicating outwards is disseminating and providing information about what is being done. A typical response was "to disseminate the activities/projects that the adolescents have carried out" (P_TF,167).

Linked to this function of disseminating information about what is being done is the promotion and recruitment of new participants. The TFs talk about the use of digital environments as "informative and convening" (A_TF,49). It is interesting to mention that in participatory practice there is also talk of the use of registration, the example would be "dissemination of activities and registration in them" (P_TF,65), which can be explained by the nature of this practice, usually constituted by processes with a specific and limited duration in time. It can also be explained by the nature of the representative practice linked to the existence of stable bodies, that only in these bodies does the use of a repository arise, fulfilling a function of information transparency, as exemplified by this response, "all the minutes, photos, calendars, etc. are posted on the website" (R_TF,57) (R_TF,57).

The last use of digital environments mentioned by the TFs associated with external communication is that of awareness-raising or sensitisation; "informative, awareness-raising and recruitment" (P_TF,17). As this response illustrates, between conveying information and attracting new participants, the importance of the actions being undertaken needs to be explained and reassured. It is also interesting that only in the self-managed practice does a reporting function appear associated with awareness-raising; "social networks serve as a platform for this movement to disseminate, report, raise awareness and make calls" (A_TF,6), which can also be explained by the nature of this practice, which is associated with processes of citizen

demands. From the analysis of the category of internal communication, it can be seen that the TFs make more use of digital environments to share information among the agents involved, pointing out the exchange of information between facilitators, families and children and adolescents, although in the latter case the communication may not be direct as can be seen in this example: "it is the means of communication between the secretary of the council and the children, although due to their age, most parents act as transmitters of the messages that are sent and not all of these parents share with their children what is communicated through these channels" (R_TF,172). This exchange of information serves, on the one hand, to facilitate the organisation of work, to remind people of responsibilities, to plan and coordinate; and, on the other hand, to generate spaces for meeting, identity and group feeling, to connect and be in contact among participants and with other related processes; "to be connected among council members, among other councils" (R_TF,96). It is noteworthy that the TFs report that the use of digital environments for internal communication has increased during this pandemic period both to stay in touch and to be able to work. This is illustrated in this response: "at this time, social networks have been of vital importance in order to be able to continue working" (R_TF,54).

Finally, the category with the fewest responses refers to the gathering of proposals, where a consultative use appears in the majority, to carry out "surveys to find out opinions" (R_TF,153). Only one response also reports the use of e-democracy platforms that allow for argumentation and voting between different proposals.

3. Comments and conclusions

The main objective of this study aims to explore what contributions are perceived by municipal leaders (EO and TF) in relation to the digital environment and what uses they make of this to promote children's participation in the municipality. The most significant result of the study is the finding of the variable that establishes significant differences between those TFs that mediate children's participation with technological environments and those that do not. This variable refers to the reasons why they encourage children's participation. Those who claim that participation is a fundamental right or who understand it as a political exercise claim to use digital tools in their regular work with groups of children and adolescents as opposed to those who claim other reasons (e.g., as a process of improvement in the areas where it takes place, development of citizenship skills), who do not make use of these tools. It is likely that among the first group of professionals there is an affective commitment and, therefore, a higher level of involvement with participation as a civic value. This interpretation is plausible as it has been proven that those who work in social-educational projects guided by human rights and social justice values reflect a higher affective commitment to the goals and objectives of the organisation (Morilla-Luchena et al., 2019).

The results show that the digital environments most commonly used to mediate children's participation are the websites of local councils, the social media sites Facebook and Instagram and the Whatsapp application. It is noteworthy that other online social media, whose popularity is widespread among 13–17-year-olds (e.g., YouTube or TikTok), or the use of blogs, virtual worlds, or online games, are not among the devices used. Similarly, there is no evidence of the use of civic technologies that are conducive to political participation with children and adolescents, similar to those used in the adult world, offering opportunities for debate (e.g., Loomio), decision-making (e.g., Agora voting, Democracia en red, Doodle) or other similar ones (Lobera & Rubio, 2015).

Another relevant finding is that local governments use digital environments essentially for informational and communicative purposes, but not for deliberative, decision-making, or creative functions. On the other hand, it should be noted that only a small number of responses link the use of digital environments to children's skill development (e.g., digital, civic, or political, or global). The increased use of digital environments in the participation of children and adolescents in local politics would enhance their education as critical, active, supportive e-citizens, co-responsible for social change and would contribute to reducing political disaffection.

Two possible explanations that help to interpret the moderate percentage of municipal referents that make use of technologies to promote participatory processes with children are: firstly, historical-cultural reasons, since children are perceived as inferior and semi-citizens (Ramiro & Alemán-Bracho, 2016),

which minimises their inclusion in participatory practices and reduces their involvement to the use of the digital environment to connect, inform and communicate; and secondly, reasons linked to the limited digital training of the technical figures who have traditionally been developing in-person children's participation initiatives.

The results of this study are in line with the review of literature and other studies on digitisation as a mechanism for civic and political participation of citizens in general (Parés, 2017) and children's citizenship (Unicef, 2019). So far, children's participation in digital environments is reduced by the perceived threat and potential risks to which children under the age of eighteen may be exposed by inappropriate use of technological devices, either by the children and adolescents themselves or by adults (Pavez, 2014). In some ways, children's citizenship rights are also at risk of being violated in the digital environment (Livingstone et al., 2017; Livingstone et al., 2020) by resistant and overprotective adult behaviours that limit children's participation. However, the pandemic context has led to the proliferation of its use as a channel for citizen participation by children and adolescents. It has forced those responsible for local policies relating to children, education, and participation to overcome narratives of risk and distrust to make way for incipient innovative experiences through the digital environment aimed at deliberation, decision-making and the development of creative, participatory actions. This scenario opens up new possibilities and challenges for a more inclusive and meaningful children's citizenship in the digital environment.

Finally, some limitations of the study should be noted. On the one hand, there is an absence of previous similar empirical studies on this subject and with these respondents. Existing studies are supported by analyses of good practices in child and youth participation (Gros & Schwartzman, 2020). As a non-probability sample, as is well known, there are limitations concerning generalisability. For this reason, the sampling error has been calculated as if the sample were probabilistic, making it possible to approximate the generalisability of the data obtained (risk of +-5.4%, confidence level of 95% and a pq of 0.50). It should also be noted that the study was conducted during the pandemic period, when the use of these digital environments proliferated. It is possible that this could lead to a bias in the results, but the results obtained show that it is still low. As a continuation of this line of research, the research project plans to ask children and adolescents about the use of digital environments in citizenship practices through a questionnaire and a participatory workshop. In short, digitally mediated children's citizenship participation in the local policy space needs to foster an involved citizenship open to debate, deliberation, collaborative and creative democracy that is inclusive and meaningful.

Author Contribution

Idea, A.N.C., C.R.P.; Literature review (state of the art), A.N.C., C.R.P.; Methodology, A.N.C.; Data analysis, A.N.C., H.M.; Results, A.N.C., C.R.P., H.M., E.N.P.; Discussion and conclusions, A.N.C., C.R.P., H.M., E.N.P.; Writing (original draft), A.N.C., C.R.P.; Final revisions, C.R.P.; Project design and sponsorship, A.N.C.

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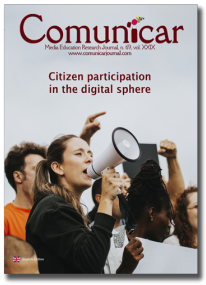

Digital media and university political practices in the public sphere

Medios digitales y prácticas políticas universitarias en la esfera pública

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ABSTRACT

In a predominantly digital communicative context, the political practices of young university students are relevant for the vitality of public spheres and the consolidation of participatory democracy. The objective of this study was to learn how the use of digital media relates to the political talk and participation practices of university students. Using quota sampling, a survey was conducted among 435 undergraduate students residing in the Metropolitan Area of Monterrey, Mexico, during the second semester of 2020. Among these students with favorable access to digital media, positive correlations with small to moderate and statistically significant magnitudes were found between the various uses of digital media and their political practices. News use was moderately correlated with political talk, as was social use with politically motivated activities, and creative use with all forms of participation. Political talk mainly affected the relationship between participation and news use. These findings support the relevance of the active role of young people in their political socialization, as social interaction and content creation were more closely correlated with political participation than news consumption was, which was more beneficial to participation when articulated through political talk.

RESUMEN

En un contexto comunicativo predominantemente digital, las prácticas políticas de los jóvenes universitarios son de importancia para la vitalidad de las esferas públicas y la consolidación de la democracia participativa. El objetivo de este estudio fue conocer cómo se relaciona el uso de los medios digitales con las prácticas de conversación y participación políticas de los universitarios. Mediante un muestreo por cuotas, se realizó una encuesta a 435 estudiantes de nivel licenciatura residentes en la Zona Metropolitana de Monterrey, México, durante el segundo semestre de 2020. Entre estos estudiantes con acceso favorecedor a los medios digitales, se encontraron correlaciones positivas con magnitudes de pequeñas a moderadas y estadísticamente significativas entre los diversos usos de los medios digitales y sus prácticas políticas. El uso noticioso se correlacionó moderadamente con la conversación política, así como el uso social con las actividades políticamente motivadas, y el uso creativo con todas las formas de participación. La conversación política incidió principalmente en la relación entre la participación y el uso noticioso. Estos hallazgos respaldan la relevancia del papel activo de los jóvenes en su socialización política, pues la interacción social y la creación de contenidos se relacionaron más estrechamente con la participación política que el consumo de noticias, el cual fue más provechoso para la participación al articularse a través de la conversación política.

KEYWORDS | PALABRAS CLAVE

Digital media, political talk, political participation, public sphere, young people, university students.
Medios digitales, conversación política, participación política, esfera pública, jóvenes, estudiantes universitarios.

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1. Introduction

Digital media are inescapable tools and spaces for current democratic processes, mainly among young people who have grown up under the digital paradigm and, in that context, have formed their notion of politics and their relationship with it (Ahmad et al., 2019; Ekström et al., 2014; Xenos et al., 2014). In this position are current university students, who are also considered an important group for the consolidation of participatory democracy (Barredo et al., 2018; De-la-Garza-Montemayor et al., 2019), since access to education implies better conditions for involvement in various public domains, such as the economical or cultural.

Through a quantitative approach using a survey, the objective of this research was to learn how the use of digital media relates to political talk and participation practices of university students in Monterrey's Metropolitan Area, the second most populated city in Mexico.

In the spectrum of their political orientations, the conversation and participation practices of young people are relevant to the vitality of public spheres (Dahlgren, 2011) in Habermas's (1991) rational, deliberative and structured sense, but also as spaces of expression of the social horizon of individual experiences (Negt & Kluge, 1993). These practices contribute to the generation of meaning about democracy in public spheres; they also transform it, and prevent its stagnation (Dahlgren, 2011) and, therefore, are indicators of its quality.

To aspire to participatory democracy, where participation extends to aspects of the decision-making process beyond voting (Wessels, 2018), and where young people benefit from the possibilities that digital media offer to take a broad and active role in public affairs, represents a challenge in the face of the global trend of political disaffection among new generations, characterized by the feeling of powerlessness, cynicism and lack of trust in the political process (Infante et al., 2019; Lannegrand-Willems et al., 2018; Torcal & Montero, 2006).

Given this, conceptualizing the political participation of young people (Brady, 1998; Norris, 2002; Tilly, 2008) in a less rigid sense, oriented to the short term and their particular interests (Ohme, 2018), as "the activities of citizens that affect politics" (Van-Deth, 2016: 1), contributes to its exploration in a predominantly digital communicative context. For that purpose, it is assumed that young people's everyday communicative experiences in the digital sphere affect their political socialization process, and thus, the form their political practices take, including their conversation (Muñiz et al., 2018; Ping-Yu & Won-Oh, 2018; Vaccari & Valeriani, 2018) and participation habits (Kahne & Bowyer, 2018; Neundorf & Smets, 2017; Xenos et al., 2014).

1.1. The digital paradigm as context in the political socialization of young people

Today's young university students belong to a generation that grew up immersed in a "new" communication paradigm, one constituted on digital media as its backbone, and hence the relevance of analyzing their impact on their political socialization process, that is, on the acquisition of the political culture that surrounds them (Greenberg, 2009). Understood as a range of media that encode and decode information in binary language, supported by electronic devices generally connected to the Internet (Wessels, 2018), digital media have resulted in new forms of communication and interaction. Characterized by the immediacy, variety and the amount of information they provide, these media challenge traditional informative practices.

In digital environments, young people are not passive consumers of content; they select, create and distribute it with relative ease, leaving trail of information (Sparviero, 2019) that simultaneously determines their experience. These media have brought about virtual socialization networks, where identities are negotiated on a daily basis and from an early age (Patra, 2018).

As agents of political socialization, digital media are not only gaining ground in the dissemination of information and in the establishment of agendas, but have also opened up alternative spaces for deliberation and participation. The particular conditions of the university population make it of interest in this field of research, as it has been found that a higher level of education and a younger age are related to a more advantageous use of the Internet and digital media (Van-Deursen et al., 2014).

1.2. Digital media access and use

The potential of these media for the activation of young citizens is initially conditioned by the physical access to technology, which is a basic factor in the relationship young people establish with it (Martínez-Domínguez, 2018; Tirado-Morueta et al., 2017). The process of appropriation of digital media begins precisely by accessing them. Van-Dijk (2017) explains access as successive phases that culminate in increased participation in various social domains, including the political domain. These phases start from motivational and physical access, referring to people's inclination to use technology, and to the spaces and devices available to them, respectively.

Beyond access, the approach to digital media use must include the variety of user practices, a complex task in the current media ecosystem. Ekström et al. (2014) identify four key factors that distinguish uses in digital spaces in order to analyze them independently but interrelated with each other. The resulting categories include: 1) News use, which refers to activities related to accessing news online; 2) Social use, focused on activities on socio-digital networks; 3) Creative use, related to content production; and 4) Game use, mainly the habits around social interaction. The authors point out the relevance of each of these aspects in the public orientations of young people but indicate that game use is the least related to civic involvement, which is why it was not addressed in the empirical part of this study.

1.3. Political domain: Conversation, participation and their interaction

Part of the discussion on political practices in the digital sphere has focused on how young people take advantage of technological tools, increasing their participation and giving visibility to discourses that were hardly included in pre-digital media. The literature has reported positive consequences of the use of digital media and social networks on deliberation (Dzisha, 2018; Hampton et al., 2017), political talk (Vaccari & Valeriani, 2018), and online and offline participation (Ahmad et al., 2019; Carbonai & Zilio, 2017; De-la-Garza-Montemayor et al., 2019; Macafee, 2018; Xenos et al., 2014). Moreover, these spaces have been the cradle of cyberactivism, and an information ecosystem as an oppositional public space that has empowered social movements during the last decades (Sierra-Caballero, 2018). However, to analyze the impact of digital media on political practices solely based on their facilitating aspects is only part of this complex field of research, since the increase in the possibilities of participation in these media does not necessarily correspond to the rise of participation in general, the quality of civic practices (Wessels, 2018), or the configuration of a democratic virtual environment (Dahlgren, 2018). Phenomena that contribute to misinformation and polarization of public opinion are becoming increasingly evident, such as an informative environment infested with fake news (Molina et al., 2021), or the effect of socio-digital networks as echo chambers that contribute to reinforce people's already established perspectives and opinions (Guo et al., 2020), and even to amplify extremist discourses (Torregrosa et al., 2020).

Without taking an excessively positive stance, it can be recognized that with the possibilities that digital media have made available to institutions and individuals, the political domain is in constant transformation. This study approaches it from the political practices of young university students, including two articulated aspects: the daily conversation about politics and political participation. By political talk we mean an informal communicative practice not circumscribed to media consumption (Muñiz et al., 2018) that, "if not always deliberative, is nevertheless a crucial part of the full deliberative democratic system" (Mansbridge, 1999: 211). Political talk is a practice of interest, because, in combination with various technological resources, it can contribute to the participatory repertoires of citizens (Peña-Serret, 2018; Vaccari & Valeriani, 2018).

Regarding political participation, Van-Deth's (2014) proposal, later revisited by Ohme (2018), is structured around the distance between the individual and political processes. Van-Deth (2014) explains participation as a multidimensional concept related to people's understanding of the political system, the place in which citizens position themselves, and the relationship they establish with power, which is manifested in different types of involvement. Van-Deth's (2014) political participation model consists of four types of activity, according to where the action is directed: 1) Voting behavior (PPI); 2) Participation directed to the political system (PPII), which includes the activities of people who, without being part of the government, are clearly directed at it or its members; 3) Participation at the community level (PPIII), which

refers to the activities carried out by members of the community to improve it, but without directing them to any government entity; and 4) Politically motivated activities (PPIV) that do not involve action directed at the government or the community, but rather the expression of a politically charged message.

Based on the relevant literature and the study objective, the following research questions were formulated: 1) How do young university students access and use digital media?; 2) What is the relationship between digital media use and the practices of political talk and participation among young university students?; and 3) How do political talk habits impact the relationship between digital media use and political participation?

2. Methodology

The study was conducted with a quantitative approach, through the application of a survey to undergraduate students residing in Monterrey's Metropolitan Area, who make up a population of 210.516 students (Gobierno del Estado de Nuevo León, 2020). After a pilot phase to refine the accuracy, clarity and exhaustiveness of the instrument, a final questionnaire was formed (Maltos-Tamez et al., 2021). It was structured in three sections: one related to the access and use of digital media, another one about various aspects of the political culture of the students, including political talk and participation practices, and a final one to obtain demographic information.

The survey was conducted during three weeks of the second semester of 2020, through the SurveyMonkey online platform. The invitation to participate in the study was distributed through Facebook, Twitter and Instagram, and shared by email and WhatsApp with teachers from different institutions, requesting participation from their students. Additionally, students were encouraged to participate and complete the instrument by the raffle of gift cards.

2.1. Sample composition

A non-probabilistic quota sample of 435 participants was identified. Data collection during the COVID-19 pandemic posed limitations on the design of the study, since the application of the instrument on an online platform and through an open call prevented the random selection of participants. However, through quota sampling, by reproducing the characteristics of the study population, it is intended "to approximate the results that would be obtained with probabilistic samples" (Romero & Bologna, 2013: 288). In this way, a gender quota similar to that of the population of undergraduate students in Nuevo Leon was assigned (Gobierno del Estado de Nuevo León, 2020), so that 212 women (48.7%) and 223 men were included (51.3%). The age of the participants ranged between 16 and 24 years, with a mean of 20 years.

The distribution of the sample according to the type of institution of the participants was contrasted with the distribution of undergraduate students in the state (Secretaría de Educación Pública, s.f.). 61.6% (N=268) of the participants belonged to the Universidad Autónoma de Nuevo León (vs. 47.7%), 20.9% (N=91) were students from large and medium-sized universities (vs. 12,1%), and 17,5% (N=76), from small or micro universities (vs. 29.3%)[1]. In addition, the distribution of the sample was compared to a measurement of the socioeconomic stratum of the participants according to their Urban Geostatistical Area of residence (AGEB) with the distribution of that same measure in the general population of the Monterrey Metropolitan Area [2]. The sample consisted of 5.3% (N=23) participants in the low stratum (vs. 14%), 24.8% (N=108) in the lower-middle (vs. 30.2%), 25,7% (N=112) in the middle (vs. 25.8%), 21.1% (N=92) in the upper-middle (vs. 16.1%), and 23% (N=100) in the high stratum (vs. 14%). These verifications provided certainty about the representativeness of the sample. Regarding the socioeconomic stratum, a distribution with less representation of the low and lower-middle levels was observed, but it is considered reasonable to find a lower number of university students in these strata compared to the general population, since those would be the sectors with less possibility of accessing university education.

2.2. Measurement of variables

Regarding access, participants were asked about Internet connection services available to them, the devices they use, and the time they spend on online activities according to Van-Dijk's (2017) approach. The use of digital media was addressed through the typology of Ekström et al. (2014), including news,

social and creative use. News use was measured using an item regarding the frequency in which students consult news on digital media on a Likert-type scale from zero (never) to four (every or almost every day). They were asked about which media they use to check the news, on a ranking scale from zero (not used) to 10 (the most used). Social use was measured using an additive index made up of seven items (Cronbach's alpha=0,775) about activities in socio-digital networks, answered on a Likert-type frequency scale from zero (never) to four (every or almost every day). They were asked about the most frequently used socio-digital platforms on the same scale. Regarding creative use, an additive index of seven items (Cronbach's alpha=0,744) related to the creation and publication of content in digital media was used. These were answered on a Likert-type frequency scale from zero (never) to four (once or several times a week).

The political talk variable was measured by an additive index of five items (Cronbach's alpha=0,769) that questioned how common it is for students to engage in different situations of dialogue about politics, both online and in person. These items were answered on a Likert-type scale from zero (not at all common) to four (very common).

Finally, political participation was measured through individual additive indices for each type of participation according to the Van-Deth (2014) model, using a Spanish-translated version with minor adaptations of the items developed by Ohme (2018): seven items for participation directed to the political system (PPII) (Cronbach's alpha=0,769), seven more for participation at the community-level (PPIII) (Cronbach's alpha=0,815), and six for politically motivated activities (PPIV) (Cronbach's alpha=0,788). The items asked the students about the frequency with which they had carried out activities related to each type of participation in the three immediate previous years, and they were answered on a Likert-type scale from zero (never) to four (more than 10 times). Additionally, an item on voting behavior (PPI) was included. In all cases, the Cronbach's alpha coefficient for the sets of items that made up the variables was greater than 0,75, indicating acceptable reliability for the indices employed.

3. Results of the analysis

The results obtained after the statistical analysis, which included quantification of variables at a descriptive level and the bivariate analysis of the indices of use and practices through Pearson's correlation coefficient, are detailed below. Going back to the research questions, in first instance, the characteristics of digital media access and use by the students were included, followed by the sections that explore the relationships of digital media use with political talk and participation among university students, as well as the incidence of political talk over these relationships.

3.1. Digital media access level and use

Access to digital media in this population is quite widespread. Almost all the respondents (98.9%, N=430) have Internet service at home, and just over half (56.8%, N=247) use the Internet through a mobile data service.

Students have an average of three electronic devices with Internet access. The most used are smartphones (91.3%, N=397), followed by laptops (78.4%, N=341), smart TVs (36.1%, N=157), desktop computers (25.1%, N=109), and video game consoles (24.1%, N=105). These youths spend an average of 12 hours a day on online activities. More than half of them (54%, N=235) indicated being connected to the Internet 12 or more hours a day.

Regarding news use, it was found that about three-quarters of students (71.8%, N=312) check news about politics in digital media at least once a week. The mean news use index was 2,39 (SD=1.20). The media that students use mainly to inform themselves are the news feed[3] of their social networks (M=7.03, SD=3.35), social network profiles of news media (M=6.23, SD=3.51), news media websites (M=5.94, SD=3.75), television (M=5.59, SD=4.20) and citizen journalism social networks (M=4.57, SD=3,56). The least used media were radio, printed newspaper, other people on instant messaging services, and subscriptions to RSS services (M≤2,17).

On the other hand, the social use index registered a mean of 1,63 (SD=0.67). The most frequently used socio-digital networks were WhatsApp[4] (M=3.93, SD=0.31), Facebook (M=3.53, SD=0.96),

YouTube (M=3.34, SD=0.95), Instagram (M=3.34, SD=1.14), Twitter (M=1.88, SD=1.67) and TikTok (M=1.47, SD=1.6). Pinterest, Reddit, Snapchat, LinkedIn, Tumblr were platforms used to a lesser extent (M≤1.00). Regarding creative use, the index obtained a mean of 0,53 (SD=0.62), finding that the most frequent content creation activities among students were publishing photographs, drawings, or artistic or expressive manifestations; and publishing opinion texts or videos (25.8% and 19.3% of the respondents carry out these activities at least once a month, respectively). Reviewing products, movies, books, etc.; making podcasts or streaming; making their own memes; uploading blog entries; and making video tutorials were less frequent activities (11.9%, 10.3%, 9.9%, 7.2% and 7% of the students do them at least once a month, respectively).

3.2. The relationship between digital media use and political talk and participation among university students

Data analysis showed that three-fourths of the respondents (74.5%, N=324) reported low and very low frequencies of conversation about politics. The political talk index had a mean of 1.17 (SD=0.78), with in-person dialogue being more common (M=1.76, SD=1.03) than online (M=0.79, SD=0.77).

Regarding political participation, the data on voting behavior (PPI) indicated that 74% (N=173) of students of legal age at the time (N=234) voted in the July 2018 elections. The index obtained for overall participation place it at levels close to the lower limit (M=0.45, SD=0.49). Table 1 shows the indices obtained for each type of participation, as well as the activities that make them up in order from highest to lowest frequency according to their average score. As can be seen, the indices for system-directed participation (PPII) and politically motivated activities (PPIV) are very similar (M=0.47 and M=0.48, respectively); participation at the community level obtained a lower index (M=0.41).

Table 1. Student's political participation practices

	Mean	SD
PPII: Participation directed to the system	0.47	0.55
Sign an online petition on a political or social issue	1.20	1.28
Invite other people or disseminate information to participate in a demonstration, strike or protest	0.70	1.12
Participate in a demonstration, strike or protest	0.35	0.68
Contact a politician via email or social media	0.32	0.74
Sign a paper petition on a political or social issue	0.34	0.72
Contact or visit a politician in person	0.20	0.60
Donate money to a political organization	0.16	0.50
PPIII: Participation at the community level	0.41	0.54
Volunteer in a local organization	0.63	0.99
Participate in cultural events to support projects in your community	0.58	0.88
Support fundraising projects for the care of your community	0.44	0.80
Collect money to support projects in your community	0.38	0.74
Maintain public facilities in your local area	0.35	0.74
Participate in meetings about your local area	0.33	0.69
Make street art in your community	0.13	0.55
PPIV: Politically motivated activities	0.48	0.63
Share social media posts about political or social issues	1.09	1.26
Express your opinion in social media posts about a political or social issue	0.85	1.20
Buy or boycott any product for political, ethical or environmental reasons	0.36	0.87
Wear badges, accessories, or clothing with a political message	0.21	0.65
Change your information or profile image on social networks for a social issue	0.28	0.70
Create a group in a social network to discuss or support a political cause	0.12	0.47

Note. N=435. The items were translated into Spanish and adapted from the original version developed by Ohme (2018).

According to Pearson's coefficient (Table 2), the social and creative uses of digital media showed positive and statistically significant correlations, but of small magnitude [5] with the political talk index. The correlation with this index was slightly stronger, reaching a moderate magnitude, in the case of news use. In addition, positive correlations of small magnitude were found between the various uses of digital media, and each type of political participation. Only in the cases of the relationship between social use and politically motivated activities (PPIV), and between creative use and all types of participation correlations of magnitude were observed.

Table 2. Correlations between digital media use, political talk and political participation among students					
		Political talk	Participation II	Participation III	Participation IV
News use	r	0.302**	0.146**	0.144**	0.198**
	p	0.000	0.002	0.003	0.000
Social use	r	0.232**	0.291**	0.146**	0.343**
	p	0.000	0.000	0.002	0.000
Creative use	r	0.226**	0.325**	0.350**	0.299**
	p	0.000	0.000	0.000	0.000

Note. N=435 **, The correlation is significant at the 0.01 level (bilateral).

3.3. Impact of political talk on the detected correlations

Finally, we examined whether political talk could influence the relationship between the use of digital media and the political participation of young people. We found that when controlling for its effect (Table 3), the correlations between news use and political participation did not reach the established value of statistical significance ($p \leq 0,01$), while most of the correlations between social and creative use and the different forms of participation were reduced in magnitude, but maintained the level of statistical significance. The exception was the correlation between social use and political participation at the community level (PPIII), which can surely be explained by the very nature of this type of participation.

Table 3. Partial correlations between digital media use and political participation among students controlling for the effect of political talk				
		Participation II	Participation III	Participation IV
News use	r	0.023	0.049	0.065
	p	0.627	0.311	0.177
Social use	r	0.220**	0.075	0.272**
	p	0.000	0.118	0.000
Creative use	r	0.261**	0.299**	0.223**
	p	0.000	0.000	0.000

Note. N=435 **, The correlation is significant at the 0.01 level (bilateral).

4. Discussion and conclusions

Among the most relevant results of the study is the identification of positive and statistically significant correlations between digital media use and political practices of university students. News use was moderately correlated with political talk, as well as social use with politically motivated activities, and creative use with all forms of participation. Political talk mainly influenced the relationship between news use and participation.

Although it is beyond the scope of the study, it is important to contextualize these results in light of the confinement due to the COVID-19 pandemic, which has modified the conditions of access and use of digital media among young people, who have had to carry out their academic activities and social interactions through the Internet. Now, given these conditions, the level of access to digital media among university students was favorable, as shown by the results where almost all of them have Internet service at home. We could then raise additional questions about why participation in the political domain is at low levels even in a population with these access characteristics (Van-Dijk, 2017), in view that the participation and conversation indices were close to the lower limit on the scale used.

These results are taken with the limitation that this study measured levels of participation, not its quality. Without going as far as that claim, when comparing participation indices, we find that system-directed participation (PPII) and politically motivated activities (PPIV) are more frequent among students than participation at the community level (PPIII), which could be explained by the time demands of the activities or by the stage of life in which the students find themselves.

This leads to reflect on the role of universities as facilitators of opportunities for participation, that is, on whether student's political socialization process as they pass through university entails a greater possibility that digital media use is helpful for political participation. Cruz-Sánchez and Garay-Cruz (2019) suggest that participatory culture in the classroom results from academic-administrative management both in learning platforms and in socio-digital networks; and they emphasize the role of teachers in creating conditions for participation. Research on the political practices of university students cannot ignore the

intersection with participatory practices that are generated in educational settings as essential spaces for socialization at this stage of life.

On the other hand, the presence of moderate correlations between social and creative uses with political talk and almost all types of participation support assumptions about the positive relationship of digital media use with these political practices (Ahmad et al., 2019; Carbonai & Zilio, 2017; De-la-Garza-Montemayor et al., 2019; Macafee, 2018; Vaccari & Valeriani, 2018; Xenos et al., 2014;). It also stresses the importance of the active role of young people in their political socialization process (Amnå et al., 2009; Ohme, 2018), and in the shaping of digital spheres as spaces open to the collective expression of their experiences (Negt & Kluge, 1993), finding that the practices of interaction and creation are more closely related to political participation than the consumption of news content, a rather passive use.

The literature has already pointed out the important relationship between news consumption and political talk (Martínez-Villarreal et al., 2019; Muñiz et al., 2018; Ping-Yu & Won-Oh, 2018; Saldierna et al., 2017; Xenos et al., 2014); however, in this study, the strength of this relationship is not transferred to the field of participation, where the observed correlations were weaker compared to other use indices. Given this, the idea of political talk as a communicative practice that could alter the political participation of young people (Peña-Serret, 2018; Vaccari & Valeriani, 2018) is considered, rather than as an end or a deliberative exercise in itself. The results suggest that there is an incidence of political talk on the relationship between digital media use and political participation, especially in the case of news use. Van-Deursen et al. (2014) indicate that the opportunities generated by media access cannot compensate for the lack of civic interest. The authors propose that the potential actually lies in the additional possibilities of expression that media offer to those who already have interest in the political arena. Political talk acts as an articulation between news consumption in digital media and political participation.

This approach to university students and the ways in which they use digital media and get involved in the political domain, suggests the relevance of social interaction and content creation in their civic activation, and that of conversation as a link between news consumption and their political participation. Future comparative approaches could contribute to contrasting this population with populations of other characteristics, even more so to the extent that it is possible to perform probabilistic sampling exercises. The contributions of the study are valuable for continuous research focused on university students, and for the orientation of institutional strategies on digital literacies and political participation. It is also necessary to continue inquiring on this matter through a qualitative research approach that deepens and qualifies the identified relationships while exploring the trajectories of use and appropriation of digital media that promote political activation among university students.

Author Contribution

Idea, A.L.M.T.; Literature review (state of the art), A.L.M.T., O.M.M.V.; Methodology, A.L.M.T. F.J.M.G., O.M.M.V.; Data analysis, A.L.M.T.; Results, A.L.M.T., F.J.M.G., O.M.M.V.; Discussion and conclusions, A.L.M.T., F.J.M.G., O.M.M.V.; Writing (original draft), A.L.M.T.; Final Revisions, A.L.M.T., F.J.M.G., O.M.M.V.; Project design and sponsorship, A.L.M.T., O.M.M.V.

Notes

[1]The classification corresponds to the size of the enrollment of the institutions. The Universidad Autónoma de Nuevo León is the only one in the "mega" category, with more than 50 thousand students. The "large" category includes institutions with enrollments of more than 10,000 students, and the "medium" category of more than 5,000. Together, these correspond to Tecnológico de Monterrey, Universidad de Monterrey, Universidad del Valle de México, Universidad Metropolitana de Monterrey, Universidad Regiomontana, and Universidad Tec Milenio. The "small" category includes institutions with fewer than 5,000 students.

[2]Participants provided their neighborhood and municipality of residence to identify their Urban Geostatistical Area (AGEB). Each of these areas was placed on an average socioeconomic level scale of five levels (low, lower-middle, middle, upper-middle, and high). The measurement was made according to six criteria: 1) Homes where at least one person aged 25 or more has higher education; 2) Homes with more than 2.5 occupants per bedroom; 3) Population entitled to health services; 4) Employed population aged 12 years or over; 5) Homes that have a car or truck; and 6) Homes that have Internet; this measurement was developed based on the methodology of the Asociación Mexicana de Inteligencia de Mercado y Opinión (2017), and the information available in the Inventario Nacional de Vivienda 2016 (Instituto Nacional de Estadística, Geografía e Historia, s.f.).

[3]News feed refers to the section of socio-digital networks that shows information updates to the user.

[4]WhatsApp was included despite not being properly a social network due to its relevance as a social interaction tool and its functionality for the dissemination of content.

[5]Interpretations of effect size follow the Cohen convention (Salkind, 2007) used in behavioral sciences, according to which the coefficients for Pearson correlations are considered "small" when they reach a magnitude of 0.1, "moderate", from 0.3, and "large", from 0.5.

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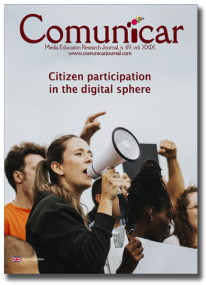

Countervalues of the digital ethos perceived by future trainers

Contravalores del ethos digital percibidos por futuros formadores

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ABSTRACT

The digital ethosphere, as a cultural environment of digital interactions, provides spaces for social and citizen participation where certain values and counter-values are promoted that determine the users' construction of their personal and cultural identity. The lack of studies that analyze the counter-values immersed in digital interactions and spaces has led to the development of this study, which seeks to analyze the students' perception of the presence of counter-values on the Internet by examining the social sphere (with classmates, friends or family), the type and the way in which they are transmitted, as well as the associated risks (information or communication) and the resources or applications available. A mixed methodological approach study was designed through an ad-hoc questionnaire that was answered by 305 students from education and teacher training faculties. The results indicated that the majority of students identify the presence of counter-values when using the Internet, highlighting manipulation and violence, followed by lack of respect, inequality, and dishonesty, as well as the risks associated with information and communication, emphasizing the implicit presence of counter-values in the social networks logics and discourses. The conclusions provide evidence on the need to include values education in critical media education, reinforcing the preparation of future teachers who can teach how to deconstruct and eradicate counter-values in the digital sphere.

RESUMEN

La ethosfera digital, como entorno cultural de interacciones digitales, propicia espacios de participación social y ciudadana donde se promueven valores y contravalores que determinan la construcción de la identidad personal de sus usuarios. La carencia de estudios para analizar los contravalores inmersos en las interacciones y espacios digitales ha propiciado el desarrollo de esta investigación, que busca analizar el alcance de la percepción de los estudiantes sobre la presencia de contravalores en Internet examinando en qué esfera social (con compañeros, amigos o familiares), de qué tipo y cómo se transmiten, a qué riesgos pueden asociarse (información o comunicación) y en qué recursos o aplicaciones. Se diseñó un estudio de enfoque metodológico mixto con un cuestionario ad-hoc que fue respondido por 305 estudiantes de facultades de educación y formación docente. Los resultados indican que la mayoría de los estudiantes identifican la presencia de contravalores cuando usan Internet, destacando la manipulación y la violencia, seguido de la falta de respeto, la desigualdad y la deshonestidad, así como los riesgos asociados a la información y la comunicación, evidenciando la presencia implícita de contravalores en los discursos de las redes sociales. Se concluye resaltando la necesidad de incluir la educación en valores en la educación crítica para los medios, reforzando la formación de futuros formadores que pueden enseñar a deconstruir y erradicar los contravalores de la esfera digital.

KEYWORDS | PALABRAS CLAVE

Digital culture, higher education, students, countervalues, digital risks, media education.
Cultura digital, educación superior, estudiantes, contravalores, riesgos digitales, educación en medios.

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1. Introduction

Our environment is techno-social, not only because the technosphere is already part of our life domain (García-Carrasco & García-Peñalvo, 2015), but because of the existence of an ethosphere, as a digital public sphere, where rationales, discourses and interactions exist as part of the global digital culture itself (Glauner, 2018). Thus, the beliefs and aspirations of this culture conform to the spaces of virtual participation and interaction (Ballesta et al., 201); the places from which group values and countervalues of belonging to that culture emerge, which are then normalized by the users until they become part of their identity. The modification of the ethos (moral features of a person or a community), in this case by the action of the digital routines, is based on the Aristotelian idea of social persuasion centered on group confirmation of the ways of being that are derived or established into our digital habits. This is the reason why the concept of digital ethos will be used during the analysis of the present work, itself derived from the rhetorical concept of ethos. This digital ethos is constructed in technological environments through the features of social ethos, shaped by the moral qualities and values perceived by people, related to the context which spells a certain content or message, and the discursive ethos, understood as the virtual presence or profile of a person, the status it has within a digital context, and the interest of the individuals with which one interacts in the digital sphere (Olaizola, 2018).

This modification or shaping of the digital ethos is created in an environment that has naturally allowed diverse practices, habits, or beliefs, which are sometimes contradictory but co-exist. Thus, while the social media "increase the probability that the perspectives, opinions, and individual matters become incorporated into the public sphere" (Turégano-Mansilla, 2020: 274), we also recognize the presence of challenges and threats to democracy, such as disinformation, or the radicalization of discourses, which exacerbate certain voices, and structure the collective attention towards "moral panic" (Jungherr & Schroeder, 2021).

Considering that the technosphere does not involve itself with a set of commitments, values, or ways of being, we can warn that the use of technologies is not neutral either (Lewin & Lundie, 2016). Participating in the digital ethos, either to consume or produce nodes of knowledge, has an influence on what we can think about it or not, as well as what we feel, and experience (Vlieghe, 2016), because the values and countervalues implicit in this public sphere can shape not only our expectations and intentions, but also our actions (Burbules, 2016). The digital divide is an example of the countervalue of inequality, determined by the purposes with which technologies are developed and applied, which discriminate, for different reasons, those who cannot access the Internet, or do so in a limited manner, making their social participation and interaction difficult (De-Agrela-Gonçalves-Jardim et al., 2017).

Diverse studies on the culture of consumption have revealed the existence of values that are implicit in different media utilized by children and youth (Hernández-Serrano et al, 2017; Oregui & Aierbe, 2019). Less frequent are specific studies on countervalues, as the present study, from the perspective of future teachers, of whom we demand not only technology-computer skills, but also "moral and ethical qualities that allow them to transform their environment and contribute with a more human society" (Llamas et al., 2020). Authors such as Kumar (2019) and Komljenovic (2020) echo this demand, and wager on extending values from education to higher education, justified, among other arguments, by the effect exerted by the digitalization of contents and interactivity, as well as by the large number of hours spent by the university students connected to the internet and the social networks (Atas & Çelik, 2019; Rostaminezhad et al., 2019). Along the same line, international commitments such as the Digital Education Action Plan, 2021-2027 from the European Union (European Commission, 2021), the 2030 Agenda (2020), or the Child and Youth Manifesto from UNICEF (2020), have demanded the development of citizens and the attainment of adequate values for co-habiting, and correct social interaction, both in-person and virtually.

1.1. Countervalues in the digital ethosphere

Ethos is a public system of values, which is socially constructed in the social interactions that provide meaning to community living, in this case, in the digital sphere. And it is the people who have shaped these values, by providing meaning, organizing, and regulating the relationships in the digital world. Starting from this, values can be defined as valued, real, or symbolic qualities, but collectively produced, which question social cohesion and the regulation of the relationships. In agreement with this concept, countervalues

would be the opposite meanings of each value (Gervilla-Castillo, 1997; Medina, 2007), as qualities that are not valued by people or groups, and which could affect the development and social co-habiting in the digital world. This process of evaluation, until a habit, a behavior, or a norm becomes a social value, is determined by the digital culture within which it is framed, with the intervention of the collective belief that this action is shared by most, makes sense for everyone, or at least, that is based on a practical reason for the subject (Parga, 2008). As a result, values can be subjective or have a universal reach. Likewise, with countervalues, which are adapted to collective beliefs or individual reasons. The most important aspect is that the effect of this structure of social values could be determined from the effects they generate (Berkowitz, 2011), by studying the presence or impact perceived starting with these values, or their countervalues.

In the digital ethosphere, the diversity and freedom of individual moral choices is assumed, but also a system of values that is socially constructed and defined. This system will be analyzed in the present study from the conception of the Internet as a socially-perceived cultural structure. The analysis will be conducted from the perspective of students, because, although previous studies have stated that this collective is aware of the existence of risky behaviors (Ramos-Soler et al., 2018; De-la-Villa-Moral-Jiménez & Fernández-Domínguez, 2019), they do not always perceive them by associating them to the countervalues that the digital medium promotes or the user re-enforces. This requires a more critical analysis of the countervalues that are recreated in the behaviors of users, equipping the students to be able to decrease or face what the medium itself absorbs (Thoman & Jolls, 2003; Lee, 2010). The objective of the critical commitment of young generations starts by considering media education that contemplates values education, to provide them with an ethical compass (Van-Stekelenburg et al., 2020) that can be used to deal with the reproduction of countervalues that oppose complete digital co-habiting. The present work is found along this line of media education, which intends to discover how the future teachers intuitively or explicitly perceive the meanings of the countervalues and the associated risks. Beginning with these consequences, it is important to establish guidelines, strategies or dynamics to empower the students and convert them into proactive teachers towards the media. The number of hours they spend connected to the networks have to become actions and behaviors that invite them not only to consume content (Rostaminezhad et al., 2019), but to interact with it, creating, designing, and modifying information on the Internet, thus becoming prosumers and prodesigners (Hernández-Serrano et al., 2017), with initiative and critical analysis of values that are needed for the development of interactions mediated by technologies (Thoman & Jolls, 2003; Lee, 2010).

According to the above, the present study is centered on analyzing the reach of student perception on the presence of countervalues on the Internet, considering the following: 1) The variables age and gender, as well as the social sphere in which these are perceived (classmates, friends, or family); 2) The types and how they are transmitted; 3) The risks they may be associated with (information or communication); 4) The resources or applications were they appear (web, videos, and social networks).

2. Material and methods

2.1. Sample

A non-probabilistic, incidental sampling method was used, selecting the samples by accessibility to the higher education centers. The study sample was comprised of 305 university students from the faculties of education, enrolled in their first (79%) and second (21%) years, from 4 universities. Three of these universities were located in Spain, and one in Chile, from the areas of social sciences in the spheres of education or teacher training. In agreement with the population, the gender distribution was heterogeneous, 15% were men, and 85% women, given the high female participation that is considered normal in teaching degrees (Figueroa & Hernández, 2019). Most of the students were younger than 20 years old (59%), followed by those who were aged between 20 and 30 (39%), and lastly, by those older than 30 (2%).

2.2. Design

A mixed methods approach was utilized to collect, analyze and relate the quantitative and qualitative data in the same study. The qualitative process served to collect information about non-numerical data,

through the description and interpretation of the answers, while the quantitative process allowed obtaining and analyzing numerical data that were contrasted to respond to the objectives of the study (Ruiz-Medina et al., 2013). Likewise, it followed a concurrent mixed design, which, according to Hernández-Sampieri and Mendoza (2018), allows systematic, empirical, and critical processes to simultaneously analyze the quantitative and qualitative data. The data were collected in a parallel manner, but separately in the instrument, just as the analysis was performed independently, although in the conclusions, one or many meta-inferences were made from both, which comprise the results found in both approaches (García-Ruiz & Lena-Acebo, 2019).

2.3. Instrument

To conduct the study, a questionnaire that measured the presence of countervalues on the Internet was designed. It was comprised by 37 items, which were answered with a Likert scale ranging from a little to a lot, and which was divided into 5 dimensions. It was completed online by the university students, who answered it voluntarily and confidentially. Afterwards, the relationships between the variables were analyzed through the use of the Chi-square test with the software program SPSS v20. Before providing the questionnaire, the items were revised to assess their validity through the validation by specialists in the area of education. The analysis data of the reliability of the dimensions of the questionnaire on the presence of countervalues on the Internet, based on Cronbach's Alpha, are the following: 1) The Internet transmits countervalues (1 item, α=0.894); 2) The Internet promotes countervalues (9 items, α=0.894); 3) Identification of countervalues with colleagues in Internet communication (9 items, α=0.894); 4) Identification of countervalues with friends in Internet communication (9 items, α=0.962); 5) Identification of countervalues with family members in Internet communication (9 items, α=0.962).

Table 1. Presence of countervalues on the Internet

Perception of university students (Quantitative Design)	Academic Year	First
		Second
	Specialty	Primary Education
		Early childhood Education
		Special Education
		Pedagogy in English
		Pedagogy in Spanish
	Gender	Male
		Female
	Age	Younger than 20 years old
		20 to 30 years old
		Older than 35 years old
Presence of countervalues on the Internet (Quantitative Design)	The Internet transmits values	
	The Internet promotes countervalues	
	Identification of countervalues with colleagues in Internet communication	
	Identification of countervalues with friends in Internet communication	
	Identification of countervalues with families in Internet communication	
Categories (Qualitative design	Countervalues perceived on the Internet	Concept of value vs countervalue
		Transmission of countervalues
	Type of countervalues perceived	Inequality
		Lack of respect
		Dishonesty
		Violence and manipulation
		Selfishness
		Insecurity
		Irresponsibility
		Oppression
	Internet, countervalues, and risks	Countervalues associated to information risks
		Countervalues associated to communication risks
	Internet resources and countervalues	Webpages, videos or comments, and countervalues
		Social networks and countervalues

For the qualitative approach, the open-ended questions were selected, and a content analysis was conducted with the objective of finding elements of the dominant narrative in the responses evaluated, through the analysis of each fragment by two of the researchers, until a satisfactory consensus was found for the assignment of categories. More specifically, content analysis was utilized as the research technique to systematically and objectively describe the themes found, and whose advantage is also the enrichment of the quantitative analysis. To achieve this, the individual responses of the students were codified, as suggested by Gil-Flores et al. (1996), after which the categories, sub-categories, and expressions of

agreement were defined, depending on the countervalues described by the students. We tried to be rigorous in the definition of the categories, by considering all the opinions in the analysis of the data, and by focusing on the analysis of the semantic meaning of the expressions. Likewise, to identify the countervalues, we took into account some studies on social and antisocial values (Sevillano, 2001; Kepowics-Malinowska, 2003; Morales-Rodríguez et al., 2013; Hernández-Serrano et al., 2016). As for the variables, the study included the presence of countervalues on the Internet, and the perception of university students for the quantitative analysis, in which we underline the variables of academic year, specialty, gender, and age; and the categories and sub-categories for the qualitative analysis. Table 1 organizes the variables analyzed.

3. Analysis and results

Table 2 was created starting with the analysis of the participant students' perception about the presence of countervalues on the Internet, to verify the existence of significant differences with the different variables selected. Within it, we analyze the presence of countervalues on the Internet from participants' perception according to gender and age, through the use of the Chi-square test. It can be observed that dimension 5 (Identification of countervalues with family members) is associated with a greater degree of significance according to gender (p=0.029). This is followed by dimension 4 (Identification of countervalues with friends in Internet communication), with statistically significant differences found (p=0.046) according to gender, without associations found between the dimensions of presence of values on the Internet, and age. As for the Chi-square analysis of the perception of future teachers on the presence of countervalues on the Internet according to specialty and academic year, it was observed that the dimension related to the identification of countervalues with family members in Internet communication was associated with a high statistically significant difference (p=0.022) with the specialty. An association with the rest of the dimensions was not found.

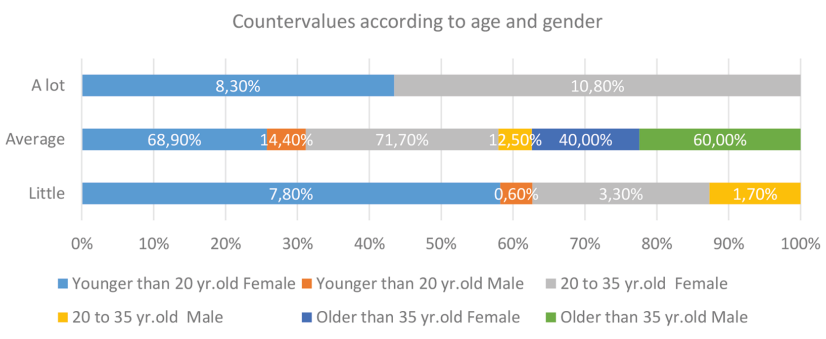
Table 2. Analysis of the presence of countervalues on the Internet

	Gender		Age		Specialty		Academic year	
Dimensions	**Chi-square**	**Sig.**	**Chi-square**	**Sig.**	**Chi-square**	**Sig.**	**Chi-square**	**Sig.**
1. The Internet transmits countervalues	0.620	0.431	3.575	0.167	0.607	0.962	0.784	0.376
2. The Internet promotes countervalues	0.656	0.720	3.616	0.461	4.345	0.825	0.250	0.883
3. Identification of countervalues with colleagues in Internet communication	4.378	0.112	2.398	0.663	12.252	0.140	3.602	0.165
4. Identification of countervalues with friends in Internet communication	6.179	0.046*	1.789	0.774	12.556	0.128	4.196	0.123
5. Identification of countervalues with family members in Internet communication	7.072	0.029*	4.555	0.336	17.876	0.022*	3.646	0.162

Note. *p<0.05 significant difference.

As for the descriptive analysis, the relationship between gender, the presence of countervalues on the Internet, and age should be underlined. More specifically, and as observed in Figure 1, 71.7% of the students aged from 20 to 35 years old, and 68.9% of those younger than 20 years old, both female, stated that they regularly perceived the presence of countervalues on the Internet.

Figure 1. Relationship between gender, presence of countervalues on the Internet, and age

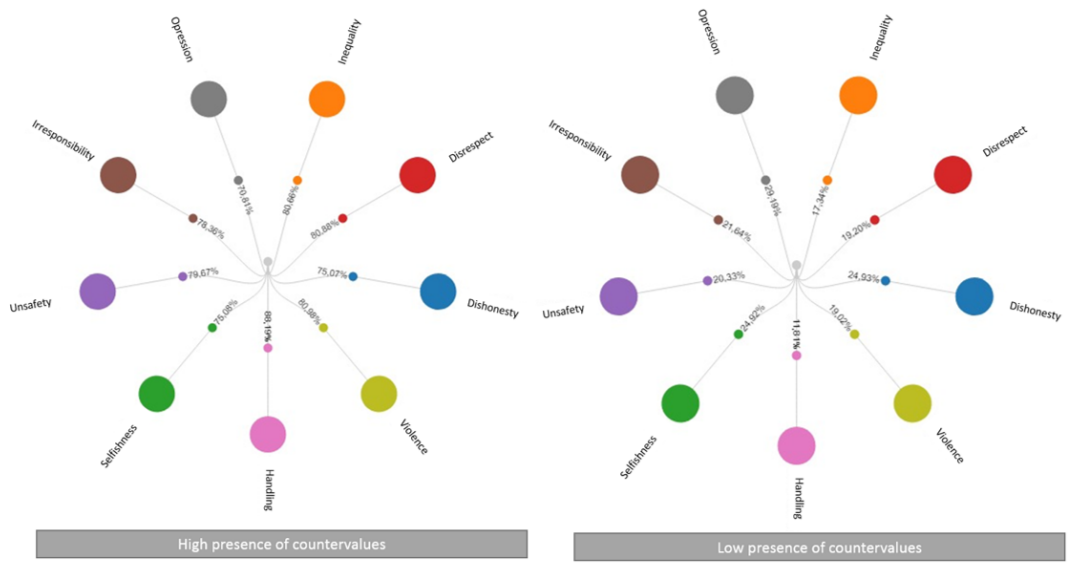


As for the analysis of the qualitative results, first of all, and considering the category "Countervalues perceived on the Internet", the students described the concept they had about value versus countervalue, showing that they were aware of the presence of countervalues on the Internet, with statements such as: "Just as values are transmitted, countervalues are also transmitted" (Stdnt.9, female, 18 years old, 1^{st} year); "Given that, if there are values, there are countervalues" (Stdnt.37, female, 19 years old, 1^{st} year). And the difference that exists between the two concepts on the Internet, as shown by the answer: "…I think there is the same number of values on the Internet as countervalues. You only have to know where to look, where to be, and what to use it for" (Stdnt.60, female, 21 years old, 1^{st} year).

Also, university students stated that they were not only able to perceive that the Internet promoted countervalues, but they also described the effects they could have, highlighting their connection with digital risks: "I think that countervalues can be generated on the Internet. The creation of the Internet has provoked, among others, Internet bullying. Also, when you are not face-to-face with the person you are talking to, you are not worried about what you are going to say, so that we become more egotistical, and less respectful towards others" (Stdnt.104, female, 18 years old, 1^{st} year).

More specifically, when asked about what types of countervalues they were able to perceive when they used the Internet, it was observed that there was a degree of identification of countervalues (Figure 2). More specifically, manipulation was found to have the greatest presence on the Internet, obtaining 88.19% of high responses in its identification by the students. Aside from manipulation, other countervalues were highly identified, such as violence, the lack of respect and inequality, and with a lesser prevalence than the rest, but still with a high percentage, dishonesty was highlighted.

Figure 2. Identification of the countervalues that were most perceived by the students on the Internet



Looking into the countervalues mentioned previously, the university students stated in their answers that manipulation and violence were countervalues that were observed when using the Internet, because some people could consider that being behind the screen strengthened them, undervaluing the content that was being shared with other users: "I consider that the countervalues are aggravated, as one could think that being behind a screen makes one stronger, and damage can be done to others, which implies the lack of respect, violence, or manipulation" (Stdnt.249, female, 19 years old, 1^{st} year). Also, in other findings extracted from the students' discourse, we identified violence and manipulation with other risks: "The Internet has many good things, but is it also a source of dangerous information, a broadcaster of countervalues such as manipulation, consumerism, violence" (Stdnt.94, female, 21 years old, 1^{st} year). The students described these countervalues in related terms such as stealing or hitting, as shown by their

answers: "Just as values are transmitted through the Internet, countervalues as well, since we watch many videos, which show us the opposite. We can observe that people steal, hit" (Stdnt.93 females, 25 years old, 2^{nd} year). Violence and manipulation were also identified with hate derived from membership to other cultures or ethnic groups: "there is an immeasurable hate against other beliefs, cultures, people, genders…" (Stdnt.279, male, 30 years old, 1^{st} year). There was also the lack of respect as a countervalue, as evidenced from the answers, through which we inferred that this countervalue was associated to one of the characteristics of the digital medium –anonymity, and more specifically on the use of the social networks- that favored it: "the Internet gives us the possibility of giving an anonymous opinion, especially in the social networks, and many values are lost, such as respect" (Stdnt.221, female, 23 years old, 2^{nd} year). If the lack of respect was identified by diverse students as a countervalue that was very much present in the use of the Internet, then access, as power or privilege in the ethosphere, where we find discourses, rationales, and interactions belonging to the digital culture, can become a reason for inequality, and therefore for countervalues, as perceived by the younger students: "For example, not having a computer or access to the Internet: inequality" (Stdnt.211, female, 19 years old, 2^{nd} year). Likewise, the students also indicated that the fact that the Internet offered users the opportunity to anonymously give their opinions could provide a reason for taking advantage and not caring about the way in which they related with other users, which verifies the presence of certain values such as selfishness or irresponsibility. More specifically, dishonesty was found, identified as the countervalue that appeared on the Internet when access and the information offered by it did not require filters that ensured the quality of the content, "On the one hand, uploading the information on the Internet could be considered positive, but the fact that no filter exists that can attest that the information is true, results in that the information may not be true" (Stdnt.243, female, 32 years old, 1^{st} year.

The students also showed their opinions with respect to the risks implied by the presence of countervalues on the Internet, associating them with two areas: information and communication. The information risks were identified with inequality or vulnerability of the people when they faced the excess of information and content present on the Internet, with statements such as the following: "We are vulnerable and we are exposed to information that is not apt" (Stdnt.285, female, 22 years old, 1^{st} year); or "Many times, due to bad information or too much freedom in the web, countervalues appear" (Stdnt.189, female, 20 years old, 2^{nd} year). As for the communication risks, moral aspects appeared associated to the existence of the countervalues: "The Internet is so accessible to everyone that it is merely impossible that all the content is ethically correct. Thus, we find pages that promote illnesses such as anorexia or bulimia, violence, fanaticisms…" (Stdnt.253, female, 18 years old, 2^{nd} year), with similar statements provided by other students: "I think that many times, when we try to teach values through the Internet, the opposite occurs, as a misunderstanding could occur" (Stdnt.298, female, 18 years old, 1^{st} year). These data provide evidence about the presence of countervalues such as oppression, insecurity, or irresponsibility.

Lastly, with respect to the countervalues present in the different digital spaces within which the students socialize on the Internet, and their capacity to perceive their presence, most attested to how the social networks had become the privileged forums where one could find and expose countervalues. More specifically, some of the comments referred to enmity or selfishness: "Many times, enmity and selfishness is produced in the social networks, for example" (Stdnt.10, female, 18 years old, 1^{st} year); "In the social networks, such as Twitter or Instagram, each person gives his or her opinions, ideas, and you can find many publications that are sexist, homophobic, xenophobic, etc." (Stdnt.40, female, 18 years old, 1^{st} year). Likewise, within social networks, the students referred to the comments that could be made of videos, publications…in which countervalues are transmitted, as affirmed by the following student: "On the Internet, you can publish everything, and it's true that now situations that could be inappropriate are monitored, but even then, comments, videos, applications, can create countervalues" (Stdnt.297, female, 18 years old, 1^{st} year).

4. Discussion and conclusion

The study presented allows us to confirm that the university students who participated in the study were able to perceive countervalues when they utilized the Internet, thereby answering the general

objective of the present work, and which in contrast with the results by Parra-Ortiz (2015) and Pérez-Pérez (2008) when they argued that values must be perceived through the actions of others, in the relationship established with others, in the environment and context, just as it occurred with the countervalues identified in the present study by the future teachers. Likewise, in regard to the analysis of the presence of countervalues on the Internet, considering the variables age and gender, and linked with the specific objective of the digital ethosphere in which the countervalues were identified, it can be affirmed that the identification of countervalues when the students interacted with family members and friends, was especially evident when a comparison with gender was made. As for the identification of countervalues by the future teachers when they used the Internet with the colleagues, highly significant results were not observed with respect to the dimensions analyzed. Also, in the relationship established with gender, the presence of countervalues on the Internet, and age, it was observed that the female students, especially the older ones, identified the most countervalues when they utilized the Internet normally, as opposed to the male students, indicating the need to replicate this result with similar samples.

As for the next objective, the type of countervalues perceived by the students and how they are transmitted, the results obtained from the open-ended questions discourses analyzed, showed that the students identified and differentiated value from countervalue, thereby confirming, as in other studies, that the future teachers were aware of the existence of values on the Internet (Morais et al., 2019). Aside from being aware of the presence of countervalues, they were able to identify some unwanted effects that could occur, alluding to risks such as digital bullying, or egotistical behaviors (Osorio-Tamayo & Millán Otero, 2020; Grotto & Makridis, 2020). As for the types of countervalues identified by the students in the ethosphere, the most perceived were mainly manipulation and violence, followed by lack of respect and inequality, and with a lower prevalence, although with high percentages, dishonesty, selfishness, insecurity, irresponsibility, and oppression.

The third objective was to analyze the reach of the perception of the students about the presence of countervalues on the Internet, considering the risks, either associated to the information available on the Internet, or to the communication established through the networks. In both cases, the students identified these risks through their discourses, and associated them to the inequality or vulnerability of the people when facing an excess of information; or the presence of content that was ethically incorrect, which incites violence or fanaticism through the networks, or even simple errors or discords due to misunderstanding, when focusing on the risks associated to communication processes. As for the fourth and last objective, related to the resources or applications that the students were able to identify when they used the Internet, it was observed that the webpages, videos, or social networks were perceived as spaces in which individuals could transmit countervalues. More specifically, evidence was shown about the presence of countervalues in social networks, when referring to Twitter or Instagram as spaces in which everyone could freely expose their opinions or ideas, sometimes unfiltered, allowing for the publication of sexist or xenophobic publications, or inappropriate expressions that not only resulted in new spaces for discrimination, but which also promoted victimization spots that could lead to self-esteem or depression problems, as indicated by De-la-Villa-Moral-Jiménez and Fernández-Domínguez (2019).

As a conclusion, the evidence found in this study centered on the identification of countervalues of the digital ethos by students, the future teachers, and allowed us to observe that they were able to perceive certain countervalues, as well as to associate them with the risk of using networks and services offered through the Internet. Due to this, it is of vital importance to include values education for the digital ethosphere, to teach future teachers how to identify and limit the countervalues associated to online risks. The aim of this type of education is that the future teachers acquire the necessary competences to participate in the digital ethos in which the values and countervalues shape interpersonal relations (Vlieghe, 2016; Burbules, 2016). Lastly, although the present study is considered to be limited and centered on future teachers, the findings provide indications about what has started to become an important topic –the digital ethosphere-, specifically for educommunication, as described by authors such as Prendes-Espinosa et al. (2018), and which has also been included in the new European Digital Education Action Plan, 2021-2027 (European Commission, 2021). This study adds interest to the studies about media teaching for the new citizens, re-enforcing the thesis by Baker and Bilbro (2017), who affirmed that the more we commit

ourselves with our new spaces and places of interaction, in this case digital, the more our system of values will be modified, and with them the canons of behavior, thought, and representation of the interactions.

Author Contribution

Idea, M.C.C.P., P.R.A., M.J.H.S., C.G.A.H.; Literature review (state of the art), M.J.H.S., M.C.C.P., P.R.A.; Methodology, C.G.A.H., P.R.A.; Data analysis, C.G.A.H.; Results, P.R.A., C.G.A.H., M.J.H.S.; Discussion and conclusions, M.C.C.P., P.R.A., M.J.H.S., C.G.A.H.; Writing (original draft), M.C.C.P., P.R.A., M.J.H.S., C.G.A.H.; Final revisions, M.C.C.P., P.R.A., M.J.H.S., C.G.A.H.; Project design and sponsorship, M.C.C.P., P.R.A.

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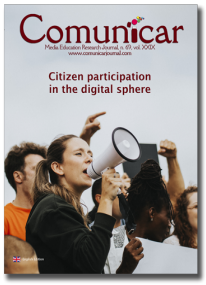

Facing disinformation: Five methods to counter conspiracy theories amid the Covid-19 pandemic

Combatiendo la desinformación: Cinco métodos para contrarrestar las teorías de conspiración en la pandemia de Covid-19

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ABSTRACT

Among the burgeoning discussions on the argumentative styles of conspiracy theories and the related cognitive processes of their audiences, research thus far is limited in regard to developing methods and strategies that could effectively debunk conspiracy theories and reduce the harmful influences of conspiracist media exposure. The present study critically evaluates the effectiveness of five approaches to reducing conspiratorial belief, through experiments (N=607) conducted on Amazon Mechanical Turk. Our results demonstrate that the content-based methods of counter conspiracy theory can partly mitigate conspiratorial belief. Specifically, the science- and fact-focused corrections were able to effectively mitigate conspiracy beliefs, whereas media literacy and inoculation strategies did not produce significant change. More crucially, our findings illustrate that both audience-focused methods, which involve decoding the myth of conspiracy theory and re-imagining intergroup relationships, were effective in reducing the cognitive acceptance of conspiracy theory. Building on these insights, this study contributes to a systematic examination of different epistemic means to influence (or not) conspiracy beliefs -an urgent task in the face of the infodemic threat apparent both during and after the COVID-19 pandemic.

RESUMEN

Entre las crecientes discusiones sobre los estilos argumentativos de las teorías de conspiración y los procesos cognitivos relacionados de su público, los estudios hasta ahora son limitados en lo que respecta al desarrollo de métodos y estrategias que podrían desacreditar eficazmente las teorías de conspiración y reducir las influencias dañinas de la exposición a los medios de comunicación conspirativos. El presente estudio evalúa de manera crítica la efectividad de cinco enfoques para reducir la creencia en conspiraciones, a través de experimentos (N=607) realizados en Amazon Mechanical Turk. Nuestros resultados demuestran que los métodos basados en el contenido al enfrentar las teorías de la conspiración pueden mitigar parcialmente la creencia conspiratoria. Específicamente, las correcciones centradas en la ciencia y los hechos fueron capaces de mitigar eficazmente las creencias en la conspiración, mientras que las estrategias de alfabetización mediática e inoculación no produjeron cambios significativos. Más importante aún, nuestros hallazgos ilustran que ambos métodos centrados en el público, que implican decodificar el mito de la teoría de la conspiración y reimaginar las relaciones intergrupales, fueron efectivos para reducir la aceptación cognitiva de la teoría de la conspiración. Basado en estos conocimientos, este estudio contribuye a un examen sistemático de distintos medios epistemológicos para influir (o no) en las creencias conspirativas, una tarea urgente frente a la evidente amenaza infodémica, tanto durante como después de la pandemia de COVID-19.

KEYWORDS | PALABRAS CLAVE

Conspiracy theories, correction methods, COVID-19, audience, China-United States relation, media influence.
Teoría conspirativa, método de rectificación, COVID-19, audiencias, relaciones China-Estados Unidos, influencia mediática.

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1. Introduction

Although conspiracist narratives already existed in antiquity and the Middle Ages, the advent of a digital networked era, alongside a post-Cold War context (in which ideological and geopolitical conflicts have taken some more hidden forms) has created a new upsurge in conspiracy theories (Oliver & Wood, 2014; van-Prooijen, 2018; Drochon, 2018). The negative consequences of conspiracy theories have been widely recognized. However, research thus far is limited regarding developing methods and strategies that could effectively debunk conspiracy theories and reduce the harmful influences of conspiracist media exposure (Krekó, 2020). Source-targeting and other pre-emptive interventions focus on the supply-side of conspiracy theory, relying on governmental policies and social media companies' censorship and removal to hopefully reduce the chance that audiences will encounter conspiratorial information. Such interventions are often viewed as morally problematic, technically ineffective, and economically unfeasible.

Considering the impotence of supply-side interventions, developing effective, audience-centered methods is more important than ever (Craft et al., 2017; Samuel-Azran & Hayat, 2019). This study adopts a protectionist and interventionist approach, examining the effectiveness of a few audience-focused countermeasures in mitigating the negative effects of conspiratorial media narratives. It engages with academic efforts to theorize and measure multiple approaches to countering conspiracy theories in the COVID-19 context (e.g., Golob et al., 2021; Mora-Rodríguez & Melero-López, 2021). Notably, this study was conducted in a period of great political uncertainty concerning relations between the US and China. Under Biden's administration, the domestic need of the US for political reconciliation provides both an emotional base and a political incentive for the growth of anti-China conspiracy theories.

2. Research on conspiracy theories

Conspiracy theories are commonly viewed as "explanatory beliefs" (either speculative or evidence-based) or "worldviews" that perceive the current political and social order, or historical or future events, as an outcome of manipulation by a small group of powerful individuals (the conspirators) acting secretly for their own benefit against the greater good (Fenster, 1999; Uscinski & Parent, 2014).

In spite of early debates viewing belief in conspiracy theory as irrational, paranoid delusions (Hofstadter, 1965), or as a strong form of resistance against state crime (Simmons & Parsons, 2005), more recent publications tend to consider conspiracy theories as a rational attempt to understand social and political contexts (Jones, 2008). Conspiracy beliefs may correspond to pre-existing stances, attitudes and beliefs at the individual level, with different personality traits from social psychology (Abalakina-Paap et al., 1999), which may follow a form of "motivated collective cognition" from group-based perspectives (Krekó, 2020), and may become bound up with perceptions of deeper machinations underlying the normal pursuit of state interest in international relations (Aistrope & Bleiker, 2018). Furthermore, conspiracy theories are deeply mediated. Digital media communication not only motivates a sense of "agency panic" but creates a phenomenon of "information overload" or an "information explosion" (Buckland, 2017) that facilitates selective media exposure and the echo-chamber effect, thereby reinforcing people's preexisting conspiratorial world views (Hollander, 2018).

Cultural perspectives that view conspiratorial mindsets as "hermeneutic of suspicion" or as a kind of "political skepticism" (Husting & Orr, 2007) are still relatively marginal in the literature of conspiracy theory. A more widely accepted lens views conspiracy theories as a defensive and ultimately self-defeating manifestation of motivated social cognition, which may pose a dangerous threat to an individual's psychological health and rationality, to society and democracy, and to international relations (e.g., Oliver & Wood, 2014; van-Prooijen, 2018). More specifically, empirical research supports that exposure to conspiracy theories can: directly increase negative feelings of powerlessness, disillusionment, uncertainty, mistrust, and anomie (Jolley & Douglas, 2014); decrease individual's trust in the government and political engagements such as voting (Einstein & Glick, 2015); interfere with intergroup relations by stirring up prejudice and discrimination (Swami, 2012); fuel violence towards others (Bartlett & Miller, 2010); lead people to disengage from social norms, and move towards radicalization (Karstedt & Farrall, 2006; Lee 2020); and, during a public health emergency, produce science denial , distorting important individual medical choices and exacerbating public health crises (Mitchell, 2019).

However, the refutation of conspiracy theories is often extremely difficult. On the one hand, both authoritarian and democratic regimes have relied on conspiracy theories, fake news, or rumors to suppress truthful information for their own political ends (Mutsvairo & Bebawi, 2019). The sensational, eye-catching conspiracy narratives perfectly fulfill the logics of today's "clickbait" media economy for most online platforms. On the other hand, restriction of misinformation by big social media companies is still facing legal, moral, and political challenges. The rhetorical strategies of conspiracy theories, such as "just asking questions" and "half-true headlines" that rely on the recipient to make a conspiracy inference, are often mobilized to circumvent regulations and algorithm-based filters. The demand-side and audience-centered approaches to correcting conspiratorial mindsets (in which the target of the intervention is the recipient rather than the source of conspiracy theories) also face challenges. Krekó (2020) summarizes several obstacles to debunking conspiracy theories, such as the problems of meta-conspiracy, the familiarity backfire effect and collective motivated reasoning (Winiewski et al., 2015). Debunking efforts face greater challenges when there is growing political uncertainty brought about by political crises and unprecedented events such as the global pandemic (Golob et al., 2021; Mora-Rodríguez & Melero-López, 2021).

3. Existing efforts in debunking conspiracy theories

While completely correcting conspiracy theories may seem like an "impossible mission", an emerging array of efforts have tried to mitigate the negative consequences of conspiratorial media exposure on individuals. These endeavors consist primarily of five approaches, including: media literacy intervention, inoculation strategy, science- and fact-focused corrections, decoding the myth of conspiracy theory, and re-imagining intergroup relations. The present study empirically tests the effectiveness of these five methods at countering conspiracy theory belief in the context of COVID-19.

3.1. Media literacy interventions

The first intervention method is media literacy education. Media literacy generally refers to specific knowledge and skills that aid the critical understanding and usage of media (Jeong et al., 2012) — the ability to access, analyze, evaluate and communicate messages in a variety of forms (Aufderheide, 1993). In the past decades, media literacy education has been conducted to address a wide range of media issues, including violence, sexual content, health, advertising, stereotypes, and fear inducing content. The usefulness of media literacy intervention is equivocal and uneven. While some experiments suggest it is successful in reducing the negative effects of the media, making children less likely to accept television representations as reality, and thus decreasing their desires to be like the characters in advertisements and purchase advertised products, others found a "boomerang effect" — an increase in the harmful attitudes of individuals who participated in the intervention (Potter, 2010). In a few media literacy lessons, participants paid more attention to the violent clips and less attention to the content of the lesson.

With the rise of fake news, false information, conspiracy theory, and sensationalism along with digital technology's ever-growing role in society, media literacy has gained increasing academic and policy-level attention as a tool to empower people with a set of skills to analyze, critique, and respond to the information that appears in digital texts. Increasing numbers of journal articles and monographs (LaGarde & Hudgins 2018) address the new challenge posed by false information and emotion-first logic in today's "post-truth" society and emphasize the importance of media literacy training for vulnerable groups (Jeong et al., 2012; Jones-Jang et al., 2021). However, so far, there is little empirical evidence to show the positive role of media literacy intervention in fighting conspiratorial narratives. Media literacy intervention aims to enhance criticism by increasing knowledge of the media, awareness of the influence of the media, and the ability to assess the realism of the media's representation of reality. This study tests the idea that media literacy intervention can combat conspiracy theory belief through strategies such as skepticism and de-biasing.

3.2. Inoculation approach

The second countermeasure belongs to the "inoculation strategies", which uses a biological metaphor to describe an approach that builds resistance to persuasive messages (McGuire & Papageorgis, 1962). In medicine, resistance to a virus can be increased by exposing someone to a weakened version of the virus (a vaccine) that is strong enough to trigger a response (i.e., the production of antibodies), but not so strong as

to overwhelm the body's immune system. The social-psychological theory of inoculation follows a similar logic: presenting some weak arguments of persuasion and misinformation (e.g., containing obvious logical fallacy) in advance is expected to raise the attitudinal immune system of the person against such threats in the future. To date, numerous studies have applied inoculation theory to various topics. The most relevant to our study is the "prebunking" intervention, which draws on the psychological inoculation theory and suggests a positive effect in cultivating "mental antibodies" against fake news and misinformation regarding climate change and the 9/11 terrorist attacks (Banas & Miller, 2013). Roozenbeek and van-der-Linden (2019) developed a browser game named Bad News, in which players take on the role of fake news creators and learn about several common misinformation techniques. This game has shown consistent and significant inoculation effects, yet

there is a key issue when conducting inoculation treatment. The inoculation approach was originally developed, and is often used, in a setting aiming at protecting individuals' (positive) pre-existing viewpoint from the influence of future malicious information (Banas & Miller, 2013; Banas & Rain, 2010). The mechanism behind inoculation is also partly dependent on people's engagement in "identity-protective motivated reasoning". However, people's pre-existing conspiratorial mindsets can be widely varied, with some people tending to see the outside world through a "conspiracy lens". As such, the inoculating effects on this subpopulation of "firm conspiracy believers" can be less effective, as they may be prone to accepting any conspiracy discourse (even if it contains logical errors) and integrating it into their already vast array of conspiratorial world views.

3.3. Fact- and science-focused correction

The third intervention approach engages with studies on correction, which usually focus on science and facts, in order to avoid the "familiarity backfire effect". A few previous studies demonstrate that, sometimes, simply highlighting factual and scientific information is enough to effectively discredit disinformation, rumors and conspiracy theories. This statement may go against the prevailing notion of "post-truth", in which emotions trump all other factors. One possible explanation for science and rationality's increasing impact on shaping beliefs might be that, in the current media ecology, people are overloaded with emotional messages from various media platforms, and that as such, rational and factual argument have gained more informational value. A meta-analysis of correction and debunking studies finds that fact-based corrections can reduce but do not entirely mitigate misperceptions generated by misinformation (Walter & Tukachinsky, 2020).

Furthermore, the fact- and science-focused correction approach can be integrated with the journalistic tool of fact checking for greater effect. As a response to the spread of inaccurate information across society, fact checking has been regarded as an effective method in correcting falsehoods. In the US, PolitiFact and FactCheck.org are fact-checking initiatives that gained popularity after the 2016 U.S. elections. Fact checkers investigate the claims made in (news) stories and make an overall recommendation regarding the extent to which the message is true or false, while describing the true state of events. Many fact checkers post such corrections on social media, such as Twitter or Facebook. Some nuanced empirical studies have demonstrated corrective information presented in fact checkers to be effective at ameliorating disinformation (Chan et al., 2017).

3.4. Decoding the myth of conspiracy theory

The three debunking methods mentioned above are all content-targeted, aimed at helping people to critically understand and analyze the conspiratorial content they encounter, discrediting such information through inoculation, or simply highlighting fact and science. The fourth and fifth counter-conspiracy-theory approaches discussed here are more human-focused and are centered on the improvement of an individual's psychological condition, as well as their sentiments on specific out-groups. This study names the fourth strategy "decoding the myth of conspiracy theory", and it essentially educates people on the nature and features of conspiracy theories, attempting to cast light on the mechanisms that allow them to infiltrate people's belief systems (e.g., what is a conspiracy theory? Why do people seek conspiracy messages during political uncertainty?). Decoding the myth of conspiracy narratives aims to help individuals

better understand the information-processing of conspiracy theories and their psychological antecedents. This is expected to strengthen feelings of self-efficacy, self-understanding, and self-control, and to reduce conspiracy ideations.

While the approaches of "decoding" conspiracy narratives and increasing media literacy both encourage critical thinking in the audience, the "decoding" approach is more about helping audiences understand their own cognitive vulnerability in the face of conspiracy narratives than criticizing the processes of media content production. Moreover, both the "decoding" treatment and the science-focused correction treatment attempt to subvert the cultural familiarity of conspiracy texts' intended meaning. However, the "decoding" treatment represents a more thorough countermeasure than science-focused correction approaches. Inspired by Bjerg and Presskorn-Thygesen's (2017) study, the science-focused correction approach can be thought of as being underpinned by a true/false proposition, which does not account for the possibility of false propositions sometimes making sense due to factors such as pre-existing conspiracy convictions. The "decoding" approach can clarify the nonsensical status of these false propositions, showing that they only "make sense" as a result of misguided use of language and a biased cognitive process of information-processing.

Building on these insights, the "decoding" approach avoids false but sensical claims, by exposing the highly biased nature of conspiracy discourses that help validate a baseline that does not make sense a priori. While the science-focused correction approach can only draw on truth verification, the "decoding approach" focuses on exposing the falseness of conspiracy theory's epistemological base — regarded as "elusive epistemology" (Baden & Sharon, 2020) — that is not explained within the process of verification and validation.

3.5. Reimagining intergroup relations

The "reimagining intergroup relations" strategy is context-specific and aims to mitigate the negative influences of conspiracy narratives that target specific groups, such as African Americans, Jews, Muslims, Asians, and homosexuals. Conspiracy theories are often characterized by binaries between "natural", "just" and "good" political order and its "evil" counterpart, undermining pluralist democratic discourse and calling for an urgent eradication of the political opposition (Baden & Sharon, 2020). Facilitated by the combined effects of conspiracy theories that "construct dissent as a Manichean binary" (i.e., a cognitive structure or worldview that considers phenomena to have two opposing sides, such as good versus evil, also see Baden & Sharon, 2020) and form "motivated collective cognition", people who hold more negative feelings (distrust, anxiety) towards out-groups might be particularly vulnerable to conspiratorial discourses that allege those groups are plotting evil plans (Kofta & Sedek, 2005).

To resist this conspiratorial labelling of certain groups as evil, the approach of imaginary re-conception — an action of re-conceiving intergroup relationships — may be utilized to call into question the us/them or self/other relationship that underlies the Manichean binary understandings; raising issues of common identity may help bridge or overcome this dichotomy. It is hoped that a re-conception approach based on reimagining intergroup relationships will have positive ethico-political effects that will help move target issues away from a state of epistemic exception and back into the realm of rational deliberation. Therefore, recalling experiences of benign intergroup contact is expected to prime positive attitudes toward outgroup members, and thus, decrease the likelihood of conspiracy beliefs targeting said outgroups. Furthermore, previous studies have found that when actual contact between groups is impractical, imagining intergroup contact can effectively reduce intergroup anxiety, reduce prejudice and discrimination, and improve intergroup relations (Turner et al., 2007).

However, the utility of this imagined approach may be limited, as this treatment focuses mainly on the "Manichean binary", which is one of three elements of Baden and Sharon's (2020) conceptualized conspiracy theories proper (CTP) — an integrated account of conspiracy theory characterizing three essential corruptions of conspiratorial discourse on democratic norms (the other two are "pervasive potency" and "elusive epistemology"). As such, our fragmented, targeted treatment of the Manichean binary may ignore the intra-action between the three corruptive forces of conspiracy theory. In this study, we seek to provide an experimental examination of the impacts of methods and strategies that could

effectively debunk conspiracy theories and reduce the harmful influences of conspiracist media exposure. These five methods are either content-focused, already enacted in existing literature and adopted in debunking practice (including media literacy intervention, inoculation strategy, science- and fact-focused corrections) or audience-focused, developed in this study as a pioneering attempt (including decoding the myth of conspiracy theory, and re-imagining intergroup relations). Notably, the categorization of the five interventions into content-based and audience-based is only for heuristic purposes. In reality, overlap occurs. For example, media literacy intervention is also operated to influence the audiences' cognition. Building on these insights, we specify the following hypotheses.

- H1: The content-based methods of counter conspiracy theory can mitigate conspiratorial belief.
- H1a: Media literacy intervention can effectively reduce conspiratorial belief.
- H1b: Inoculation strategy can lead to a reduced belief in conspiracy theory.
- H1c: Science- and fact-focused corrections can effectively weaken conspiracy belief.
- H2: The audience-focused method of countering conspiracy theory can mitigate conspiratorial belief.
- H2a: Decoding the myth of conspiracy theory is an effective method of reduction in conspiracy belief.
- H2b: Re-imagining intergroup relationships can help reduce conspiracy belief.

4. Method

4.1. Case selection

The experiments tested the effectiveness of countermeasures to the cognitive effect of the "Wuhan lab" COVID-19 conspiracy theory. The "Wuhan lab" conspiracy theory represents one of the most circulated COVID-19 conspiracy theories in the US at the time the experiments were conducted. The Wuhan lab conspiracy theory claims that the coronavirus originated in a laboratory linked to China's biowarfare program. This theory was picked up by the Trump administration to deflect attention away from criticism about the handling of the outbreak.

4.2. Sample

To explore the influence of intervention approaches on people's conspiracy beliefs, we designed a survey experiment. Our participants (607 adults from the United States) were recruited from Amazon Mechanical Turk (MTurk) in October and November 2020. Participants were paid $3 for their participation. Our sample is 40% female and 78% white. The median age of the sample was 34, and the median respondent had a 4-year college degree.

4.3. Design and procedure

This study adopted a between-subject experiment design, which was adopted by Jolley and Douglas (2014) and Warner and Neville-Shepard (2014) to examine the media effect of (counter-) conspiracist messages. The survey experimental method allows us to isolate the causal impact of debunking efforts on decreasing individuals' conspiracy beliefs. Participants were randomly assigned to one of six conditions — five conditions involving counter-conspiracy theory interventions and the sixth being a control condition. Following the manipulation, participants rated their beliefs in the conspiracy theory. Participants also provided their demographic details consisting of sex, age, party identification, political orientation and highest educational qualification.

More specially, in the first debunking method (media literacy intervention), participants were asked: "For this activity, please watch the media provided. While you are watching, analyze the media. Please bear in mind the following questions: in your opinion, what are the aim and purpose of the producer of this video? What level of credibility do you think the material presented in the video has? To what extent do you think the content presented in the video is consistent with journalism's values of objectivity and neutrality?"

Then, participants were exposed to media stimulus containing conspiracy narratives. After watching the video, participants were asked to type their answers regarding the production, message, and language

of the conspiratorial media content. Following this manipulation, participants completed the dependent measures. In this experiment, the media literacy stimulus was used to strengthen the critical thinking capacity of the audience; they were strongly encouraged to reflect on the objectivity, credibility and neutrality of the conspiracy narratives.

In the second counter-conspiracy theory method (inoculation strategy), participants were asked to view a short video that contained some obvious logical loopholes and fallacies. Then, they watched a debunking statement illustrating the fallacies in the previous video. The participants were then exposed to a more persuasive video of conspiratorial content. Following this, participants completed the dependent measures.

In the third intervention approach (fact- and science-based correction), participants were asked to view a short video from the World Health Organization (WHO), which provided a scientific explanation regarding the origins and transmission method of COVID-19. After watching the video, participants completed the dependent measures.

In the fourth method (decoding conspiracy theory myth), participants were asked to view a short video like a "mini lecture" in which two social psychologists give a brief introduction to the features of conspiracy theory and why individuals tend to seek conspiratorial explanations. After the video exposure, participants completed the dependent measures.

In the fifth method (improving intergroup relations), participants were instructed to imagine interacting with a Chinese individual. Participants were asked: "Please spend the next five minutes imagining that you are talking to a Chinese person that has sat next to you on the train. You spend about thirty minutes chatting until you reach your stop and the train departs. During the conversation, you find out some interesting and unexpected things about him, please think about what those things were and list them into the textbox." Because the aim of this method is to prime participants to think of the Chinese benignly, their specific answers about the imaginary content are not included in the analysis. Following this manipulation, participants completed an evaluation of Chinese people, and completed the dependent measures.

In the control group, participants only completed the dependent measures, and were not exposed to any intervention methods, including the five counter-conspiracy theory methods described above.

4.4. Measurement (dependent variable)

The conspiracy beliefs scale measures an individual's conspiratorial belief relating to China and Chinese people with four items, on a scale of 1 (strongly disagree) to 5 (strongly agree); one items is coronavirus-focused and another three are more general. The specific items can be found in the Appendix.

5. Results

Table 1 provides some descriptive statistics on the conspiracy beliefs scores for the six groups of participants. The sample size for each group ranged from 97 to 103. The sample mean of the control group was higher than those of Groups 2-4 and only slightly lower than that of Group 1.

Table 1. Descriptive statistics of the conspiracy beliefs scale

	N	Mean	Std. Dev.	Std. Error	Minimum	Maximum
Control	101	3.302	1.088	0.108	1	5
Group 1	102	3.458	1.123	0.111	1	5
Group 2	97	3.183	1.068	0.108	1	5
Group 3	103	2.896	1.229	0.121	1	5
Group 4	102	2.833	1.094	0.108	1	4.75
Group 5	102	2.922	0.989	0.098	1	5
Total	607	3.098	1.121	0.046	1	5

To test for H1 and H2, we followed a multiple linear regression approach, with the conspiracy beliefs scale as the dependent variable and five dummy variables corresponding to the five treatment groups as the independent variables. For each dummy variable, its value was 1 for data points belonging to the treatment group represented by the dummy variable, and 0 otherwise.

Since our hypotheses focused on the five types of mitigation methods "effectiveness at reducing conspiratorial belief", a one-sided test was adopted. To mitigate the issue of multiple comparison, we

applied the Sidak correction to adjust to the significance level required for the estimated coefficient for each independent variable to be statistically significant (Sidak, 1967). The results of the test are summarized in Table 2.

Our first group of hypotheses inquired on whether content-based counter conspiracy methods can mitigate conspiratorial belief. Specifically, H1a predicted that the media literacy intervention can effectively reduce conspiratorial belief. No such effect was supported by the results, as the estimated coefficient for Group 1 was not statistically significant (Beta=0.16, SE=0.16, p=0.844).

H1b predicted that the inoculation strategy can lead to reduced belief in conspiracy theory. No such effect was supported by the results, as the estimated coefficient for Group 2 was not statistically significant (Beta=-0.12, SE=0.16, p=0.776).

H1c predicted that science- and fact-focused corrections can effectively weaken conspiracy belief. Consistent with this hypothesis, the mitigation effect was significant (Beta=-0.41, SE=0.15, p=0.004), since the p-value was less than 0.0102, the Sidak correction adjusted significance level for 5% significance level. The group that watched the video providing a scientific explanation regarding the origins and transmission method of COVID-19 showed a statistically lower level of conspiratorial belief compared to the control group.

Our second group of hypotheses queried on whether audience-focused methods of countering conspiracy theory can mitigate conspiratorial belief. Specifically, H2a predicted decoding the myth of conspiracy theory to be an effective method of reducing conspiracy belief. Consistent with this hypothesis, the mitigation effect was significant (Beta=-0.47, SE=0.16, p=0.001), since the p-value was less than 0.002, the Sidak correction adjusted significance level for 1% significance level. The group of participants that watched the video of two social psychologists explaining the features of conspiracy theory and why individuals tend to seek conspiratorial explanations showed a statistically lower level of conspiratorial belief compared to the control group.

H2b predicted that re-imagining intergroup relationships can help reduce conspiracy belief. Consistent with this hypothesis, the mitigation effect was significant (Beta=-0.38, SE=0.16, p=0.007), since the p-value was less than 0.0102, the Sidak correction adjusted significance level for 5% significance level. The group of participants that were instructed to imagine interacting with a Chinese individual obtained a statistically lower level of conspiratorial belief compared to the control group.

Table 2. Regression results for comparing treatment groups with the control group

Dependent variable: Conspiracy beliefs scale			
	Beta	**Std. Error**	**P-Value**
Group 1	0.156	0.155	0.844
Group 2	-0.119	0.157	0.776
Group 3	-0.406**	0.154	0.004
Group 4	-0.469***	0.155	0.001
Group 5	-0.380**	0.155	0.007
Constant	3.302****	0.110	<0.000

Note. *p<0.10; **p<0.05; ***p<0.01; ****p<0.001.

6. Discussion

The present study tested the causality between five counter-conspiracy theory approaches and the extent of individuals' consequent conspiratorial belief. The results partly supported our predictions, with some unexpected, yet important findings. The content-based methods of counter conspiracy theory were shown to partly mitigate conspiratorial belief. While the intervening approaches of media literacy and inoculation did not demonstrate a significant reduction of conspiracy belief, science-and fact-focused corrections were shown to be effective mitigators. Our findings also clearly illustrated both audience-focused methods to be effective reducers of conspiracy theory acceptance.

First, both media literacy intervention and inoculation approaches were ineffective at reducing audiences' beliefs in COVID-19 induced conspiracy theories. While previous research that adopted these two methods to debunk conspiracy theories and misinformed content showed mixed results, our study adds empirical evidence to the pessimistic side. The media literacy intervention and inoculation approaches'

ineffectiveness is partly due to two issues of temporality in the specific context of this experiment —media literacy intervention that helps individuals obtain skills, capacities and knowledge of criticism on media is a gradual process whose effects are cumulative incremental, and uneven. Moreover, it has been found that when conducting media literacy education, interventions with more sessions are more effective than interventions with just one (Jeong et al., 2012). Therefore, it is reasonable that a "single dose" of media literacy as a countermeasure to conspiracy theory would be less effective in the immediate setting, but may produce long-term consequence through further treatments. In addition, some argue that when identifying and discrediting misinformation in cyberspace, a more specific "information literacy" intervention might be more relevant than general "media literacy" education (Jones-Jang et al., 2021).

The inoculation method faces a different temporal challenge, in that it is essentially a "prebunking" —rather than debunking— approach that helps cultivate "mental antibodies" or, in other words, resilience against future harm brought by interaction with similar but benign conspiracy narratives. As our study is not a longitudinal survey, it is not entirely unexpected that the inoculation method did not work well in mitigating the negative effect of conspiracy theories in the short term. Not to mention that those with pre-existing conspiratorial mindsets might accept conspiracy discourses even if they contain obvious factual or logical errors. Another potential explanation for the ineffectiveness of inoculation is that our study did not include the element of "affect" into its inoculation strategy. When testing the inoculation strategy's effectiveness at inducing resistance to conspiracy theories, Banas and Miller (2013) found that affect could serve as a peripheral cue. In our case, conspiracy narratives that China was involved in secret plots regarding COVID-19 can provoke strong negative feeling towards the Chinese government, which lends those narratives appeal. In other words, the evidence of the conspiracy theories may not hold up well to scrutiny, but pre-existing bias can make the narratives "feel right" while viewed. In this vein, although the inoculation approach aims to highlight the logical flaws of weak and false arguments, this method might be undercut by feelings that defy rationality and logic.

Second, our findings suggest that science- and fact-focused corrections effectively reduce individual acceptance of conspiracy narratives. It should be noted that our survey was conducted in a period when anti-China sentiment and conspiracy theories about the pandemic had converged and culminated to an extraordinary degree: the study was conducted just days before the 2020 presidential election, which was perhaps the most polarized in contemporary US politics, combined with years of anti-China propaganda and a recent proliferation of misinformation related to COVID-19. Our results, however, went against the prevailing notion of "post-truth" in which emotions triumph over analytical thinking, suggesting a "bounce-back" phenomenon as a potential new theorization — that is, once people have long been overloaded with strong emotional messages coming from various media platforms, the informational values of rational and factual arguments rises, diminishing conspiracy theories' capacities to fan radicalized beliefs. This revived attentiveness to factual argument may thus come to override the disruptive effects of the negative emotions produced by conspiracy theories. Moreover, Cook and Lewandowsky (2011) argued that efficient correction should focus on the facts, rather than false belief, in order to avoid the misinformation becoming more familiar. Further, refutation should include an alternative explanation. These two key elements of fact- and science-focused correction were carefully embedded in our intervention.

Third, our findings demonstrated that the audience-focused, "decoding" treatment to be effective at reducing conspiracy belief, which is consistent with our predictions. The "decoding" treatment explains how pre-existing biases, beliefs, and conspiracy narratives are co-constituted and implicated with each other, so that "false but still sensical" claims do not a priori make sense regardless of their localized beliefs. This leads to audiences being less likely to accept conspiracy narratives, as substantiated in our results. Furthermore, the "decoding" treatment was developed as an integrated approach, addressing all three core components of conspiracy theories proper (CTP). Our results demonstrated that this integrated, audience-focused approach could be slightly more effective than the content-focused, science- and fact-focused corrections at reducing conspiracy beliefs. This original approach reduces the general receptivity to conspiracy theories by targeting their root cause. Another effective method belonging to this strand is to recall people's experiences of successfully controlled events, in order to strengthen self-efficacy and reduce conspiracy ideation (Krekó, 2020).

Fourth, though "decoding" treatment represents a more integrated countermeasure to conspiracy theories, our results suggest that re-imagining intergroup relationship with the Chinese in a positive light also leads to a significant reduction of conspiracy belief about COVID-19 from a "China threat" perspective. While a nationwide representative study in Poland found intergroup contact to be a significant predictor of attitudes toward Jews, it was not significantly related to belief in Jewish conspiracy theories (Winiewski et al., 2015); our study shows more promising results. Conspiracy theory belief often functions through an epistemic state of exception (Baden & Sharon, 2020; Bjerg & Presskorn-Thygesen 2017). Based on our results, the "re-imagining" approach reproduced an effect of desecuritization because the audience tended to downgrade or cease to treat the Chinese group as an existential threat to a valued referent object (Roe, 2004; Jutila, 2006). By re-imagining a casual, informal and private conversation with an outgroup member (a Chinese person) in a prosaic context (presumably on the daily train ride home or workplace) with a prescribed aim to discover something interesting, this imaginary intergroup communication helps deconstruct the epistemic exception relied upon by conspiracy narratives to render an outgroup antagonistic, thus undermining the securitization frame of the American-Chinese relationship that dominated politicized intergroup relationships during the COVID-19 pandemic.

7. Conclusion

While most studies on conspiracy theory and beliefs have focused on the cognitive mechanism of conspiracy theories, this paper looks for the solution. To this end, the present study tested the causality of five approaches of counter conspiracy theory and the resultant extent of individuals' conspiratorial belief. Our results demonstrate that the content-based methods of counter conspiracy theory can partly mitigate conspiratorial belief: while media literature and inoculation strategy did not demonstrate a significant reduction of conspiracy belief, the science-and fact-focused corrections led to a significant reduction in conspiracy beliefs. Our results also support both audience-focused interventions' effectiveness (i.e., decoding the myth of conspiracy theory and re-imagining intergroup relationship) at reducing conspiracy theory acceptance.

Last, we should address two limitations. One is that this paper explored only the immediate effects of debunking approaches on conspiracy theory belief. It is, therefore, notable that the usefulness of these approaches may fade away in the context of longitudinal survey that measures their long-term effects. The other limitation is that this study did not account for individual differences, i.e., how different personalities influence the outcome of intervention approaches in reducing conspiracy belief. A critical consideration of different individual psychologies, local cultures, group dynamics, and political systems may suggest new avenues for the study of reduction in conspiracy belief via developing multiple tests on these moderators, and their effect on the relationship between intervention approaches and conspiracy belief. Rather than measuring how subjects' belief in specific conspiracy theories is moderated by individual psychological traits and cognitive structures in a given culture and time, we might develop a more theoretically grounded scale that directly taps these factors of moderation to jointly explain how to either enhance individual resilience against conspiracist thinking or to rescue individuals from the cognitive trap of conspiratorial provocation.

Author Contribution

Idea, G.T. and L.T.; Literature review (state of the art), G.T., L.T.; Methodology, G.T., Y.R.; Data analysis, G.T., Y.R.; Results, G.T., L.T., Y.R.; Discussion and conclusions, L.T., G.T.; Writing (original draft), G.T., L.T., Y.R.; Final revisions, G.T., L.T., Y.R.; Project design and sponsorships, G.T., L.T., Y.R.

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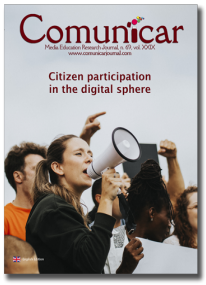

Young people and social networks: Between the democratization of knowledge and digital inequality

Jóvenes y redes sociales: Entre la democratización del conocimiento y la inequidad digital

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ABSTRACT

The growing access to the Internet, devices, and social media has revolutionized communication processes and democratized access to information and content creation. However, several researchers have shown that although access to the Internet is readily available, the virtual world is a mirror of the society in which we live where digital inequity exists. Several studies present evidence that social status does not affect the presence of social network users, but it does affect the way it is used and content creation, although it concerns studies that were mostly carried out in European and North American contexts. This research explores the socioeconomic profile of young people concerning the consumption and creation of content, and the virtual world of adolescents related to social inequalities found in the real world. This study followed an exploratory quantitative design by means of a survey that was applied to 2,115 high-school students from high-performing educational institutions in Ecuador. The results highlight three units of analysis: (1) reasons for using the platform (2) time of consumption (3) type of content that young people create. In line with previous studies, it points out how the socioeconomic environment has an effect on how young people use social networks. Similarly, it shows an increase in the democratization of content creation processes.

RESUMEN

El creciente acceso a Internet, dispositivos y redes sociales ha revolucionado los procesos de comunicación y democratizado el acceso a la información y la creación de contenido. Sin embargo, varios investigadores han mostrado que, si bien el acceso al Internet es fácilmente alcanzable, el mundo virtual es un espejo de la sociedad en la que vivimos existiendo inequidad digital. Varios estudios presentan evidencia de que el estrato social no afecta la presencia de usuarios en las redes, pero sí afecta su uso y la creación de contenido, si bien se trata de estudios desarrollados mayoritariamente en contextos europeos y norteamericanos. La presente investigación explora el perfil socioeconómico de los jóvenes en el consumo y creación de contenidos, y el mundo virtual de los adolescentes en materia de desigualdades sociales encontradas en el mundo real. La investigación siguió un diseño cuantitativo exploratorio a través de una encuesta que fue aplicada a 2,.115 estudiantes de educación secundaria y bachillerato de instituciones educativas de alto rendimiento de Ecuador. Los resultados dan cuenta de tres unidades de análisis: 1) razones de uso de la plataforma; 2) tiempo de consumo; 3) tipo de contenido que crean los jóvenes. En consonancia con estudios anteriores, se señala cómo el entorno socioeconómico tiene un efecto en cómo los jóvenes usan las redes sociales. Al mismo tiempo se muestra un auge en la democratización de los procesos de creación de contenido.

KEYWORDS | PALABRAS CLAVE

Social networking sites, YouTube, participation, content, young people, socioeconomic level.
Redes sociales, YouTube, participación, contenido, jóvenes, nivel socio-económico.

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1. Introduction

The concept of knowledge has had diverse connotations in different cultures and societies throughout history. According to Raddaoui (2012), the systems for the creation and dissemination of knowledge were traditionally characterized by their elitism since only certain privileged classes had the possibility of creating content for the masses. According to García-Leiva (2017), the arrival of the Internet made the creation and distribution of content simpler, faster, and more economical – thus permanently changing the present and future of knowledge generation.

Studies about the Internet and social networks normally focus on access, leaving aside fundamental problems of inequality, which are represented by how users utilize social media (Micheli, 2016). This is important for adolescents, considering that social networks use has had a major influence on their daily lives. Therefore, this study aims to determine whether the socioeconomic status of young people affects in any way their participation in social networks, especially the YouTube platform. Other demographic factors such as gender, age, race and ethnic origin were not considered seeing that one wishes to determine whether participation in young students' social networks follows a pattern of 'social reproduction' that is geared towards the (re)production of discrimination processes and 'digital inequality' (Bourdieu, 1973 as cited in Micheli, 2016). Previous studies (Hargittai, 2008) have concluded that Internet use tends to reproduce patterns of social stratification; however, there are no definitive results with respect to the subject matter.

Some research papers (Hargittai & Walejko, 2008; Blank, 2013; Hoffmann et al., 2015) have established that there is a relationship between participation in social networks and the socioeconomic level of young people, which is measured by factors such as family income and that of the parents. In this respect, Blank (2013) clarifies that users of less privileged contexts create more content than their counterparts.

Our research contributes to this conversation in various ways. On the one hand, previous studies utilized data from the United States and Europe. In this sense, this is one of the first analyses that have been carried out in a Latin American context, i.e. whose social, political, educational and economic reality is a far cry from the aforementioned countries. On the other hand, the sample consists of students receiving secondary school education from high-performing institutions from throughout country. For this reason, there is ample diversity in the responses. Finally, the incorporation of socioeconomic variables such as income and the level of education of parents are related with YouTube usage and creation–i.e. fundamental aspects that we believe should be analyzed in detail, especially in Latin America.

1.1. Social networks

Over the last decade, social networks have been intensely introduced in the lives of millions of people who belong to various contexts and socioeconomic levels of society. According to Romero et al. (2013), the social network capacity that is provided to communicate and connect people has resulted in a great number of users utilizing them with diverse objectives—ranging from the creation of businesses to communication with friends and family members.

Shiau et al. (2017) assert that social networks are the new way in which people interact and form relational ties. One of the earliest definitions of social networks was provided by Kaplan and Haenlein (2010: 61), who affirm that social media are "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and that allow the creation and exchange of user-generated content". Web 2.0 is a term that has been used to describe the new way in which users began to use the Web, thereby creating contents that are continually modifed by users on a collaborative basis. For this reason, one may conclude that Web 2.0 is a social creation that fosters collective intelligence and which goes beyond the one directional communication of Web 1.0 (Latorre, 2018). Social networks have certain particularities that make them unique. For example, users can create a list of contacts that is visible to other members of the same network, they can upload and share photos and videos not only among their personal contacts, but also globally, as well as write comments on other people's profiles, and send private messages among users (Fardoun et al., 2012), create content, develop profiles for a website or application and participate in groups and networks with specific themes (Obar & Wildman, 2015).

The first social networks started operating at the beginning of the 1990s, with 'Six Degrees' being the first in 1997. However, the most popular ones appeared at the beginning of 2000. MySpace and LinkedIn first started operating in 2003, while YouTube made its first appearance in 2005. Moreover, a year later, in 2006, Twitter and Facebook were founded, with Instagram having its debut in 2010. Currently, there are 3.8 billion active users of social networks, i.e. with a penetration level of 49% in the world's population and with an annual growth of 9.2%. The most predominant social networks are: YouTube, with 1.9 billion users (YouTube, 2019), which is followed by Facebook, with 1.95 billion; Instagram, with 928.5 million; and Twitter with 339.6 million (We are Social & Hootsuite, 2020).

This study focuses on the participation of students on YouTube as it is one of the most disruptive platforms within the current media ecology. Since its creation, it has become one of the greatest platforms in the world to access, search, view, share, and create video content, among other specific uses implemented by its users. (Pires et al., 2019). According to Castillo-Abdul et al. (2020), it went from being a website for recording and reproducing videos to becoming a social network that is based on its interactiveness and the creation of contents, which are of a multiple nature such as: lifestyle, games, sports, fashion, etc. For Bautista-Sancho (2012: 124), YouTube creates "countless communities based on the unlimited types of interests in which infinite forms of social relations are developed", which feed on a continuing source of creativity coming from young people and adults. According to Vizcaíno-Verdú et al. (2019), it is the young public that has made YouTube into a space for the creation of ideas and customs by means of digital and cultural hybridization, i.e. where groups are formed based on their common interests instead of being in sync with a social and cultural profile –thus developing cognitive, emotional, and social skills and fostering the building of identities.

1.2. Social networks, inequality and digital exclusion

Social networks constitute one of the most important tools for communication. Their effectiveness, accessibility, cost, and the possibility of facilitating conversations in real-time enable them to play a fundamental role not only as a means of communication, but also as instruments that influence political, economic, social, and educational decision-making at a global level (Al-Rahmi & Othman, 2013). This is a positive step since they have become the port of entry for part of the population that was 'digitally excluded', e.g. in developing countries, or in disadvantaged segments of the population (Correa, 2016). According to Micheli (2016), the fact that the usage of the Internet has become so ubiquitous does not mean that social inequality has disappeared, or that it has not contributed to the digital world. Furthermore, the author asserts that digital inequality should be explored in the world of social networks since the types of activities that are organized and the opportunities that exist via the web could become –after having overcome the obstacle of access by factors such as digital skills and knowledge – a source of inequality.

At this point, it is important to highlight the fact that although there is access and a level of familiarity with social networks, it does not mean that there is no equality in their usage by family members with underprivileged socioeconomic profiles and who have on average fewer digital skills and mostly use the Internet for enjoyment instead as activities for the development of intellectual capital (Hargittai, 2008; Micheli, 2016).

1.3. Social networks and our youth

At present, adolescents and young people spend countless hours on social networks (Fardoun et al., 2012). For Cipolletta et al. (2020), adolescents are a social group that are highly dependent upon social networks since 94% of adolescents between 13 to 17 years of age use social networks, while more than half of them (56%) are online various times a day. According to Boyd (2014), this has an explanation since social networks affect issues such as the creation of identity, social life, digital literacy and academic life. For Sánchez-Díaz-de-Mera and Lázaro-Cayuso (2017), it is important to understand how young students from secondary schools, i.e. those who grew up in a digital eco-system mediated by social networks, interact in a digital world. This is not only shaping their learning processes, but also their social development. Conversely, social networks provide social capital, which could be harnessed by young people with limited financial resources to carry out specific tasks, acquire skills, or achieve certain goals such as accessing

employment opportunities (Baumer, 2018). With respect to the question of interaction and the creation of knowledge, social networks facilitate a new eco-system whereby users not only consume information, but also generate it - thus converting themselves into "pro-sumers", namely those who make social networks a means of production and consumption (Briciu & Briciu, 2020). For Hargittai (2008), the socioeconomic and family background of a young student such as his/her race, ethnic origin, and the level of schooling of his/her parents do not reflect an influence (a statistically significant relationship) on social network usage. However, these socioeconomic background factors seem to affect how and why they use them, that is, whether they are being used for educational and professional growth purposes or entertainment.

According to Anderson and Jiang (2018), a phenomenon that has caused considerable change in the social network use is the ownership of smartphones, which has become a ubiquitous device among young people. In countries such as the United States, 95% of adolescents are reported to have a smart phone, and of that figure, 45% are said to be online almost constantly. Additionally, the authors found that although it is clear that Facebook has traditionally dominated competition by attracting the attention of users, there has also been a turn in the preference in their usage among American youths since approximately a third said that they had visited Snapchat (35%) or YouTube (32%) more often, while 15% said the same about Instagram. In comparison, 10% of adolescents said that Facebook was the online platform that they used more frequently. In addition, fewer youngsters cited Twitter, Reddit, or Tumblr as the site that they visited regularly.

In Ecuador, only 45.5% of families have access to the Internet (INEC, 2019) – with the 15 to 29 age group being the one that used social networks the most from their mobile phone (with 94.1%), followed by youths younger than 15 years, which comprised 93% (Ministry of Telecommunications, 2016). According to the National Institute of Statistics and Census (INEC, 2019), Facebook was used by 55.4% of Ecuadorians, followed by WhatsApp, with 52%, and other social networks such as Instagram, with 18.2%; and finally YouTube, with 15.4%, respectively (Rodríguez, 2020). Finally, Halpern et al. (2020) indicate that there have been efforts by governments from all over the world to guarantee global access of ITCs. Notwithstanding, the digital gap has been maintained especially in secondary education. The authors also highlight the Chilean study regarding the management of information, communication and digital ethics, i.e. where it was shown that only 1.8% of young college students would only have an advanced level of skills and digital competences, which would be an indicator for a need for improvement and investment in the education and development of the digital competences of young students.

1.4. Creation of content

Access to the Internet and social media has made content creation become a much more accessible task by facilitating the arrival of a new generation of journalists, critics, and artists who have self-published their work to the detriment of the domain of mass media which, although continue to exist, no longer enjoy the status of sole providers of information. According to Blank (2013), self-publication or 'personal publication' not only includes text (as a blog), but also music, photos, videos, books, pamphlets and other products that can be created at little to nothing and distributed via the Internet to global audiences.

Social networks have not only opened up possibilities for receiving information unidirectionally but have also provided an opportunity for average citizens to be content creators. Thus, social networks have become a point of convergence for individuals with the same interests. In fact, various educational institutions use them to publish their resources, videos, research projects, etc. (Rosemary et al., 2013). Conversely, their usage has been popularized as a tool for students to carry out projects and tasks by means of the creation of videos or the publication of blogs – i.e. two of the most commonly assigned tasks, especially from the onset of the global pandemic to the beginning of 2020.

As a society, we are progressively adapting to the phenomenon of social networks. The impact that their usage will have in the next few years cannot be measured since their accelerated growth and continuous transformation make it difficult to project the long-term impact it will have on social and educational processes. This dynamic has greatly affected the roles of users as the creation of knowledge is bidirectional. According to Blank (2013), there is a strong relationship between demographic variables and content creation, i.e. where age is one of its most consistent predictors, and because young people

tend to create more content than older persons (Blank & Dutton, 2012). Blank (2013) asserts that there are two perspectives regarding social stratification and content creation: the first one is centered on the fact that Internet accessibility provides unprecedented participation opportunities and increases 'individual autonomy' in the selection and content creation. The second perspective is that self-publication increases 'individual freedom' and facilitates the participation of people from all social spheres in an unprecedented number of debates, which is positive since it increases the diversity of information and opinions in the civic sphere.

2. Material and methods

This research was carried out by following an exploratory quantitative design. The method selected allowed us to identify how a phenomenon occurs within a real context (Creswell & Poth, 2018), that is, to explore, describe, and understand the social and educational reality (Yin, 2011) regarding the usage and interactions of social networks by young people, namely YouTube and its relationship with socioeconomic levels. The research instrument was designed within the framework of the project "Youtubers and Instagramers: Towards a management model of learning", which was developed by the Universidad Técnica Particular de Loja in the call for research proposals from 2019-2021 (PY2583). This instrument aims to analyze the dimensions of media competences proposed by Ferrés and Piscitelli (2012) within the context of YouTube and Instagram. It was a survey consisting of 44 closed questions with nominal and ordinal measurements. Its validation was carried out by international experts, including research professors from Spain, Portugal, Brazil and Peru. The reliability of the survey via Cronbach's Alpha provided an index of 0.791 as a result (Ríos-Hernández et al., 2020). 2,115 students were surveyed from high-performing educational institutions in Ecuador and voluntarily authorized their participation by means of a written document, which was optional and anonymous. At the time of the questionnaire, they had an average age between 12 and 18, and were studying in the eighth, ninth, and tenth year of secondary school and during the first, second, and third years of high school in the national school system.

For the quantitative analysis, the data from the student surveys were processed mathematically and systematically using SPSS (v.22.0). Three variables were utilized: 1) sector of the educational institution: urban or rural; 2) monthly family income; and 3) level of education of the household representatives as shown in Table 1.

Table 1. Descriptive statistics of the sample

		Recount	% of N columns
Sex	Male	972	46.0%
	Female	1143	54.0%
Educational institution sector	Urban	1850	87.5%
	Rural	265	12.5%
Monthly family income	Less than $500	930	44.0%
	From $501 - $1,500	906	42.8%
	More than $1500	279	13.2%
Level of education	No formal studies or primary school	199	9.4%
	Secondary Schooling	696	32.9%
	University: Tertiary (Bachelor's) and Fourth Level (MA/Ph.D.)	1220	57.7%

Validation of the data was carried out by triangulating the results and the corresponding relationship with the theoretical framework, which underpinned the analysis of the results in order to approximate valid and reliable interpretations. Ethical aspects were taken into account during data collation by means of permits so as to direct the information towards educational aims. The administration of the data was managed objectively and was combined with the collated evidence. Finally, the dissemination of the data took into consideration the privacy of the participants and was linked with the institutional policies involved in the study.

3. Results

The results are shown in three categories or units of different analyses: 1) Reasons for using the platform; 2) Time of consumption; and 3) Type of content that young people from secondary education and high school create.

3.1. Reasons for usage

The data were analyzed to determine the main reasons for using YouTube among the following alternatives: 1) Entertainment; 2) Education; 3) Work; 4) Generating online contacts; 5) Generating offline contacts.

Table 2. Reasons for using YouTube

Entertainment		**Yes**	**No**	**Yes**	**No**
Monthly family income	Less than $500	835	95	89.8%	10.2%
	From $501 - $1500	848	58	93.6%	6.4%
	More than $1500	270	9	96.8%	3.2%
Total		1,953	162	92.3%	7.7%
Level of education	Without formal studies and primary education	167	32	83.9%	16.1%
	Secondary	629	67	90.4%	9.6%
	Third (B) and fourth level (MA/PhD)	1,157	63	94.8%	5.2%
Total		1,953	162	92.3%	7.7%
Sector of educational institution	Urban	1,725	125	93.2%	6.8%
	Rural	228	37	86.0%	14.0%
Total		1,953	162	92.3%	7.7%
Education					
Monthly family income	Less than $500	690	240	74.2%	25.8%
	From $501 - $1500	672	234	74.2%	25.8%
	More than $1500	206	73	73.8%	26.2%
Total		1,568	547	74.1%	25.9%
Level of education	Without formal studies and primary education	143	56	71.9%	28.1%
	Secondary	540	156	77.6%	22.4%
	Third (BA) and fourth level (MA, PhD)	885	335	72.5%	27.5%
Total		1,568	547	74.1%	25.9%
Sector of the educational institution	Urban	1,391	459	75.2%	24.8%
	Rural	177	88	66.8%	33.2%
Total		1,568	547	74.1%	25.9%
Work					
Monthly family income	Less than $500	285	645	30.6%	69.4%
	From $501 - $1500	255	651	28.1%	71.9%
	More than $1500	56	223	20.1%	79.9%
Total		596	1,519	28.2%	71.8%
Level of education	Without formal studies or primary education	56	143	28.1%	71.9%
	Secondary	233	463	33.5%	66.5%
	Third (BA) and Fourth Level (MA, PhD)	307	913	25.2%	74.8%
Total		596	1,519	28.2%	71.8%
Sector of educational institution	Urban	523	1,327	28.3%	71.7%
	Rural	73	192	27.5%	72.5%
Total		596	1,519	28.2%	71.8%
Generating online contacts					
Monthly family income	Less than $500	87	843	9.4%	90.6%
	From $501 - $1500	80	826	8.8%	91.2%
	More than $1500	11	268	3.9%	96.1%
Total		178	1,937	8.4%	91.6%
Level of education	Without formal studies or primary education	13	186	6.5%	93.5%
	Secondary	66	630	9.5%	90.5%
	Third (BA) and Fourth Level (MA, PhD)	99	1,121	8.1%	91.9%
Total		178	1,937	8.4%	91.6%
Sector of educational institution	Urban	143	1,707	7.7%	92.3%
	Rural	35	230	13.2%	86.8%
Total		178	1,937	8.4%	91.6%
Generating offline contacts					
Monthly family income	Less than $500	26	904	2.8%	97.2%
	From $501 - $1500	22	883	2.4%	97.6%
	More than $1500	6	273	2.2%	97.8%
Total		54	2,060	2.6%	97.4%
Level of education	Without formal studies or primary education	6	193	3.0%	97.0%
	Secondary	20	676	2.9%	97.1%
	Third (BA) and Fourth Level (MA, PhD)	28	1,191	2.3%	97.7%
Total		54	2,060	2.6%	97.4%
Sector of educational institution	Urban	44	1,805	2.4%	97.6%
	Rural	10	255	3.8%	96.2%
Total		54	2,060	2.6%	97.4%

In the entertainment category, the usage of YouTube increased on the basis of socioeconomic status. Students with lower incomes and those whose parents had a lower education level tended to use YouTube to a lesser degree than their more privileged counterparts. Moreover, only 86% of the students who lived in rural areas used YouTube for entertainment purposes versus 93.2% of students who lived in urban areas.

In the education category, there are no significant variations between the level of family income and YouTube usage for educational purposes. However, there is a variation with regard to the family representative's level of formal studies – the latter being the group of students whose parents have secondary school qualifications and who use YouTube for educational purposes (77.6%), which is followed by the next group who have third level (BA) and fourth level (MA/PhD) qualifications, i.e. with

72.5%. Finally, the group with no formal studies or primary education is 71.9%. As with the previous category, students from urban areas use YouTube more for educational purposes than the students from rural areas.

In the employment category, there is evidence that young people with lower family incomes (30.6%) use YouTube to improve their employment profile in a greater measure than those students with higher income (20.1%). On the other hand, students with parents who have no formal studies or only primary education (28.1%) and secondary education (33.5%) are those who use YouTube more to learn about employment. Moreover, the students whose parents have a university education (25.2%) are those that use the platform less for these purposes. No significant difference in this category was found among students who live in urban and rural areas.

With regard to the category of generating online contacts, the students with lower earnings (9.4%) are those that used the platform more to generate these types of contacts. A decreasing pattern is observed in this category since the students with higher income are those that use the platform less for these purposes (3.9%). Variations regarding the level of education of the family representative in this category were negligible. It was observed in the rural area that there was a greater tendency than in urban areas to use the YouTube platform to generate online contacts. Finally, with regard to generating contacts offline, there is a slight tendency of students with a less privileged socioeconomic profile to use YouTube for this purpose in a greater measure than their more privileged counterparts (Table 2).

3.2. Time usage

With regard to time usage, it was discovered that the young people with a moderate usage of the platform (less than 1 hour a day) had an inverse relationship with family income, that is to say, the higher the earnings, the less the platform was used. However, when analyzing the figures for higher usage, namely the group of 1 to 3 hours and 4 to 6 hours, it was found that the greater the income, the greater the usage of the platform. On the other hand, the same pattern follows for the academic profile of the household representatives as moderate usage (less than 1 hour daily) follows a decreasing pattern. However, a more prolonged use of Youtube shows that the higher the parents' educational level, the greater was the use of the social network. Finally, there is a clear universal tendency in the urban sector to consume more content than in rural areas (Table 3).

Table 3. Duration of daily usage of YouTube

		Less than 1 hour	From 1 to 3 hours	From 4 to 6 hours	From 7 to 9 hours	More than 9 hours
Monthly family income	Less than $500	39.4%	43.9%	12.6%	2.4%	1.7%
	From $501 - $1500	27.0%	49.4%	18.4%	2.8%	2.4%
	More than $1500	19.8%	55.7%	19.0%	2.9%	2.6%
Total			31.5%	47.8%	15.9%	2.7%
Level of education	Without formal or primary education	49.2%	38.6%	9.5%	1.6%	1.1%
	Secondary	35.6%	44.7%	15.2%	2.4%	2.1%
	Third level (BA) and fourth level (MA, PhD)	26.3%	51.0%	17.4%	3.0%	2.3%
Total			31.5%	47.8%	15.9%	2.7%
Sector of educational institution	Urban	30.7%	48.7%	15.9%	2.5%	2.2%
	Rural	36.9%	41.8%	16.1%	3.6%	1.6%
Total			31.5%	47.8%	15.9%	2.7%

3.3. Creation of content

With regard to the type of content that young people create, there is evidence to prove that the socioeconomic profile of the students had a slight influence on the type of content that the young people created. Specifically, eight categories of different types of content were analyzed by participating youth which were the following: 1) Entertainment, 2) Education, 3) Video games, 4) Technology, 5) Viral Content, 6) Fashion and beauty, 7) News, and 8) Personal events. Table 4 displays the results of preferences in the creation of content for the sample, which is mostly homogeneous, but has slight variations between categories and sub-categories.

The first part of the table gathers data regarding the classification of content, i.e. where family income is a variable. The result shows that for the entertainment, education, and technology categories there was an inversely proportional trend, that is to say, that students with fewer financial resources were those that

created more contents in these categories. With regard to the video game and personal event categories, the students belonging to the middle-class were those that created more content. Finally, with respect to the fashion and beauty and information (news) categories, the students with resources on opposite poles of the spectrum were those that created more content, whereas students with middle income families did not create the same level of content as their counterparts. The second part of the table shows the results of content classification depending on the level of formal studies of the family representative. A decrease is seen in the creation of content for entertainment, education, technology and information (news), that is to say, the lower the level of formal studies of the family representative, the more content created in those disciplines. On the other hand, in the video game, viral content and personal event categories, a proportional trend was observed that states that when the parents' level of formal study is high, there is an increment in the creation of content in these categories. Finally, in the fashion and beauty category one sees a similar trend to that of the first table in which the opposite poles of the educational spectrum are those that create more content, while the group whose parents have secondary education is the one that creates less content in this category.

The third part of the table shows that in the urban area there is a light preference to create content in the fields of fashion and beauty, information (news), and personal events, while in rural areas it shows a slight trend in creating contents in entertainment, education, video games, technology and viral content (Table 4).

Table 4. Type of content that students create in Youtube

Variables		N		Entertainment	Education	Video games	Technology	Viral Content	Fashion and Beauty	Info. (news)	Personal Events
Monthly family income	Less than $500	930	F	312	165	106	93	71	78	73	16
			%	33.5%	17.7%	11.4%	10.0%	7.6%	8.4%	7.8%	1.7%
	From $501 - $1500	906	F	289	138	129	68	69	63	38	25
			%	31.9%	15.2%	14.2%	7.5%	7.6%	7.0%	4.2%	2.8%
	More than $1500	279	F	78	30	37	22	23	21	18	5
			%	28.0%	10.8%	13.3%	7.9%	8.2%	7.5%	6.5%	1.8%
	Total	2,115	F	679	333	272	183	163	162	129	46
			%	32.1%	15.7%	12.9%	8.7%	7.7%	7.7%	6.1%	2.2%
Level of education	Without formal studies or primary education	199	F	74	48	12	22	12	17	20	3
			%	37.2%	24.1%	6.0%	11.1%	6.0%	8.5%	10.1%	1.5%
	Secondary	696	F	232	127	98	71	55	46	50	14
			%	33.3%	18.2%	14.1%	10.2%	7.9%	6.6%	7.2%	2.0%
	Third and Fourth Level	1,220	F	373	158	162	90	96	99	59	29
			%	30.6%	13.0%	13.3%	7.4%	7.9%	8.1%	4.8%	2.4%
	Total	2,115	F	679	333	272	183	163	162	129	46
			%	32.1%	15.7%	12.9%	8.7%	7.7%	7.7%	6.1%	2.2%
Sector of the educational institution	Urban	1,850	F	590	284	228	155	142	144	118	44
			%	31.9%	15.4%	12.3%	8.4%	7.7%	7.8%	6.4%	2.4%
	Rural	265	F	89	49	44	28	21	18	11	2
			%	33.6%	18.5%	16.6%	10.6%	7.9%	6.8%	4.2%	0.8%
	Total	2,115	F	679	333	272	183	163	162	129	46
			%	32.1%	15.7%	12.9%	8.7%	7.7%	7.7%	6.1%	2.2%

4. Discussion and conclusion

The socioeconomic profile does not affect the presence of young people in the virtual world. However, this factor, together with the geographical profile, influences the reasons why social networks are used and the time spent on them. The results show that young people with an underprivileged socioeconomic status and who belong to rural areas use YouTube to a lesser degree and for shorter periods of time than their more privileged counterparts who live in urban areas, i.e. those who use this social network for entertainment and for long periods of time. Following Michelli (2016) and Helsper (2012), this fact indicates that the resources of those who are offline tend to expand, that is to say, if a young person has offline leisure time at his/her disposal, he/she will mirror it online.

Moreover, students with a low socioeconomic profile seek to improve their professional profile online to a greater extent than young people with parents with secondary and higher education qualifications. According to Palo and Drobot (2010) the "financial and human capital of the family", that is to say, the

financial resources, abilities, and capacities that the parents possess and put at the children's disposition to develop their professional skills are more tangible in families with high academic profiles. Therefore, the most privileged youths and those with access to these resources do not look for them online. This indicates that the search for social capital (Baumer, 2018) in social networks to improve professional profiles or to seek employment is one of the aspects that show inequities imported from the offline world.

In addition, mirroring the results provided by Michelli (2016), it was observed that the youths with limited financial resources find in social networks a means of extending their online and offline contacts, of expanding their social networks, of making new friends, and gaining visibility – thus taking advantage of the socialization characteristics of the networks, while their privileged counterparts are not so active in the expansion of their contacts. With regard to the creation of content, the youths with privileged profiles and with access to more and better electronic devices (Palo & Drobot, 2010) tend to create more content in the areas of video games, viral content and personal events, whereas the less privileged groups create more content in entertainment, education and technologies. This discrimination or distinction among these themes is explained by what is defined as 'relational terms', that is to say, in the expression of displeasure regarding the preferences of other people with a lower social level than their own (Bourdieu, 1965 as cited in Michelli, 2016).

The point of convergence in the creation of content focuses on the categories of fashion and beauty, and news. This can indicate that – without taking into consideration the profiles analyzed here – both categories show trends in equality and growing democratization among the young participants in this study. Although it is certain that a tendency exists in the democratization of content creation, some trends that reproduce social inequality could be observed. Regardless, youths belonging to all of the analyzed socioeconomic groups create content in a greater or lesser measure in all the categories. Therefore, we could say that there is an ongoing process in the democratization of knowledge by means of the free and active creation of users' contents between the ages of 12 and 18. Finally, the findings from this article provide further details about a theme that has not been analyzed fully in the Latin American context, which reinforces the need to invest more resources in the development of digital competencies in primary and secondary education in Latin America and globally.

Author Contribution

Idea, L.A.V., D.R.R., M.I.S.; Literature Review (state of the art), D.Y.G., L.A.V.; Methodology, L.A.V.; Data analysis, L.A.V., D.Y.G.; Results, L.A.V., D.Y.G., D.R.R.; Discussion and conclusions, L.A.V., D.Y.G., M.I.S.; Writing (original draft), L.A.V., D.Y.G.; Final revisions, L.A.V., D.Y.G. D.R.R., M.I.S.; Project design and sponsorships, L.A.V., D.R.R., M.I.S.

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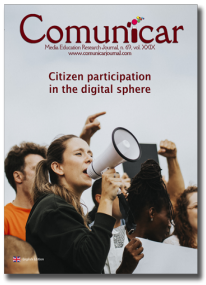

A web-based serious game about self-protection for COVID-19 prevention: Development and usability testing

Juegos serios en web para la auto-protección y prevención del COVID-19: Desarrollo y pruebas de usabilidad

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ABSTRACT

The number of new COVID-19 cases continues to rise rapidly in many countries despite vaccination. The best way to counter the spread of COVID-19 is self-protection. This study documents the development of a web-based serious game (WSG-COVID-19.SP) to promote effective learning strategies for self-protection against COVID-19 and to test the game's content validity and usability. WSG-COVID-19.SP was developed using situated learning theory and diagnostic feedback mechanism. The game includes six situation storylines with 17 learning objectives. It uses a problem-solving approach to foster practices such as wearing masks, washing hands, and social distancing. Portfolio analysis was used to diagnose learning problems and report on the learning process. An overall summary index—the scale-level content validity index (S-CVI)—was used to evaluate content validity. Usability was tested through a website survey from 71 students from one university to gauge their technological acceptance and the game's capability to promote future self-protection behaviors. The S-CVI was 0.81. Usability and acceptability were neither related to the users' college major (whether it is information technology-related) nor to gender. Among the respondents, 84.5% agreed to continue with the self-protection practice as they were motivated by the real-time diagnostic function. The WSG-COVID-19.SP game system has adequate content validity and a high user satisfaction rating.

RESUMEN

Los casos de COVID-19 siguen aumentando rápidamente en muchos países a pesar de la vacunación. La mejor forma de combatirlo es la protección personal. En este estudio desarrollamos un juego serio de la web (WSG-COVID-19.SP) para promover las estrategias de aprendizaje para protegerse contra el COVID-19. También probamos la validez y usabilidad del sistema. WSG-COVID-19.SP fue desarrollado de acuerdo a la teoría situada de aprendizaje y retroalimentación diagnóstica. Contiene seis historias con 17 objetivos de aprendizaje. Se usa un enfoque de resolución de problemas para promover el uso de mascarillas, lavado de manos y distanciamiento social. Se usó el análisis de portafolio para identificar los problemas y el proceso de aprendizaje. El índice global de validez de contenido de la escala (S-CVI) fue utilizado para evaluar su eficacia. La usabilidad fue probada mediante una encuesta de web de 71 estudiantes de una universidad para evaluar su aceptación tecnológica y la capacidad del juego para promover la protección personal. El S-CVI era 0,81. La usabilidad y aceptabilidad no correspondían con la especialización del usuario (ya sea que esté relacionada con la tecnología de la información) ni con el género. Un 84,5% de los usuarios quería continuar la práctica porque estaban motivados por los resultados diagnósticos. WSG-COVID-19.SP exhibe un contenido válido y una alta satisfacción del usuario.

KEYWORDS | PALABRAS CLAVE

COVID-19, serious game, usability, interactive scenario, situated-based learning, self-protection.
COVID-19, juegos serios, usabilidad, escenario interactivo, aprendizaje basado en la situación, protección personal.

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1. Introduction

1.1. Background and importance

The COVID-19 pandemic has put tremendous pressure and burden on the medical system and has negatively impacted economic development on a global scale (Nicola et al., 2020). Despite vaccinations, the number of newly confirmed cases continues to rise rapidly in many countries (Gardner, 2020; WHO, 2021). SARS-CoV-2 can survive on aerosols and various surfaces and use those as transmission routes (Santarpia et al., 2020). Moreover, an infected person can spread the disease with or without symptoms (Liu et al., 2020). However, as long as people follow the standard cleaning procedures, wear masks, and maintain social distance, the risk of contracting the disease via exposure to various surfaces, the air, or other people is low (Pitol & Julian, 2021); therefore, these three measures are the best ways to protect oneself against COVID-19 (Chamola et al., 2020; WHO, 2021). A study has found that the combined effect of adhering to all three measures is more powerful than using one measure alone (Álvarez-Pomar & Rojas-Galeano, 2021). The challenge for health educators, then, is to promote the implementation of these correct protection measures to prevent COVID-19. In 2020, distance education became ubiquitous as a result of the pandemic (Kim, 2020). The increasing popularity of e-learning and internet-based applications has greatly expanded the possibilities for learning, and the use of these innovative media has been trending upward (Chamola et al., 2020). Multimedia, including text, image, video, and audio (TIVA), has been widely used for health education on COVID-19 prevention websites (CDC, 2020; WHO, 2021) because TIVA-based materials are quick to produce, easy to use, and inexpensive. However, there are still many disadvantages in using TIVA for health education (Nayef, 2015). For example, it only delivers one-way information transmission, provides less diverse and uninteresting content, and it is unlikely to motivate the user to actively seek information (Garris et al., 2002). Additionally, it is difficult to provide scenario simulations in such a learning environment, which yields a lower learning retention rate and offers fewer opportunities for putting learning into practice (Brown et al., 1989). The difficulty in conducting assessment and diagnosis and the inability to correct the learning process are also significant barriers (Blackburn & Hakel, 2006). Thus, it is a challenge to design self-learning material to compensate for and overcome the limitations of TIVA and to improve the outcome of learning about self-protection against the pandemic. The use of a serious game, involving both entertainment and education purposes, is a useful model to address the aforementioned issues and has been applied to COVID-19 prevention through the quiz format to assess performance (Gaspar et al., 2020; Suppan et al., 2020).

1.2. Study aims

The current study developed an interactive scenario-based web serious game (hereafter, WSG-COVID-19.SP). The purpose of the game is for the users to learn about the self-protection measures against COVID-19. WSG-COVID-19.SP adopts four learning mechanisms: game scenarios for increasing learning motivation, simulated practice to build self-protection skills, diagnostic feedback to increase understanding, and portfolio analysis to identify misconceptions and problematic behaviors in COVID-19 prevention. WSG-COVID-19.SP is expected to motivate users to implement self-protection measures. It is also expected to be useful for preventing diseases with similar transmission models. Therefore, the content validity of the game was evaluated by involving healthcare workers. Usability testing was done to determine the degree to which the game enabled the users to learn about the self-protection measures and use them continuously. The research questions are as follows:

- Are the contents of WSG-COVID-19.SP valid and satisfactory?
- Do users' college major (information technology-related or non-related) and gender affect their perceived system usability?
- Can WSG-COVID-19.SP identify user misconceptions and problematic behaviors in COVID-19 prevention by analyzing the learning records?

2. Literature review

2.1. Game-based learning

Motivation is a critical factor for effective learning. The element of uncertainty in games can increase and maintain the participation of players (Kim, 2020) and arouse their psychological need for quickly overcoming the challenges and reaching the goals (Freitas, 2018). As an instructional method, games are a valuable tool for enhancing learning outcomes. When learners play an enjoyable game, they often assimilate the game's viewpoints. Therefore, the effectiveness of digital game-based learning (GBL) is a proven strategy to increase learning interest and motivation in a myriad of subject areas including mathematics, business, computer science, and language (Park et al., 2019). Using GBL as the foundation, serious games (SG) possess the entertainment characteristics of gameplay but are used for learning or training purposes (Wattanasoontorn et al., 2013). SG has also been applied to many domains for knowledge building, such as conducting efficient training in the field of health, e.g., using SGs with elderly people for disease prevention and rehabilitation (Wiemeyer & Kliem, 2012).

As a response to COVID-19, Suppan et al. (2020) developed "Escape COVID-19," a serious game that promotes safe practices for healthcare workers. The game uses single choice, multiple choices, and drag-and-drop test items, along with the corresponding feedback after answering. Similarly, Gaspar et al. (2020) developed a mobile serious game that uses a quiz format to assess user performance and cartoon-style cards to enhance motivation. They used Google Analytics to analyze the statistics of the game use. Their purpose was to educate and reach out to young players with scientific information about personal care relating to COVID-19 prevention. However, such an interactive scenario and practice experience may be insufficient if a game interacts with the players through choice questions only.

2.2. Situated learning theory and scenario-based learning

Multimedia materials (e.g., video, audio, and animation) have been widely adopted in teaching and training. They facilitate self-learning effectively because learners tend to find the content attractive (Chang et al., 2010). However, to offer learners an authentic learning experience, multimedia alone is insufficient (Kinshuk et al., 2016). Situated learning theory is a constructivist cognition theory that emphasizes learners' need for an authentic learning context (Brown et al., 1989). The theory proposes that learners should be placed directly in an authentic scenario, a manually set up simulation setting, or a digitally produced virtual simulation scenario so that they can learn the targeted skills by continuously interacting with people in the different scenarios. Scenario-based learning (SBL) follows the principles of situated learning theory (Naidu et al., 2007) and it uses interactive scenarios to enable learners to demonstrate their decision-making process. With technology and a sound framework, SBL can motivate students to take the initiative in their learning and provide them with an instructional environment to safely construct and solve real-world problems (Vlachopoulos et al., 2017). For example, Richardson et al. (2017) applied the SBL approach to assist nursing and midwifery students in acquiring the appropriate attitudes and knowledge related to sustainability and climate change. Similarly, Torkshavand et al. (2020) adopted simulation-based learning to facilitate students' knowledge and skills for elderly patient care.

2.3. Learning portfolio analysis

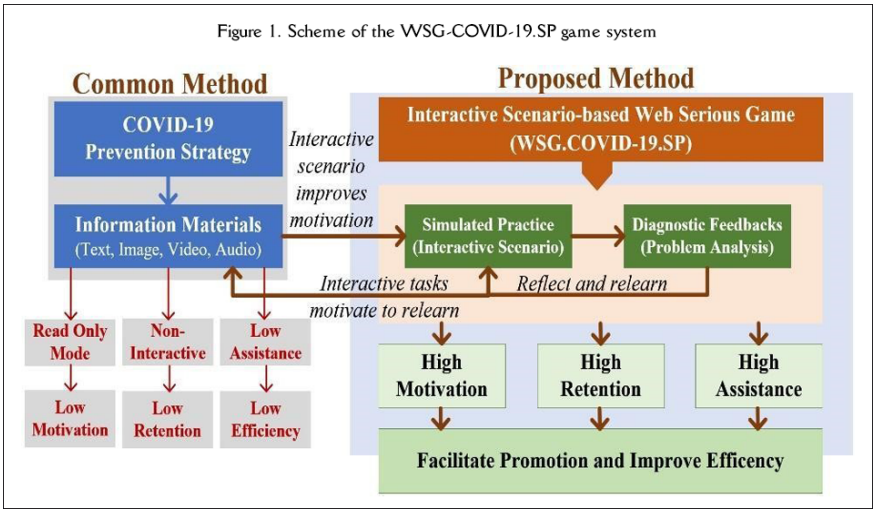
A learning portfolio is a collection of a learner's work, organized in a way that supports the instructional process and evaluation (Alzouebi, 2020). It can enhance self-regulation and goal-oriented motivation (Šliogeriene, 2016) and effectively document and manage the learning processes and analyze them in real time. For instructors, learning portfolios can help identify the blind spots in their instruction, while for learners, comprehensive and detailed documentation of each step in the learning process provides an opportunity for reflection (Kim, 2020). Learning portfolios can be used, for example, to assess software operating skills (Su & Lin, 2015), investigate the differences in learner behavior and preferences by employing multi-platform learning analytics (Ruipérez-Valiente et al., 2020), or personalize learning with adaptive scaffolding (Su, 2020). In this study, the users' learning and operational portfolios were analyzed to identify their learning problems to facilitate self-learning.

3. Design and methods

3.1. Theoretical basis

Rooted in situated learning theory and employing interactive scenario mechanisms, WSG-COVID-19.SP (Figure 1) is designed according to the following propositions. 1) An interactive scenario is used to increase the users' motivation to revisit the TIVA-based information and be repeatedly tested using the simulated assessment to help them understand their weaknesses (Bardach et al., 2020). 2) Simulated practices (Torkshavand et al., 2020) can improve users' knowledge about COVID-19 prevention and their ability to apply that knowledge in their daily lives. 3) Diagnostic feedback (Su, 2020) can enhance users' understanding of epidemic prevention information and the necessary self-protection measures. WSG-COVID-19.SP has the functionality of storing all operational and assessment records, allowing the users to learn from the system-generated evaluations.

Figure 1. Scheme of the WSG-COVID-19.SP game system



3.2. Concepts and assessment indicators of self-protection against COVID-19

The study designed the learning activities and assessment indicators (AI) (Table 1) in WSG-COVID-19.SP based on the information about the necessary self-protection measures against COVID-19 provided by WHO (2020) and CDC (2020). One AI example is 1.1.a, which deals with the concept of "face masks," including "how to choose" the appropriate mask. The corresponding learning indicator is "surgical mask." All AIs were evaluated and confirmed by medical professionals in fields such as infectious disease control, public health, family medicine, and nursing.

Table 1. Concepts and assessment indicators of COVID-19 prevention

Main Concept	Sub-Concept	Assessment Indicator (AI)
1. Face Mask	1.1. How to choose?	1.1.a. Surgical mask
	1.2. When to use?	1.2.a. Out in public
		1.2.b. All people two years of age and older
		1.2.c. Sick and interacting with others
		1.2.d. Visiting a hospital
		1.2.e. In confined or crowded places (bookstore, department store, library, theatre, etc.)
2. Handwashing	1. When to wash your hands?	2.1.a. Before eating
		2.1.b. After blowing your nose, coughing, or sneezing
		2.1.c. Before touching your face, eyes, nose, and mouth
	2. How to rub your hands?	2.2.a. Scrub hands for at least 20 seconds
		2.2.b. Seven steps for hand-rubbing: palm to palm, back of hands, fingers interlaced, knuckles, thumbs, fingertips, and wrists
	3. How to wash your hands?	2.3.a. Handwashing procedure: wet, lather, rub, rinse, and dry
		2.3.b. Seven steps of handwashing
3. Other	1. What to watch out for?	3.1.a. Monitor your health daily (see a doctor when feeling ill)
		3.1.b. Healthy people should avoid going to hospitals
		3.1.c. Cover mouth and nose with a tissue when coughing or sneezing
		3.1.d. Maintain social distance (6 feet apart)

3.3. Definitions of scenario tasks in WSG-COVID-19.SP

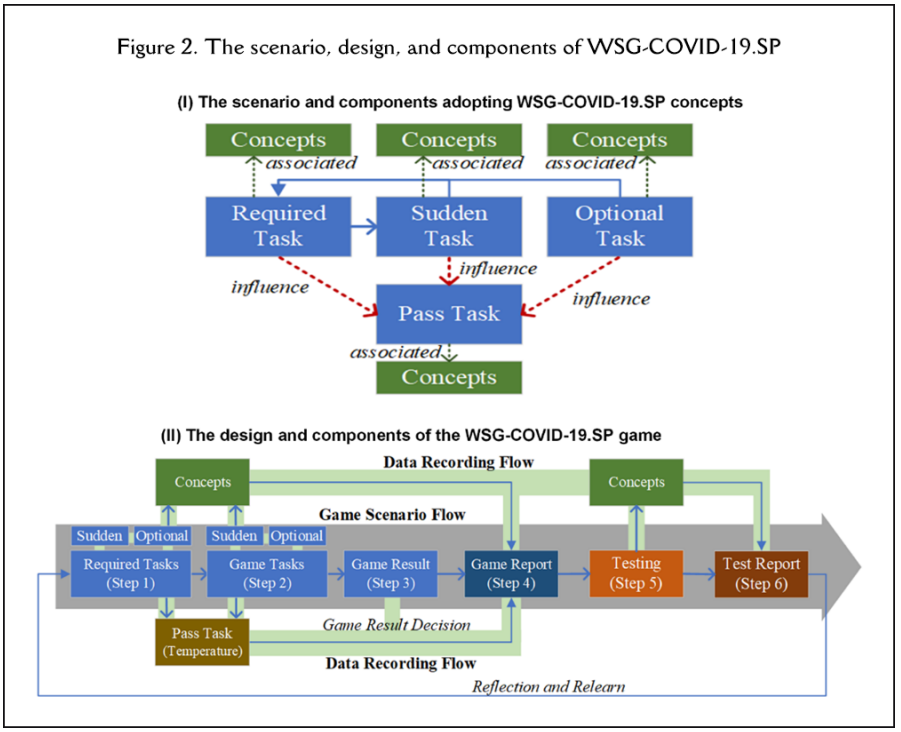
There are four types of scenario tasks in the game, which are designed to simulate the knowledge and behaviors related to infection prevention that should be put into practice in daily life. The tasks are defined as follows. 1) Required task: the primary task related to epidemic prevention. 2) Sudden task: a sudden event that may occur in daily life. 3) Optional task: a task that is related to the required task but is optional. 4) Pass task: the task that determines the outcome of the game. Each task is associated with the prevention-related concepts defined in Table 1. The scenarios in WSG-COVID-19.SP were constructed as shown in Figure 2.I. The required task is the core of each game scenario and is supported by the sudden and optional tasks. The performance on these three tasks determines the result of the pass task and the user's success in completing the game level.

3.4. Design and components of WSG-COVID-19.SP

The design of WSG-COVID-19.SP consists of six steps (Figure 2.II), each with a specific objective. Steps 1 and 2 create the core game scenario based on the scenario tasks (a required task, a sudden task, and an optional task as defined in Section 3.3). The pass task uses the "forehead temperature" as the primary condition for passing the level. The tasks in the scenarios are all connected to the essential epidemic prevention concepts to assess whether users can complete them by properly applying their epidemic prevention knowledge. The pass task evaluates users' understanding of epidemic prevention, and the score is represented by the forehead temperature bar on the screen (see, for example, Figure 3.I.c). During the game, all responses to the scenario tasks are documented by the system to enable the analysis of conceptual understanding and behavior.

Subsequently, Step 3 takes the pass tasks from Steps 1 and 2 and determines the outcome of the game. Then, Step 4 conducts an automatic analysis of the system's record of user responses through the diagnostic feedback mechanism. The system then produces a report on the accuracy of the responses in the epidemic prevention scenarios to help users understand their learning status. In Step 5, after the game scenarios are completed, the users are provided with a multiple-choice test to assess their epidemic prevention knowledge. In essence, their conceptual understanding is evaluated again using a different format.

Figure 2. The scenario, design, and components of WSG-COVID-19.SP



Furthermore, a report is also provided for this second test to help the users reflect on their learning. They can examine their misunderstandings and reflect on their COVID-19 prevention knowledge based on the two personalized diagnostic results (the game report and the test report). They may choose to go through WSG-COVID-19.SP again to correct their previous conceptual and behavioral mistakes. In short, a scenario-based game with a variety of tasks can motivate users to self-learn and self-assess repeatedly to correct any misconceptions and problematic behaviors by re-playing the game. This cyclical self-learning model of "playing, assessment, diagnostic feedback, understanding the problem, practice, and correction" can help users implement COVID-19 prevention and self-protection measures more effectively.

4. Usability testing and result analysis

4.1. Participants

4.1.1. Content validity evaluation by healthcare workers

Six experts were involved in evaluating the validity of the knowledge and content related to COVID-19 prevention. They represented several health-related fields: a family physician, an infectious disease physician, two public health professionals, and two nursing professors.

4.1.2. Usability testing by field users

As a web-based game system, WSG-COVID-19.SP is published on the university website by the research team. The study participants completed the usability questionnaire on their mobile devices within a month of using the game system. Participation was voluntary, and participants could withdraw from the study at any time. At the beginning of the research activity, a general introduction about the purpose of the study was provided to all the participants, and their consent was obtained. In total, 71 users (college students) completed the game system survey. The number of male and female participants was comparable.

4.2. Usability testing tool

The users completed a self-administered questionnaire on a mobile device to provide feedback on their experience with the system. The questionnaire was designed based on the Technology Acceptance Model (TAM) (Davis, 1989; Venkatesh & Bala, 2008). It investigates the users' behavioral intention to use WSG-COVID-19.SP and the feasibility of promoting this game. The study also examined two external variables—users' perceived comparison and diagnosis (Liaw, 2008)—to determine the effect of the scenarios. Additionally, we assessed the cognitive load that the system placed on the users (Sweller et al., 1998).

Table 2 defines each item in the questionnaire. The questionnaire contains eight measurement scales and uses a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The internal consistency of the questionnaire was reliable (Cronbach's alpha=0.903).

Table 2. Operational definitions of the questionnaire measurements

Measurement Scale	Description
Comparison	The superiority of WSG-COVID-19.SP game system in providing situated experience, conceptual learning, and assessment than the current COVID-19 prevention promotion method (i.e., TIVA-based materials)
Diagnosis	The usefulness of the automatically generated diagnostic reports by the diagnostic feedback mechanism at the end of learning in the serious game
Perceived satisfaction	These scales are defined based on the TAM model (Davis, 1989). Satisfaction is the attitude toward using the technology. Intention-to-use is the behavioral intention to play the WSG-COVID-19.SP game in the future.
Intention to use	
Perceived usefulness	
Perceived ease of use	
Perceived enjoyment	The interest in and enjoyment of the game system as defined by TAM 3 (Venkatesh & Bala, 2008).
Cognitive load	The load that is generated by assigning specific tasks to the users' cognitive systems (Sweller et al., 1998).

4.3. Learning process in WSG-COVID-19.SP

4.3.1. TIVA-based information materials

After reading the TIVA-based materials related to COVID-19 on the research website, users enter WSG-COVID-19.SP to further their self-learning and self-assessment through interactive scenario-based

learning, making up for any deficiencies in the TIVA-based materials. The COVID-19 prevention knowledge on the current TIVA website includes four domains:

- Knowledge of COVID-19: global pandemic trends and the mechanism of the disease.
- Taiwan's policies and regulations related to COVID-19 prevention.
- Guidelines and principles for basic self-protection measures.
- Environmental risk factors related to COVID-19 and the appropriate disinfectants.

4.3.2. Entering WSG-COVID-19.SP

In WSG-COVID-19.SP, each screen and storyboard displays the interactive tools and scenario-based learning prompts as shown in Figures 3 to 5. As users enter the game, they are given instructions about the learning objectives (Figure 3.I.a). Furthermore, a menu can be accessed at any time (Figure 3.I.b–c), as well as the required task for the day (Figure 3.I.c). There are two days' worth of scenario tasks (see Figure 3.II for Day 1 and Figure 4.I for Day 2; also see Steps 1 and 2 in Figure 2.II). Note that the scenarios require the users to practice social distancing in places such as theaters, department stores, and clinics.

4.3.3. Game outcome indicator (the pass task)

In the game, forehead temperature is used as a game outcome indicator. It reflects the accuracy of the user's responses and determines the user's success or failure. In other words, the pass task is to keep the forehead temperature under 37.5 °C. If the forehead temperature on the screen is <37.5 °C, then the level is completed successfully, and vice versa. Whether the forehead temperature is displayed is up to the user. The game's open design allows users to exercise their judgment and critical thinking. The game does not display the forehead temperature by default at the beginning (Figure 3.I.e). However, every time users enter an indoor space, they are asked if they would like to measure the forehead temperature.

For infection prevention and self-protection, the assessment items include mask-wearing, the right time to wear a mask, the correct handwashing technique, and the right time to wash hands. Take mask-wearing for example. The first thing users need to do upon entering the game is to visit the pharmacy and select a mask before tackling any of the tasks (Figure 3.I.h). If a user forgets to buy a mask, he or she will be at risk of infection, and the forehead temperature bar will show a fever as the user works through the tasks.

4.4. Scenarios and learning tasks in WSG-COVID-19.SP

Five scenarios (a hospital, public park, classroom, bookstore, and restaurant) and one additional sudden task were designed for Day 1 (Figure 3.II) and Day 2 (Figure 4). Supplies such as masks and alcohol-based sanitizers are shown on the screen. Users use their mobile devices to interact with the virtual people or events in the scenarios to complete the tasks.

In the process, they need to apply their TIVA-based knowledge through critical thinking and problem-solving skills to deal with the problems and situations they encounter. They can protect themselves by carrying out appropriate actions to prevent infection. To attract and maintain user attention, the game scenarios are designed such that both the difficulty and the fun increase as the challenge level goes up. Users must perform more actions in the task to achieve the learning objectives. The self-protection measures are repeatedly shown in various scenarios to ensure deeper learning. If the users do not demonstrate the correct self-protection behaviors in the game, they are at risk of infection.

4.4.1. DAY 1 scenario

For Day 1 of the game (Figure 3.II), users complete up to two actions for each task to achieve the learning objectives for self-protection.

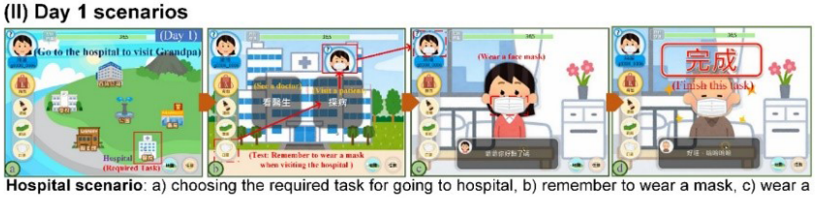
- In the hospital scenario, the learning objectives include "taking the forehead temperature" and "wearing a mask" when visiting patients in the hospital.
- In the public park scenario, the learning objectives are "how" and "when" to use alcohol-based sanitizer to disinfect the hands before touching the eyes and nose.
- In the classroom scenario, the learning objectives are "taking the forehead temperature" and "how to wash your hands" before eating.

Figure 3. Interface and scenarios for Day 1 of the game

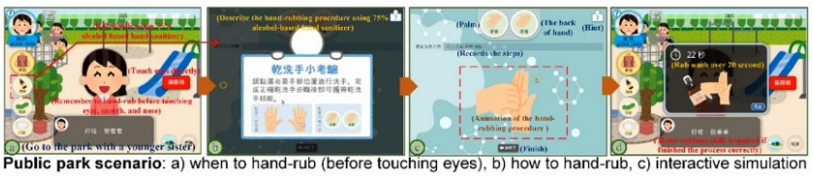
(I) Interface and screenshots in WSG-COVID-19.SP game system

Entering the WSG-COVID-19.SP game system: a) the game goal, b) the interface, c) daily tasks of day 1, d) optional task for buying mask, e) checking the forehead temperature (game outcome indicator for pass task), and f-h) key steps of choosing the correct mask

(II) Day 1 scenarios



Hospital scenario: a) choosing the required task for going to hospital, b) remember to wear a mask, c) wear a mask when visiting Grandpa, and d) finish this game task in hospital scenario



Public park scenario: a) when to hand-rub (before touching eyes), b) how to hand-rub, c) interactive simulation of hand-rubbing, and d) the duration of hand-rubbing in seconds

Classroom scenario: a) show statuses of required tasks, b-c) when to hand-rub (before eating), and d) hand-rubbing before eating

4.4.2. Day 2 scenario

The game scenarios for Day 2 (Figure 4) are more challenging than those for Day 1. Users have to perform more actions for each task to achieve the learning objectives.

- In the bookstore scenario, the two learning objectives are "using tissue paper" and "disinfecting the hands with alcohol" after sneezing.
- In the restaurant scenario, the tasks are "taking the forehead temperature" and "wearing a mask" when entering the restaurant, as well as washing the hands correctly (Figure 4.II) before eating.
- Furthermore, a sudden task is added to promote deeper learning. The learning objective of the sudden task is decision-making regarding "wearing a mask" and "choosing a safer place".

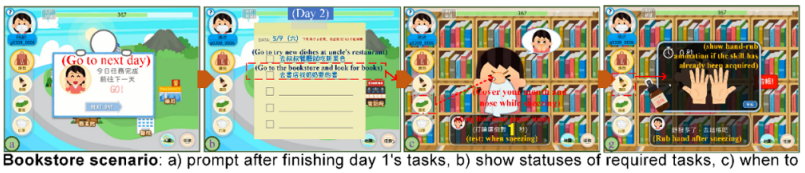
4.4.3. Personalized diagnostic report

After users complete the interactive simulation scenarios, the diagnostic feedback mechanism in WSG-COVID-19.SP automatically analyzes their learning portfolios to provide a personalized diagnostic report,

which enables them to understand their misconceptions and incorrect practices. Based on the diagnostic results, the system then presents one of three possible outcomes: safe (low risk), moderate risk, and high risk (Figure 5.a).

Figure 4. Scenarios for Day 2 and the handwashing procedure

(I) Day 2 scenarios



Bookstore scenario: a) prompt after finishing day 1's tasks, b) show statuses of required tasks, c) when to cover mouth and nose (while sneezing), and d) hand-rubbing after sneezing

Sudden task: a) patients are outside in public, b) make the decision according to task situation, and c-d) avoid going to hospitals if not necessary

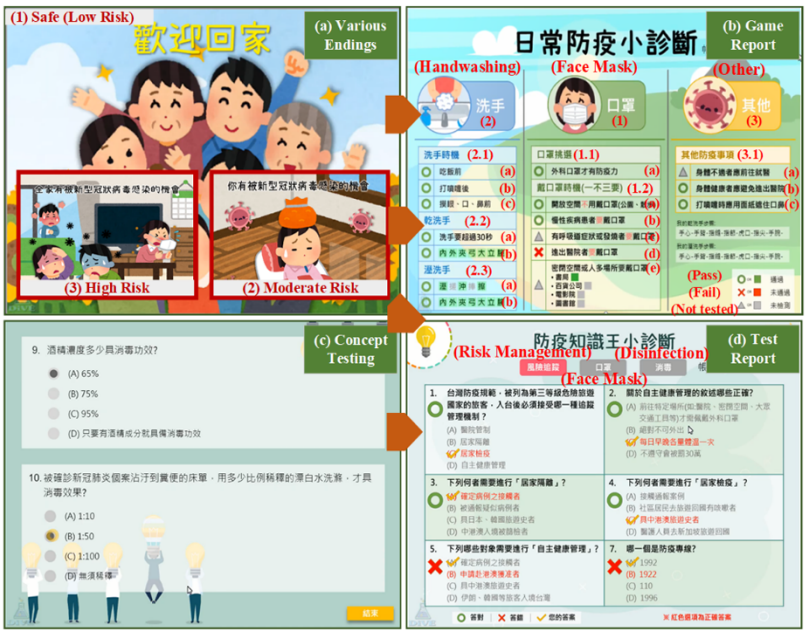
Restaurant task: a) when to wash hand (before meals), b-c) description of the interface, and d) criteria for passing the level

(II) A standard procedure of handwashing

The procedure of handwashing: a) interface, b) wet hands, c) apply liquid soap, d-j) the seven steps of handwashing, and k) rinse, and l) dry hands

The diagnostic report of performance (Figure 5.b) provides individualized results based on the items listed in Table 1 to help users understand their errors. Additionally, the game system uses choice questions to test their basic infection prevention knowledge (Figure 5.c), followed by a report of the test results (Figure 5.d). Consequently, users are motivated to further pursue the relevant knowledge and re-test themselves. As such, this model can promote users' COVID-19 prevention knowledge and self-protection measures.

Figure 5. Personalized diagnostic report in WSG-COVID-19.SP



4.5. Results

4.5.1. Content validity

The experts defined and evaluated the content and scenarios of the proposed WSG-COVID-19.SP scheme from three perspectives: 1) the specificity of the content, 2) practicality of the method, and 3) readability of the wording. They evaluated each item in the game using a 4-point Likert scale ranging from 1 (not appropriate) to 4 (appropriate). The mean score of each item ranged from 2.8 to 3.4. The content validity index (S-CVI/Ave) for the overall scale was .81, indicating adequate content validity.

4.5.2. Usability

This section presents the results of the website questionnaire on the usability of the system. We examined the item mean differences between the users in information technology (IT)-related majors and those in non-related ones, and between males and females (see Table 3).

The usability of WSG-COVID-19.SP was rated by all 71 users. The results show that the users were interested in the game and perceived enjoyment while playing (Mean±SD: 4.16±0.77). Furthermore, they rated the system as providing a better situated experience, and better conceptual learning and assessment (4.28±0.74) compared with TIVA-only materials. Because WSG-COVID-19.SP can automatically generate a diagnostic report at the end of a learning session, the users rated the diagnostic feedback mechanism (4.28±0.74) as highly useful.

WSG-COVID-19.SP was designed with the following functions in mind: game-based enjoyment, effective assessment and learning, and a meaningful diagnostic report. As expected, the users perceived the game system as useful (4.33±0.67), highly satisfactory (4.35±0.65), and easy to use (4.09±0.79). They also indicated a high intention to use it in the future (4.28±0.68). Moreover, except for cognitive load, all indicators in the usability test were rated at least 4.0 out of 5, and the scores were not affected by user background. While cognitive load was rated as moderate (2.92±1.10), it is worth noting that the users in an IT-related major experienced a significantly lower cognitive load (2.26±1.13) than those in a non-related major (3.18±1.03). Thus, "user major" is an independent variable that affects cognitive load. However, the same cannot be said of "gender" because while females appeared to have a lower cognitive load (2.7±0.89) than males (3.08±1.23), the difference was not statistically significant.

Table 3. Usability testing in general and by IT-related major and gender

Scales	Total	IT-Related Major			Gender		
		Related	Non-related	*p* value (*t*-test)	Male	Female	*p* value (*t*-test)
	Mean (SD) (N=71)	Mean (SD) (N=35)	Mean (SD) (N=36)		Mean (SD) (N=41)	Mean (SD) (N=30)	
Perceived Enjoyment	4.16 (0.77)	4.17 (0.82)	4.15 (0.74)	.920	4.16 (0.84)	4.17 (0.69)	.965
Comparison	4.28 (0.74)	4.29 (0.71)	4.28 (0.78)	.964	4.32 (0.79)	4.23 (0.68)	.641
Diagnosis Report	4.32 (0.69)	4.29 (0.75)	4.36 (0.64)	.650	4.34 (0.73)	4.30 (0.65)	.805
Satisfaction	4.35 (0.65)	4.33 (0.68)	4.36 (0.62)	.858	4.33 (0.72)	4.38 (0.54)	.727
Intention to Use	4.28 (0.68)	4.29 (0.67)	4.28 (0.71)	.961	4.25 (0.74)	4.32 (0.60)	.673
Perceived Usefulness	4.33 (0.67)	4.31 (0.71)	4.35 (0.64)	.838	4.32 (0.72)	4.35 (0.60)	.840
Perceived Ease of Use	4.09 (0.79)	4.14 (0.83)	4.04 (0.77)	.595	4.18 (0.81)	3.97 (0.76)	.260
Cognitive Load	2.92 (1.10)	2.66 (1.13)	3.18 (1.03)	.047*	3.08 (1.23)	2.7 (0.89)	.152

4.5.3. Portfolio analysis

To investigate user misconceptions and learning problems, the error rates of the assessment indicators (AI) (Table 1) in the learning records were analyzed. Based on the change of error rates between the first and the second system use, three types of conceptual change can be defined: 1) Less problematic concepts, with both error rates being ≤20% (AI-3.1.b, AI-3.1.c), 2) concepts that need to be strengthened, with both error rates being ≥ 30% (AI-2.1, AI-2.2.b, AI-2.3, and AI-3.1.a), and 3) improved concepts, with the first error rate being ≥30% and the second being ≤20% (AI-1.1, AI-1.2, AI-2.2.a, AI-2.3.a, and AI-2.3.b). It was found that the concepts to be strengthened (type 2) were mainly related to "handwashing" and the concepts with significant improvement (type 3) were related to "How to wash your hands?".

5. Discussion

In the current study, WSG-COVID-19.SP can be referred to as a serious game because it was designed for a primary purpose other than pure entertainment. Its content focuses on acquiring and assessing the knowledge and skills needed for self-protection during the COVID-19 pandemic (Gentry et al., 2019).

In the usability test, the 71 users rated WSG-COVID-19.SP with a score of at least 4.0 out of 5 on almost all indicators. Except for the cognitive load indicator, these scores were not affected by the users' college major, a variable that we use as a rough indicator of their IT competency. The scores were also not affected by their gender. Overall, the users indicated a high intention to use it in the future. They also thought that the current system design provides game-based enjoyment, effective assessment and learning process, and meaningful diagnostic reports for self-reflection and self-correction.

The high level of usability can be attributed to the following factors. 1) WSG-COVID-19.SP presents reliable information obtained from the TIVA-based COVID-19 materials published by public agencies on reputable health information websites (CDC, 2020; WHO, 2021). 2) It was developed based on appropriate theories including situated learning theory (Brown et al., 1989; Naidu et al., 2007), problem-based learning (Vlachopoulos, & Makri, 2017), and digital game-based learning (Park et al., 2019) to apply learning portfolio analysis techniques (Alzouebi, 2020; Su & Lin, 2015) and produce diagnostic feedback (Su, 2020). The adopted theories and design elements enhance self-regulation and goal-oriented motivation (Šliogerien , 2016) and improve users' understanding of epidemic prevention information and the necessary self-protection measures.

In this study, cognitive load was the only dependent variable affected by users' IT competency. When using the system, the users in an IT-related major experienced a significantly lower cognitive load than those who were not. It is known that IT skills may affect users' perceptions and acceptance of a digital system (Lopez-Sintas et al., 2020). IT competency can be improved through repeated practice. The gender of the users had no significant effect on their cognitive load. Regarding IT competency and gender differences, our findings are similar to those from a previous meta-analysis study (Siddiq & Scherer, 2019). Specifically, the gender gap may not be as large as previously expected in the domain of information and communication technology.

An interesting finding related to how the WSG-COVID-19.SP system uses portfolio analysis to identify common misconceptions is that the concept of "When to wash hands?" had the highest error rate

at 51% (AI-2.1, see Table 1), followed by "hand-rubbing procedures" (AI-2.2, a 26% error rate) and "handwashing procedures" (AI-2.3, 33%). Even though the standard procedure of handwashing has very rigorous requirements and must be followed strictly to be scored as correct, surprisingly, the most common error was about the right time to wash the hands, with an error rate as high as 51%. This indicates that most people tend to be complacent about this particular epidemic prevention measure, forming a weak link in the chain of epidemic prevention efforts. For example, for the concepts of "Choosing a mask" (AI-1.1, 17%), "When to wear a mask?" (AI-1.2, 29%), and "Monitor your health daily (taking the forehead temperature)" (AI-3.1.a, 67%), users may know the information but still neglect to perform the correct actions in practice. Thus, through the use of simulated scenarios, users may become more vigilant about epidemic prevention in their daily lives. These portfolio analysis findings identified the concepts that needed a better promotion campaign, a functionality that cannot be provided by TIVA-based materials or existing serious games for COVID-19 education as they have yet to take into account these error-prone concepts and behaviors (Suppan et al., 2020; Gaspar et al., 2020).

The aforementioned results effectively answer the research questions listed in the introduction section. Therefore, it can be concluded that WSG-COVID-19.SP demonstrates a valid serious game design with adequate content validity (S-CVI/Ave=.81) (Polit & Beck, 2006). Additionally, it is easy to use and usable for learning the concepts and skills needed for self-protection against COVID-19. Consequently, and importantly, users will likely continue to use this serious game system in the future.

5.1. Limitations

This research is still in the developing stage for the serious game WSG-COVID-19.SP for learning self-protection skills against COVID-19. The game's content validity and usability are continuously being tested. Note that the results presented in this paper do not confirm the effectiveness of this game in improving actual real-world self-protection or successful application to other populations.

The sample used for the usability test was a small number of college students. If the game were to be promoted in hospitals and used as an assistive device for healthcare professionals in health education, potential hospital users including the general public and clinic outpatients should be included in future research samples.

6. Conclusions

This study provides evidence of the usability and user perceptions of the WSG-COVID-19.SP game system, an interactive scenario-based web application designed to empower people in preventing COVID-19 through situated practices. Usability and acceptability were evaluated and reported as adequate by the users. The participants perceived WSG-COVID-19.SP as useful for promoting the self-protection measures against COVID-19 due to the game scenario design and the diagnostic feedback feature. In addition, the portfolio analysis can indeed identify the problematic areas in users' understanding and practices of COVID-19 prevention measures. Based on these findings, we plan to design an experimental study in the future to examine the effects of the game on self-protection behaviors in real life. This serious game can be applied to prevent other infectious diseases with similar transmission models and to test the effects of their corresponding prevention campaigns.

Author Contribution

Idea, J.M.S., C.J.W.; Literature review, J.M.S., C.J.W.; Methodology, J.M.S., C.J.W., Y.C.Y., T.N.W.; Data analysis, J.M.S., M.J.L.; Results, J.M.S., C.J.W., Y.C.Y., T.N.W.; Discussion and conclusions, J.M.S., C.J.W., Y.C.Y., T.N.W. M.J.L.; Writing (original draft), J.M.S.; Final revisions, C.J.W.; Project design and sponsorshop, C.J.W.

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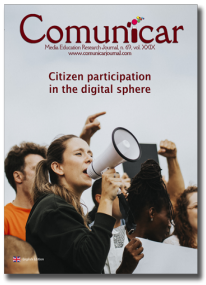

Digital creativity to transform learning: Empowerment from a com-educational approach

Creatividad digital para transformar el aprendizaje: Empoderamiento desde un enfoque com-educativo

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ABSTRACT

Daily media use by an entire generation shows the distance that exists between the reality experienced by young people and the institutions responsible for their education. Formal education is still closely linked to the passive role of literary receivers, ignoring the potential of connected communication for student empowerment. At the same time, there is a growing interest in education from the professional media field. We have called this line of force the com-educational vector. In this study, we aim to describe the potential of a com-educational perspective to favor the empowerment of young people. The implemented methodology combines a chained articulation involving the analysis of multimodal discourse of com-educational platforms with interviews with privileged observers. The results show that the implementation of digital creation can be used for the construction of identity, interaction and socialization of students through emotion, empathy and the capacity for transformation. It enables the establishment of nodes between concepts, relational understanding, meaningful reconstruction and appropriation. It is concluded that, under this proposal, formal education institutions could move from a reactive model to a prospective model, revising the codes of emission and reception, and proposing meanings from creative action and feedback with the community.

RESUMEN

Los usos mediáticos cotidianos de toda una generación evidencian la distancia que existe entre la realidad que vive la juventud y las instituciones responsables de su formación. La educación formal sigue estrechamente vinculada al rol pasivo de los receptores literarios, obviándose el potencial de la comunicación conectada y la narrativa digital para el empoderamiento del alumnado. Al mismo tiempo, se está produciendo un interés creciente desde el ámbito mediático profesional por la educación. A esta línea de fuerza la hemos denominado vector com-educativo. En esta investigación, tenemos como objetivo describir potencialidades para favorecer el empoderamiento de los jóvenes desde una perspectiva com-educativa. La metodología implementada combina, en una articulación encadenada, el análisis del discurso multimodal de plataformas de carácter com-educativo con entrevistas a observadores privilegiados. En los resultados se explicita que la implementación de la creación digital se puede emplear para la construcción de la identidad, la interacción y la sociabilización del alumnado a través de la emoción, la empatía y la capacidad de transformación. Permite establecer nodos entre conceptos, la comprensión relacional, la reconstrucción significativa y su apropiación. Se concluye que, bajo esta propuesta, las instituciones de educación formal podrían transitar de un modelo reactivo a un modelo prospectivo, revisando los códigos de emisión y recepción, y proponiendo significados desde la acción creativa y la retroalimentación con la comunidad.

KEYWORDS | PALABRAS CLAVE

Media literacy, educommunication, school, education, digital media, young people.
Alfabetización mediática, educomunicación, escuela, educación, medios digitales, jóvenes.

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1. Introduction

In the last year, the critical situation faced by formal education in various fields (Feito, 2020; Burgos et al., 2021) has worsened due to the global impact of COVID-19 (Wan, 2020; Pérez-Tornero, 2020). Yet this diagnosis regarding the critical status of education has been constant since the middle of the twentieth century. In 1968, the title of a UNESCO Report (Coombs, 1971) echoed this concern: "The World Educational Crisis". In a subsequent report for the same organization, emphasis was placed on the repercussions of the scientific-technical revolution, as well as the need to ensure democratic educational processes (Faure, 1983). Furthermore, Delors (1996) cites the growing concern regarding global interdependence and globalization resulting from new media.

Today, there are parallels between the notion of liquid society as described by Bauman (2003) and the problems of the education system. For Erstad et al. (2021), two key issues have been detected early on in the twenty-first century in relation to educational challenges of the future, namely, the provision of education and the role of educational institutions in society. In the evolution of education, significant issues have emerged for institutions and teachers, who need to adapt their educational projects to the demands of today's society. Yet merely equipping classrooms with technological resources does not guarantee success or educational innovation if this action is not accompanied by changes in school organization, syllabi and actions that promote media literacy for teachers, families, and students (Cannon et al., 2020). For this institution, whose well-established tradition is founded on the pillars of industrialized society, the nation state, credentialism, mass-oriented needs and relative professional stability, this redefinition of its idiosyncrasies and goals can, in effect, present itself as a critical process. Risks and potentialities are at the center of this ongoing discussion. To the goal of Education for All (EFA) established by UNESCO (2014), another aim is added which reconsiders the role of education in the relationship between human beings, thought, knowledge and society. Another aim is the need for greater student empowerment to achieve more fair societies (UNESCO, 2019). In this regard, some contemporary scholars have questioned the role of teachers themselves, citing insufficient digital training and skills (Pozo-Sánchez et al., 2020). Nevertheless, their work continues to be crucial in exploiting the potential of ICT in education and promoting media literacy among students (Lorenz et al., 2019).

1.1. Education versus disruptive technology

In addition to this identity crisis, educational institutions must face the relevance of two socio-technological innovations in contemporary society, namely, digital phenomena and the Internet, which have ushered in new modes of interaction, learning, participation and the acquisition of information (Moraño-Fernández et al., 2021). Siemens (2006) identifies a transition from traditional education to new learning processes based on network technology. A change occurs at two levels associated with knowledge: one in relation to its characteristics and the other in the environment in which it arises. Siemens' theory of connectivism is based on the idea that individual knowledge depends on a network system, and when applied to education, digital resources allow students to learn new content, obtain accurate information and know how to distinguish accurate content from information that is not credible (Sánchez-Morales et al., 2021).

Despite its imbalances, ICTs have an influence on the meanings that are constructed and shared among youth, in addition to replacing libraries, compartmentalizing cultures and making access to information more democratic (Pérez-Lindo, 2014). Thus, ICTs are intimately tied to their social settings, everyday lives, interactions, and the way they imagine their current and future situation (Sánchez-Vilela & Borjas, 2021).The ways in which younger generations (Z and Alpha) use media and technology evidence the existing rift between youth and formal education institutions. According to Pereira et al. (2019), in today's societies, learning retains an excessively academic approach. Knowledge that is acquired in these educational institutions is not integrated with learning achieved by students in informal settings. The interests and skills they develop in their free time via virtual platforms or interaction with their peers is ignored. In this sense, numerous studies have highlighted risks and opportunities for formal and informal education based on media use (Greenhow & Lewin, 2016; Guerrero-Pico et al., 2018).

1.2. The com-educational vector as an opportunity for empowerment

In view of this situation, there are a myriad of educational proposals based on media use and storytelling as a formula for empowerment, based on the perspective defined by Zimmerman (2000) as a new approach allowing the development of different measures that can contribute to social change . Research conducted by Shiel et al. (2012) on orality, Wallace (2000) in writing, or the digital creativity experiences proposed by Hull & Katz (2006) highlight the importance of this approach. The latter authors emphasize the critical perspective afforded by access to technological tools and the opportunity of favoring the importance of the skills themselves through practice. Kupers et al. (2019: 93) propose a specific framework centered on creativity "as an essential skill for the twenty-first century". At the same time, there is a growing tendency in connection to media and storytelling: the increasing convergence between professionals and institutions in the field of mass and new media and education. These are corporations and individuals, "storytellers who have mastered the art of narration and discursive strategies in their respective fields, people who are offering varied and specialized solutions for learning" (Sánchez-López, 2020: 124). An inverse version of this academic approach embodying a more traditional paradigm exists (the notion of educommunication), and here it has been identified by the author as the com-educational vector. This approach includes many unexplored strategies and formulas that could serve to foster the use of storytelling and media in training spaces, bridging the gap between media use among youth and formal education mentioned above.

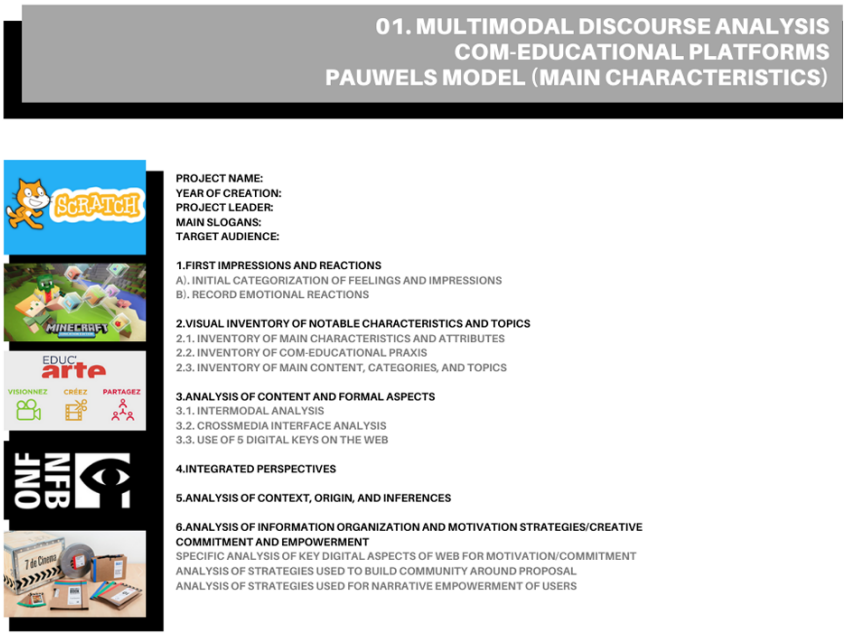
In this regard, there are a number of experiences involving digital platforms such as NFB/Education created by the National Film Board of Canada, Minecraft Education, Scratch, Educ'arte and Maleta 7 de Cinema. The NFB is the Canadian government's producer and distributor of public film and digital media projects. The content and formats it creates are notable for their innovative nature. The platform is divided into three sections: FILMS, INTERACTIVE and EDUCATION. The last section provides users with educational content, including more than 3,600 projects, and a resource bank of tools and apps. Minecraft is a video game which has entered the education field with its Minecraft Edu website. This versatile platform is open to all users. Its educational approach is founded on cooperation, problem solving, communication and cybercitizenship through project-based learning. Scratch is a project developed by the Lifelong Kindergarten group part of MIT Media Lab. Its creators maintain that Scratch helps introduce users to programming through the creation of games, interactive stories, animation, and the possibility to share projects with the community. Scientific research has shown that games are an effective way to introduce programming in childhood and adolescent learning, while stressing their capacity for improving academic performance and problem-solving skills (Fidai et al., 2020). Arte (www.arte.tv/es/) is a French-German platform offering educational resources through Educ'Arte, which boasts an extensive audiovisual catalog. It is structured in various levels, disciplines, and topics through the use of tags. In addition, its system allows teachers to exchange materials easily with other teachers, fostering connectivity and social ties. La Maleta 7 de Cinema consists of a series of educational materials created by Eduxarxa, its approach founded on practical and entertaining methods. It offers resources taken from the cinema. The activities it offers seek to foster reflection, analysis, and resource creation. Spearheaded by the Film Archive of Catalonia (Filmoteca de Catalunya), this project is an example of synergistic cooperation between a media organization and educational institutions. With this sample of platforms serving as our point of departure, in this study we gathered the opinions of expert digital creators to explore the potentialities for media and narrative empowerment among youth from a com-educational perspective.

2. Method

Our research design involves the use of a number of instruments for data collection articulated in a chain-like manner. First, Multimodal Discourse Analysis (MDA) was employed in combination with the research framework model developed by Pauwels (2012). The first sample consists of the com-educational web platforms (whose focus is on education through communication) which use media as a means for learning (NFB/Education Canada, Minecraft Education, Scratch, Educ'Arte, La Maleta 7 de Cinema). This non-probability sampling is situated within the subjective judgmental sampling framework, where samples are selected by considering some of their characteristics, ruling out the use of probability sampling

procedures (Corbetta, 2007) In this case, the samples were selected because they can be classed as com-educational (Figure 1).

Figure 1. Summary of MDA (Pauwels' Model) applied to the com-educational platform sample



Using the results obtained from the analysis, a script was created for a questionnaire and preliminary coding was performed for the second part: interviews with privileged observers. These individuals, as "knowledgeable experts offer a direct and in-depth vision of the phenomenon which grants them a position of privileged observation" (Corbetta, 2007: 358).

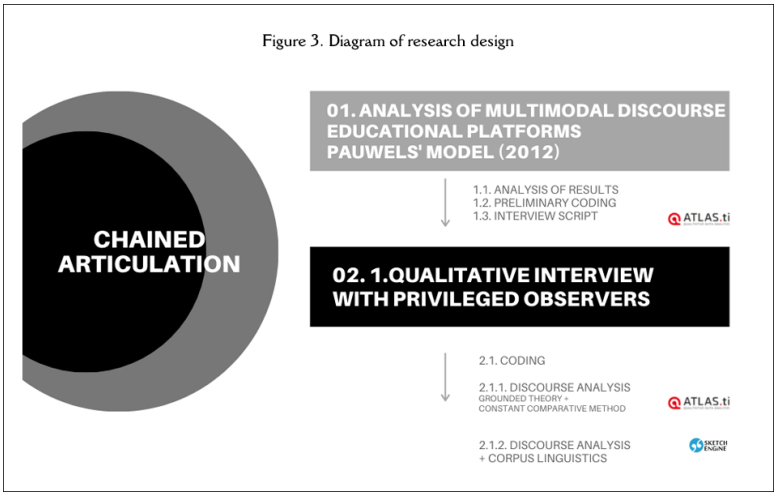
Figure 2. Profiles selected for the sample of privileged observers to be interviewed

We were interested in gaining a greater and more in-depth understanding of the education through communication approach based on their expert (and creative) knowledge, with a focus on empowerment. The sample was selected as per the judgmental sampling framework. Rational criteria were applied, avoiding chance selection which may be associated to lack of knowledge of the population characteristics. The condition for selection of sample subjects was their professional profile as expert storytellers in the digital sphere, through a classification system based on impact and influence criteria (Figure 2).

Two procedures were employed to analyze the data obtained in the interviews. The first was based on Grounded Theory, which is "a methodology of analysis linked with data collection that uses a systematically applied set of methods to generate an inductive theory about a substantive area" (Glaser 1992:30), along with CCM (Constant Comparative Method) which combines inductive coding of categories with a simultaneous comparison of all the units of meaning obtained (Glaser & Strauss, 1967). Next, once all the interviews had been conducted, an open coding of the data obtained from the transcriptions was performed. Selective coding was conducted next. ATLAS.ti was employed to simplify the process. During this step, sentences and paragraphs were selectively marked, with each having a code assigned. After these were reviewed, a final version was prepared, which was validated by two experts external to the study. In the coding system, codes indicated in red were eliminated from the final version, and those in green were established as final (Table 1: https://doi.org/10.6084/m9.figshare.14554839.v1).

In the second part of this study, the interview transcriptions were processed using a combination of discourse analysis and corpus linguistics (CL). Corpus Linguistics is an empirical approach that is used in the study and description of real language use based on the comparative use of a language corpus (Nartey & Mwinlaaru, 2019). This second part of the study called for a greater level of rigor in the interpretation of the media narrator discourse. Specifically, the thesaurus, usage diagram, most frequent words, and keywords were analyzed. The results obtained during this step support the preparation of code descriptions set forth in Tables 2 and 3, and the empowerment codes presented in Section 3.3. Two programs were employed in the method: ATLAS.ti and Sketch Engine. The first is mainly used when working with unstructured data, facilitating their processing and systematization. The second is a text analysis tool that enables the study of language behavior based on the use of a metacorpus. Figure 3 is a diagram of the research design, including techniques and methods used in data analysis.

Figure 3. Diagram of research design



3. Analysis and results

3.1. Code: "Digital storytelling", "mediations", and "idiosyncrasy" (ND)

This code encompasses the key characteristics of the platforms under analysis, along with the observations made by the privileged observers in this regard. A summary of the data obtained is provided in Table 2, which is specifically linked to its possible effective uses in empowerment.

Table 2. Summary of results for 'digital storytelling' and 'idiosyncrasy' code Key aspects in digital environments that can be employed to foster empowerment	
Code	**Key digital aspects. ND_DIG Code Summary**
Connectivity ND_DIG_CON	Fosters relations between users, configures connections with other similar or complementary nodes online and in society.
	Pedagogical experience can be extended using pre-existing nodes or those created ad-hoc.
	The community replaces teacher/public as evaluating figure.
Hypermedia ND_DIG_HIP	Structure upon which projects are created.
	Facilitates accessibility and usability.
	Container of multimodal materials.
	The platforms position community projects preferentially.
Interactivity ND_DIG_INT	Features varying degrees of intervention, degrees of control, and different layers of depth.
	The interface is the nuclear element.
	It is used to strengthen identity (personal space), agency (capacity to act within a system), and community (relationships between project participants).
	There is an offline component generated around the narratives, tied to fandom and in-person events.
	Offers new opportunities in the teacher-student-community relationship.
Transmedia ND_DIG_TM	The story is extended to different media and platforms.
	Users build upon the narrative Universe.
	Includes canon and fandom, possessing a central and other underlying nodes.
	The concept of "Universe", as in all narratives, is central to its construction.
Virtuality ND_DIG_VR	Transcends desktop interface.
	Incorporates new forms: Virtual reality (users can occupy a virtual space through their immersion in a virtual universe), augmented reality (based on the superposition of digital layers on the real world), and mixed reality.
	Allows users to create universes and spaces of diegetic identity.
	Allows for transhuman potentialities: Skills that would be impossible in the real world.

In this section the study also considers three primordial reasons for mediated digital creation: "emotion" (personal need, individual impulse), "empathy" (connection with others, society, and community), and "transformation" (improving reality, social impact).

3.2. Code: Learning (AP)

During the study, researchers noted the disparaging opinion held by interviewees regarding formal education, characterizing it as hermetic, shackled to theory and conservative in the face of change. One of the interviewed profiles, [AM_AP_APF 2:9], declared: "I know what I don't want in a classroom. I know that for me, the educational system gave me the boot because I didn't conform to their canon of the type of students we were supposed to become. But we are killing creativity in the schools".

Table 3. Potentialities of the com-educational model for learning	
Code	**AP CODE Summary**
AP_FC	Students/users play a central role in the communicative process, facilitating learning that is student/user-centered and feeling empathy towards the story.
AP_FC	Users fashion identity profiles and personal experience is configured based on their own criteria and tastes.
AP_FC	Dramatic fictional arc and mechanics that integrate learning processes.
AP_FC	A single space includes multimodal services: exercises, videos, links, downloadables, applications, etc. beyond the textbook.
AP_FC	Reinforcement of positive stimulus and concentration through narrative schemes (dramatic climax, gamification, student-centered, empathy, etc.).
AP_FC	Deeper understanding via connected layers. Superposition allows for changes in perspective or story uses (access to parallel lines: immersion, creation, connection, etc.) and voluntarily delve deeper.
AP_FC	Creation and connection of relevant channels that foster shared experiences between users, moving beyond the boundaries of the educational community, expanding their relationships with society, and building connections through feedback and impact.
AP_EF	Immersion through the narrative construct of a Universe.
AP_EF	Enhanced, direct, and recognizable capacity for transformation and impact in relation to system projects, the community itself and its members.
AP_EF	Creativity (linked to transformation), agency (capacity to act, identity, and identification) and community (giving it value, support, and interaction-feedback) are placed at the center of processes.

Media narrators believe that media creation is not given its due value in formal education. They state that institutions tend to drag their feet when it comes to incorporating technological innovation. They are critical of the central role of memory-based methods, as well as the persistence of the behaviorist educational model and resistance to innovation. Nevertheless, they cite some teachers who employed different perspectives in the classroom. AG_PC_CE 29:92 states that "a student [explained that] enduring a lecture from a professor is like watching a black and white Lumière Brothers' film".

On digital mediations and their uses, there is a consensus on the idea that teachers' work could be simplified through the direct participation of professionals and experts in digital and media creation. They stress that storytelling is an effective formula in learning: "Storytelling seems to be a game, but in reality, it's learning. Storytelling is learning, because you take on a story about something, you take a stance on a situation, and, above all, we can say that the information 'sticks' to you. When you have told it yourself, then you make it yours" [MH_AP_APF 7:17]. It allows us to create relational links between concepts through nodes, always in accordance with the required learning objectives, attaining significant and comprehensive understanding of the phenomenon in question. In conjunction with digitalization, the com-educational perspective offers opportunities to improve the teaching-learning process. Table 3 contains potentialities of this model as a function of the codes generated in this study: AP_FC (Aprendizaje desde Forma de Contar/Learning from the Storytelling Manner) and AP_EF (Aprendizaje creativo en la Educación Formal/Creative Learning in Formal Education).

3.3. Code: Empowerment (EMP)

At this point, we observe that technological instrumentation is given a meaning, beyond its mechanical or recreational senses, where the focus is on media creation through digital tools. Its processes show an evident constructivist approach and favor a perspective that fosters critical thinking, innovation, and creativity: "I think it would be cool if this also existed in universities and schools, providing students with digital tools, not like: 'I'm going to give you a lesson' but: 'Give me the lesson, teach me how you would use it and then let us get the most from it' (MH_PC_CE 35:24). Under this perspective, the role of the contemporary user transcends the "sender-receiver" concept. A greater number of possibilities arise, with different degrees of community intervention (social networks or fan fiction), more levels of creative intervention options (co-creation, collaboration), and diegetic interaction. In addition, some mention is made of a passive and inactive user role, like that of a spectator, in the search for the traditional cathartic function of storytelling. In terms of the study, the references - imitation - praxis triad is the cornerstone of media empowerment. This latter aspect in particular is emphasized: "I think that any presenter or voice actor would tell you that when facing the mic, you need to try it out and record, and record, and rehearse, and rehearse, and rehearse" (JM_AP_APF 6:2). Creation is situated as the nuclear element: "It's lots of practice, trial, and error" (AM_PC_MET 9:8). There is consensus on the need to generate real projects in authentic situations. Simulation of the creative process and context must approximate reality as much as possible, and be adaptable to the idiosyncrasies of formal education. Creative praxis, error, analysis, and solutions, to which experience can be added, are the keys to greater empowerment. This is associated to project-based learning and the basis of constructivism. Beyond the narrative project itself, direct interaction with the social and professional spheres is proposed which transcends the traditional limits of the classroom. Thus, the nucleus of the learning community would be situated in the educational space, but designed to connect to and receive direct feedback from media professionals and society.

In terms of assessment, it is established that this must respond to the functioning of media industries. Assessment criteria is proposed that is based on a real distribution or, alternatively, on a realistic simulation, making use of expert and professional criteria. Interviewees agree that the project subject to assessment should include real creations (media projects), distancing themselves from the use of exams as an assessment method: "If I were a teacher of a subject, I mean, in fact, I don't think I would ask them to take an exam, I would ask them to tell me a story" (ES_PC_EV 32:7). The role of partner or guide substitutes the paradigm of the vertical monologue of the teacher; it facilitates the teaching-learning process, offers new challenges, orients processes, and connects students to other social spheres. The persistence of the figure of the "tutor" is recommended for creators, owing to their experience, usefulness, and the trust they inspire among students. According to the expert's criteria, mediated creative learning will overcome the resistance to its implementation seen in institutions of formal education. This is mainly due to their adaptation to social reality which places a high value on and even demands digital creativity, according to experts. It is not a strange or intrusive phenomenon but one that is already part of society and its workings. In this sense, DF_PC_SOC 43:26 stresses the following: "I believe that society is far ahead of the educational [institution]. I don't mean teachers so much [...] it's the infrastructure, [...] society

really wants, it is hungry to live in the future". Given the appropriate guidance, media empowerment among citizens brings about communicational feedback and mutual enrichment with the media itself: "It has more to do with empowering citizens and at the same time, empowering the medium the citizen is contributing to" (MH_EMP_CO 14: 26). Enhancing motivation and commitment depends on the community's recognition of the importance of citizen (and student) participation.

4. Discussion and conclusions

The analysis of com-educational platforms, as observed in Sánchez-López et al. (2019), along with the contributions of the communication experts in the form of privileged observers delineate a way forward in literacy education (general, and media-based in particular) which departs from behaviorist perspectives, formulating an alternative founded on agency, community and, fundamentally, on the notion of media-based narrative creativity. Numerous authors cite resistance on the part of the institutional culture of formal education when it comes to implementing processes associated to digital creativity in classrooms (Cipollone et al., 2014), and the difficulty in consolidating digital initiatives in schools (Pettersson, 2021). Furthermore, many point to a certain tendency for implemented technology to reproduce prior practices (Glover et al., 2016), under the shaky premise that technology alone will automatically improve learning (Matthews, 2020).

The com-educational vector differs from the more technological approach outlined by Portalés (2019) pertaining to digital skills. She presents a pedagogical model that emphasizes the role of students/users and their mediated creative actions in a community-based environment where they can find assistance, interaction/feedback, and where their interaction is valued. Digital tools and technologies are used as a means to amplify this end. Here, what takes on special relevance is the notion of agency (understood as an action or intervention that brings about a change to the system); students find they can identify with the content, be heard, have an impact on, and find their place in the social/community space. With regard to knowledge, media-based narrative creation represents an opportunity to establish nodes between concepts, relational understanding, and the meaningful reconstruction of discourse and its appropriation. The analysis of platforms and our experts' observations also show how it is rooted in emotion, empathy and the capacity for transformation (linked to agency). Under this perspective, agency, creativity, community, emotion, empathy, and the capacity for transformation are the pillars of empowerment. In this view, agency (individual and collective) takes on meaning with benefits for all. The community system stimulates and values creativity and individual-group action. Its impact improves the collective whole.

We agree with Price (2019) when he encourages the re-consideration of pedagogical literary practices in order to foster student creativity and thinking. In this case, the aim is to favor meaningful experiences that will bring about changes in education. Along these same lines, studies conducted by Scott (2019), and Yang & Wu (2012) have served to corroborate this view as to the viability and success of implementing media creativity in the learning process. However, there were precursors in the use of mediations in the classrooms, and these were found in the field of educommunication. Scholars such as Freinet (1986), Freire (2005), Kaplún (2008), and Vygotsky (2004) established models, based on both theory and praxis for media creativity aimed at empowerment. In keeping with the last author, the com-educational vector also takes a prospective view of education. Contrary to the model in which students confine themselves to reproducing past cultural patterns, Vygotsky envisions an educational approach in which students have the skills to face and resolve problems that have yet to arise, as indicated by Kozulin (1998). We leave behind a reactionary and reactive model for one that is at the forefront: meaning that it is constructed through autonomy, agency and creation; codes between sender-receiver are verified –this also occurring as part of creative praxis; mediation is instrumentalized in accordance with personal and group goals; the projection of possible futures based on the concern for and recognition of the community in which the student has grown, the one he/she transforms and which in turn also transforms him/her. The fourth wall of the classroom is thus broken, linking educational institutions to society.

There are two clear lines of research that can serve to lend continuity to and build upon this knowledge in the future. First, a larger sampling of com-educational platforms would be beneficial in this regard. Similarly, more knowledge can also be gained by conducting more interviews with privileged observers.

Creators who use other formats may also be included as they could offer more input on the topic of empowerment, as well as other professionals working in the field of education and students, who would provide a vision from the educational setting itself. The second line of research relates to the configuration and application of com-educational methods in real contexts. In this study we have observed a potential for close cooperation between communication professionals and the education community. An initiative of this kind could be implemented in two steps: first, the design, construction, and implementation of a com-educational method which has already been defined in Sánchez-López (2020), and its application in real educational contexts, and second, an evaluation of its effectiveness. This would involve the use of quantitative surveys and focus groups to obtain feedback from young users and communities. From this, the effectiveness of the theoretical-practical com-education framework can be confirmed for subsequent impact-transformation. To this end, it would be necessary to further develop the concept of the com-education phenomenon itself, using data obtained from the above research.

Author Contribution

Idea, I.S.L.; Literature Review (state of the art), I.S.L., M.B.R.; Methodology, I.S.L.; Data analysis, I.S.L., M.B.R.; Results, I.S.L.; Discussion and conclusions, M.B.R., I.S.L.; Writing (original draft), M.B.R; Final revisions, I.O.S.; Project design and sporsonships, I.S.L., I.O.S.

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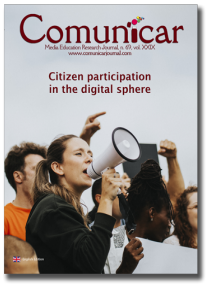

The impact of serious games in mathematics fluency: A study in Primary Education

Impacto de los juegos serios en la fluidez matemática: Un estudio en Educación Primaria

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ABSTRACT

In recent years there has been a renewal of educational software encouraged by the incorporation of specific designs based on serious games. Previous studies on their use do not provide conclusive data on the advancement in learning, both at a general level and in specific contents. The main objective of this work is to study the impact of the use of serious games in primary education classrooms, specifically on mathematics fluency, taking into account gamification variables and teaching experience. A quasi-experimental study was carried out with a pretest-posttest design, without a control group and with several experimental groups, involving 284 students from the first to the fourth grade. The results show a significant improvement in mathematics fluency with the use of serious games in the different grades and classroom groups studied. The gamification strategy promotes even greater progress over the classes where it has not been implemented. There is a similar time of use of serious games by both novice and experienced teachers, with better results in mathematics fluency in the case of the second group. It also shows the relationship between the results obtained and the school grades of the students. The findings point to the potential of using serious games designed specifically for school environments and challenge previous work on generational barriers in teachers.

RESUMEN

En estos últimos años ha habido una renovación del software educativo propiciada por la incorporación de diseños específicos basados en juegos serios. Los estudios previos sobre su uso no ofrecen datos concluyentes sobre el avance en el aprendizaje, tanto a nivel general como de contenidos específicos. El objetivo principal del presente trabajo es conocer el impacto del uso de juegos serios en las aulas de educación primaria, concretamente en la fluidez matemática del alumnado, atendiendo a variables de gamificación y experiencia docente. Se lleva a cabo un estudio cuasi-experimental con pretest-postest, sin grupo control y con varios grupos experimentales, en el que participan 284 estudiantes de primero a cuarto curso. Los resultados muestran una mejora significativa de la fluidez matemática con el uso de juegos serios en los distintos cursos y grupos-aula estudiados. La estrategia de gamificación promueve un progreso aún mayor respecto a las aulas en las que no se ha implementado. Se observa un tiempo de uso similar de los juegos serios por parte de profesores noveles y experimentados, con mejores resultados en fluidez matemática en el caso de los segundos. También se muestra la relación existente entre los resultados obtenidos y las calificaciones del alumnado. Las conclusiones señalan el potencial del uso de juegos serios diseñados específicamente para entornos escolares y cuestionan trabajos previos sobre las barreras generacionales en el profesorado.

KEYWORDS | PALABRAS CLAVE

Serious games, gamification, primary education, mathematics education, teachers, academic performance.
Juegos serios, gamificación, educación primaria, educación matemática, docentes, rendimiento académico.

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1. Introduction and state of the art

In the past years, there has been a renewal of educational software thanks to the incorporation of specific designs based on serious games. "Serious game" refers to a game in which "education (in its various forms) is the primary goal, rather than entertainment" (Michael & Chen, 2006: 17), with the focus placed on specific contents, regardless of the form and the structure that are being used (Zagalo, 2010). These initiatives build on one of the possibilities of serious games, but we should not lose sight of the richness of all the modalities of serious games, based on their ludic structure, purpose or scope (Alvarez & Djaouti, 2012; Romero-Rodríguez & Torres-Toukoumidis, 2018). The design of experiences from this perspective, which has multiple parallels with the field of videogames, provides teachers in educational centers with a new way of working. In addition to these developments, we should mention the emergence of initiatives that include several gamification-based elements, placing the focus on the domain of motivation (Pérez-Manzano & Almela-Baeza, 2018). Although their implementation usually has positive effects, it is greatly dependent on the contexts of application (Hamari et al., 2014).

Some studies related to the use of serious games in the classroom reveal improvements in learning (Clark et al., 2016; Wouters et al., 2013), or identify progress in students' cognitive capacity (Lamb et al., 2018). This situation informs the school curriculum (Carvalho et al., 2018). However, there are also certain studies that, while reporting benefits in the level of student participation and involvement, do not provide conclusive data on learning progress in general (Chauhan, 2017; Fisher et al., 2020), or in relation to specific contents (Boendermaker et al., 2017; Mellado et al., 2018). Additionally, although teachers do not rule out the possibility of using serious games, there are only very sporadic experiences (Del-Moral & Fernández, 2015). Kaufman's work (2013) refers to the existence of a generational barrier (i.e., teacher not older than 35 years), as teachers above this age lack previous positive experiences with this type of software (Marín-Díaz et al., 2019). This situation reveals a strong relationship between teachers' attitude toward this type of software and its potential use in the classroom (Stieler-Hunt & Jones, 2015).

What all available studies suggest is how beneficial serious games are to students' attitude, with a remarkable impact on the domain of motivation (Filella et al., 2017; Gómez-García et al., 2016). This factor should be borne in mind when considering the use of these resources in the classroom, especially in areas of the curriculum deemed critical, such as languages and mathematics. Specifically, calculus and its automation are still some of the main challenges to be tackled at these levels of education (Baroody et al., 2009). It is not just one more element of content: continued improvement in these learnings throughout compulsory education serves as a guarantee that spreads to schoolwork in general (Duncan et al., 2007) and may become a good predictor of learning at higher levels (Geary, 2011). Therefore, this space is potentially useful for the implementation of serious games, which might facilitate learning that requires some sort of automation. There are currently several pieces of software that have been designed as serious games specifically for these contents and which, in some cases, also enable the use of gamification as a potential complement, as this is, precisely, a key strategy in the domain of motivation (McGonigal, 2011). Gamification may take place in parallel, reinforcing motivation in a non-ludic context (Teixes, 2015). It provides help in the progress toward a final goal, thereby increasing students' interest considerably (Zagal & Altizer, 2014).

At present, it is possible to access online serious games designed to be used in educational centers around the world, breaking the traditional barriers of publishing markets and opening the door to experimentation with initiatives available to other countries. The use of these products in the Spanish context may be challenging, since in some cases there are differences with the curricula of the country of origin, as happens with the learning of calculus. It is common to present addition and subtraction at the same time, in grades 1 and 2, and multiplication together with division in grade 3, as contained in the proposal of the U.S. Council of Chief State School Officers (2020) under what has been called "Common Core State Standards", compared with the much more linear guidelines of the curriculum applied in Spain.

Precisely, the contents relating to calculus have been a recurring focus of work in the field of serious games in the past years, with a direct impact on the field of mathematics fluency (Baroody et al., 2013). The latter is understood as a sign of skillfulness in algorithm solving. It is based on principles such as efficiency, precision, the use of strategies and flexibility (Kling & Bay-Williams, 2014). The development

of fluency maximizes efficiency and precision, and making progress in fluency is a protective factor against failure in the areas of mathematics or reading (Meiri et al., 2019). Evidence of these processes can be identified as an indicator of performance according to the specific learning proposals.

Recent studies have explored the benefits that this type of software bring to mathematics fluency, and such benefits have become the reference to assess these products (Van-der-Ven et al., 2017). An example of this is Reflex Math, with a substantial level of use in American classrooms at different educational levels (Cozad, 2019; Cress, 2019; Sarrell, 2014). The software generates a personalized learning route based on response times and error rates. It also provides help to students through a virtual trainer. The figure of the virtual trainer provides some guidance to develop strategies for overcoming any difficulties detected in the individual learning routes, adapted to the specific situation of the student. Errors are not seen as penalties; rather, they become opportunities for improvement. In this sense, errors are analyzed by the system to activate the support processes by the virtual instructor. In addition, the software has a built-in gamification system that rewards students by improving their avatars and awarding them diplomas, but never giving them academic benefits, through redeemable points based on the number of activities carried out, the frequency of use of the software or the correct completion of the tasks. This type of rewards that are external to the use of the software and the promotion of these rewards are a supplemental task that should be managed by teachers. Students carry out their work independently. Teachers can monitor the process through specific tools that provide information based on the data collected by the system. However, we should not lose sight of the fact that the use of software with these characteristics reveals, again, certain contradictions. A number of studies focused on mathematics have demonstrated benefit in learning (Fernández-Robles et al., 2019; Pires et al., 2019), while other studies suggest the contrary (Hieftje et al., 2017).

In this scenario, we designed a research study with the general purpose of understanding the impact of the use of serious games on mathematics fluency among primary education students. Our research, conducted in real classroom contexts, was based on several variables of interest, such as the grade level of the students, the application of gamification, the classroom group and teaching experience. We also intended to understand the relationship between the results derived from this learning initiative and the grades obtained by the students. The findings from this study may be useful to governmental agencies and educational centers in decision-making processes related to the provision of resources and the development of innovative strategies in the classroom-based methodologies used.

2. Materials and methods

2.1. Design

In response to the objective described, a pretest-posttest quasi-experimental design without a control group and with several experimental groups was used. Totally standardized conditions were sought, i.e., a common school scenario with classroom groups already formed and without any sort of randomness. Each group worked independently between the two tests that were applied, using the educational software Reflex Math. Those in charge of the implementation were, in each case, teachers in the area of mathematics, who were all given the same indications to use all the possibilities provided by the system. The study was carried out after obtaining informed consent from the school where it was conducted.

2.2. Participants

The research was carried out in a school that offered three lines for each level, with the participation of 12 primary classes between levels 1 and 4. This was a private school financed by public funds through an agreement with the State and located in an urban area of Galicia. The study sample was constituted by 284 students. A total of 54.2% were boys and 45.8% were girls. A total of 24.3% of them were in the first grade, 25.4% were in the second grade, 25.7% were in the third grade and 24.6% were in the fourth grade. Our proposal was previously submitted to the management team and the 25 members of the staff teaching at the primary education stage. They were given information explaining the characteristics of the program and the research proposal, as well as the implications of the use of the software for their teaching. Lastly, a positive evaluation was obtained for their participation in the research, particularly from

the teachers responsible for the area of mathematics, who were expected to be more deeply involved in the process.

2.3. Tool

The Basic Math Operations Task (BMOT), developed by Foegen and Deno (2001), was used to assess the learning of calculus. Access to this tool was gained through Sarrell's work (2014). Its use required a full translation into Spanish of both the pretest and the posttest. In both cases, combined addition, subtraction, multiplication and division calculation operations were presented. This proposal perfectly suits the educational level envisaged at this school in the third and the fourth grades. For the first and the second grades, our proposal was adapted to the curricular level and included only addition and subtraction operations. The correction of the test generates an indicator of individual performance based on the summation of all correct answers in a maximum of one minute. This indicator is one of the potential benefits that can be directly derived from the use of the software, hence the advisability of using it.

2.4. Procedure

The research was conducted in the first term of the year 2019-2020. The pretest was applied in September 2019, and the posttest was applied in December that year. The use of the software was integrated into the duration of the mathematics class; following the developer's guidance, it was used in three sessions per week. Also, student data were collected in relation to academic performance, specifically the students' grades in all the areas evaluated at this stage at the end of the term, at the time the posttest was applied. As to the teachers, data on the number of years of teaching experience were collected. By accessing the system's database using a tool intended specifically for teachers, it was possible to compile individual data on the number of days of use of the program, the volume of activities completed and the use of gamification strategies.

2.5. Data analysis

The statistical software SPSS v. 25 was used for data analysis. Univariate descriptive analyses based on measures of central tendency and dispersion were carried out. Because parametric assumptions were not met for related situations (comparison between the pretest and the posttest), the Wilcoxon signed-rank test was applied, for which a level of significance of 0.05 was set. For independent situations, the Mann–Whitney U test was used to find out whether there were significant differences ($p<0.05$) between the classes in which gamification had been applied and those that had not applied it. It was also used to find differences between the classes with novice teachers and those with experienced teachers. Also, the statistic $r=|z| / \sqrt{N}$ was calculated as measure of effect size (Field, 2018; Fritz et al., 2012). For the interpretation of r, we followed the criterion proposed by Cohen (1988), with the extension suggested by Rosenthal (1996). Spearman's ρ coefficient (r_s) was used to establish the degree of association between the different variables analyzed. Statistical significance ($p<0.05$) and relationship strength were jointly considered for its interpretation, for which the indications given in the specialized literature (including, among others, Sánchez-Huete, 2013) were followed. Lastly, the coefficient of determination (R^2) was calculated to have an approximation to the amount of variance of academic performance as explained by the results of the learning method based on serious games.

3. Analyses and results

First, we will present an overview of the effect of serious games on mathematics fluency to later analyze it according to the grade leven were the games were used. Additionally, the results of the proposal will be analyzed according to the application or non-application of gamification, and also with regard to each specific class, considering the distinction between novice teachers and experienced teachers in those classes with gamification conditions. We will finish with a study of the relationships between the results achieved through this learning proposal and the grades obtained by the students.

3.1. Serious games and improvement in mathematics fluency

The software was used for a mean of 27 days, over which the students carried out 5,747 activities on average. After using the software, a statistically significant improvement of great magnitude was seen in mathematics fluency (n=284, Z=-14.291, p=0.000, r=0.60), which went from an average score of 8.99 (pretest) to 17.79 (posttest). The time of use of the software was clearly related to the number of activities solved (r_s=0.82, p=0.000).

When we look at each educational level, it can be seen that the posttest score comes hand in hand with two aspects that turn out to be revealing, with a generally significant relationship that tends to be moderate in the case of time of use (grade 1, r=0.20, p=0.108; grade 2, r=0.36, p=0.002; grade 3, r=0.39, p=0.001; grade 4, r=0.40, p=0.001) and moderate with regard to the number of activities solved (grade 1, r_s=0.37, p=0.002; grade 2, r_s=0.65, p=0.000; grade 3, r_s=0.48, p=0.000; grade 4, r_s=0.48, p=0.000).

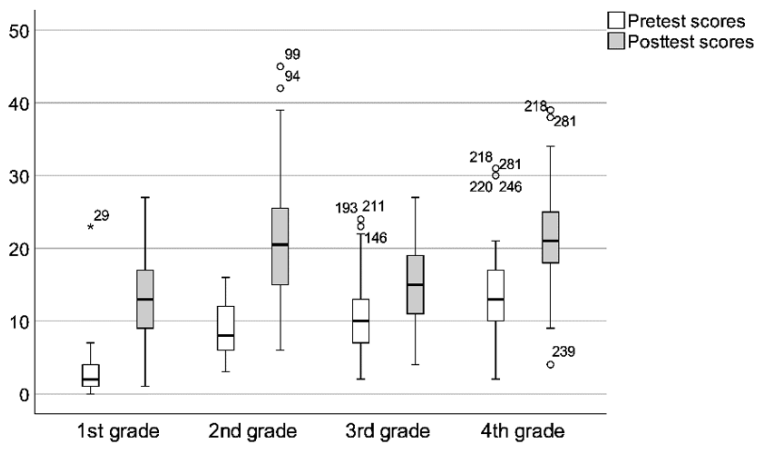
Table 1 contains the main descriptive statistics for each level. Significant differences are found between the scores obtained in the pretest and those attained in the posttest, with a difference of great magnitude in all cases: in grade 1 (Z=-7.225, p=0.000, r=0.62), in grade 2 (Z=-7.378, p=0.000, r=0.61), in grade 3 (Z=6.354, p=0.000, r=0.53) and in grade 4 (Z=-7.251, p=0.000, r=0.61).

Table 1. Descriptive statistics by grade

	First grade (*n*=69)			Second grade (*n*=72)		
	M	Md	SD	M	Md	SD
Pretest score	2.97	2	3.16	8.64	8	3.651
Posttest score	12.80	13	5.43	20.99	20.5	8.139
Days of use	28.3	27	4.9	29.6	28.5	6.1
Activities solved	5,662.4	4,775	2,829.6	6,775.5	5,733.5	3,918.5
	Third grade (*n*=73)			Fourth grade (*n*=70)		
	M	Md	SD	M	Md	SD
Pretest scores	10.64	10	4.66	13.57	13	6.04
Posttest scores	15.45	15	5.71	21.84	21	6.52
Days of use	29.4	29	8.7	21.3	20.5	5.2
Activities solved	6,620.1	6,344	3,315.3	3,865.4	3,445	1,890.6

As Figure 1 shows, the scores were lower and tended to be more concentrated in the pretest, while the posttest scores reached higher values and had greater dispersion. Substantial progress was made between the baseline situation and the final situation at the end of the term at all educational levels.

Figure 1. Comparison between the pretest scores and the posttest scores by grade



3.2. Serious games and gamification in the classroom

The software proposed included a gamification strategy to be used in the classroom as a complementary element, which was employed by some of the teachers. The pretest score was lower in the classes where gamification was implemented, and four points higher in the classes in which gamification was not applied (Table 2). This is a statistically significant difference of medium magnitude (*RYes*=123.24, *RNo*=181.43, *Z*=-5.628, p=0.000, r=0.33). It is important to note the variable "grade" in this result, since the classes that implemented no gamification were of the third and the fourth grades, while the classes that did implement gamification covered also the first and the second grades. However, the posttest reflected greater progress in the classes with gamification (a 10-point difference between the two means) compared with the classes in which gamification had not been applied (6.38 points). This difference is significant in the case of the progress made by the classes that had gamification versus the progress of the classes in which gamification was not used, with an effect size that comes close to medium (RYes=158.68, RNo=109.80, Z=-4.729, p=0.000, r=0.28). In fact, the posttest score does no longer reveal any significant or remarkable differences between the classes that applied gamification and those in which it was not implemented (RYes=139.59, RNo=148.38, Z=-0.850, p=0.395, r=0.05). In addition, the classes with gamification attained more days of use of the program and showed a higher number of activities solved by the students. Statistically significant differences with a medium effect size were obtained for the days of use (RYes=164.82, RNo=97.39, Z=-6.517, p=0.000, r=0.39), and an effect size close to medium for the number of activities (RYes=157.58, RNo=112.02, Z=-4.399, p=0.000, r=0.26).

Table 2. Descriptive statistics according to use of gamification in the classroom

	Gamification in the classroom (*n*=190)			No gamification in the classroom (*n*=94)		
	M	Md	SD	M	Md	SD
Pretest score	7.64	7	5.50	11.73	11	5.78
Posttest score	17.63	17	7.75	18.11	18	7.06
Days of use	29.1	28	6.6	23.4	23	7
Activities solved	6,257	5,220.5	3,399.6	4,718.7	3,892.5	2,781.8

At an intragroup level, there was a statistically significant improvement of great magnitude in mathematics fluency, both in the group that benefited from gamification in the classroom (n=190, Z=-11.959, p=0.000, r=0.61) and in the group in which gamification had not been implemented (n=94, Z=-7.638, p=0.000, r=0.56), although the effect size was greater for the former.

3.3. At classroom level: Novice teachers versus experienced teachers

All classroom groups made progress in mathematical calculus fluency after the serious gaming experience (Table 3). However, there were groups whose level of progress was clearly lower, as occurred in A8 and A9. Equally, this situation extended to apply to effect size, which was large in all classes (r=0.62) but lower in A8 (r=0.43) and A9 (r=0.49). We started from a similar scenario for all cases; however, diverse ways of use, appropriation and management can be seen among the teachers.

At this point in the analysis, a potential relationship between these data and the teacher's professional experience emerges. In order to make comparisons between classes under this criterion, we took educational levels as reference, since the requirements of the curricula were similar. At the same time, there had to be a coincidence between the conditions of implementation or non-implementation of gamification in the classroom. In this sense, we saw that both the teachers with greater seniority (more than 30 years of teaching experience) and the novice teachers (between 1 and 5 years of teaching experience) used the software in a similar way during class time.

Even in some cases, higher values were obtained for the teachers with greater seniority and, in addition, better posttest results were seen among the students who had more experienced teachers. In this regard, in the second grade, in which all the teachers used gamification, those who were more experienced (in A4 and A5) attained better mean results in the posttest than the novice teachers (A6) (M=21.81 versus M=19.33), made more intensive use of the program (M=30.6 days versus M=27.7) and obtained a higher rate of activities carried out (M=7,299.9 versus M=5,726.6). It was seen that there were no significant differences between the values obtained for the novice teachers and those for the experienced

teachers, with small effect sizes (pretest: Z=-0.665, p=0.506, r=0.08; posttest: Z=-1.005, p=0.315, r=0.12; days of use: Z=-1.580, p=0.114, r=0.19; activities solved: Z=-1.374, p=0.170, r=0.16).

Table 3. Descriptive statistics by class

Grade 1 (*n*=69)	A1 (*n*=24)			A2 (*n*=22)			A3 (*n*=23)		
	M	Md	SD	M	Md	SD	M	Md	SD
Pretest s.	2.42	2	2.10	3.86	2	4.76	2.70	2	1.82
Posttest s.	12.08	12.5	5.83	13.32	14	6.11	13.04	12	4.35
Days of use	28.5	27	6.1	28.4	27.5	4.4	28	28	4
Activities	5,940.8	4,566	3,515.6	6,059	5,557	3,147.5	4,992.5	4,604	1,288.4
Grade 2 (*n*=72)	**A4 (*n*=23)**			**A5 (*n*=25)**			**A6 (*n*=24)**		
	M	Md	SD	M	Md	SD	M	Md	SD
Pretest s.	7.70	8	3.02	9.96	9	3.91	8.17	8	3.67
Posttest s.	20.04	20	6.35	23.44	21	10.23	19.33	20.5	6.82
Days of use	29	28	4.7	32.1	32	7.3	27.7	28	5.3
Activities	6,314.6	5,708	3,072.1	8,206.4	6,140	5,357.6	5,726.6	5,145.50	2,198.8
Grade 3 (*n*=73)	**A7 (*n*=25)**			**A8 (*n*=24)**			**A9 (*n* = 24)**		
	M	Md	SD	M	Md	SD	M	Md	SD
Pretest s.	11.24	10	4.19	8.21	8	2.98	12.46	11	5.54
Posttest s.	17.92	18	5.62	11.29	10	4.71	17.04	18.5	4.44
Days of use	35.6	35	7.1	26.4	24	7.72	26	25.5	7.9
Activities	8,334.1	7,747	3,129.6	5,899.9	5,222.5	3,382.6	5,555	5,076	2,797.7
Grade 4 (*n* = 70)	**A10 (*n*=23)**			**A11 (*n*=24)**			**A12 (*n*=23)**		
	M	Md	SD	M	Md	SD	M	Md	SD
Pretest s.	13.43	12	6.99	14.29	13.5	5.55	12.96	13	5.67
Posttest s.	23.39	24	6.49	21.13	20	7.13	21.04	20	5.87
Days of use	21.4	22	5	22.8	22	5.8	19.6	19	4.4
Activities	4,171.4	3,668	1,778	4,247.5	3,768	1,694.7	3,160.6	2,434	2,066.6

As to grade 3, for the two classes that were compared (A8: novice teacher; A9: experienced teacher), in which gamification had not been used, similar values were obtained in the use of the software and the number of activities solved (Table 3). In fact, there were no significant differences in this regard (Table 4); in contrast, the pretest and posttest scores did show significant differences, with a notable effect size.

Table 4. Mean ranks and statistics of the Mann–Whitney *U* test for A8 and A9

	R_{nov}	R_{exper}	*U*	*Z*	*p*	*r*
Pretest score	18.44	30.56	142.500	–3.011	0.003	0.43
Posttest score	16.69	32.31	100.500	–3.876	0.000	0.56
Days of use	24.75	24.25	282.000	–0.124	0.901	0.02
Activities solved	24.79	24.21	281.000	–0.144	0.885	0.02

3.4. Relationship between the posttest scores and the academic performance of the students

In general, a significant and moderate relationship can be seen between the posttest scores and the grades obtained in mathematics in the first term, except in the third grade (grade 1: r_s=0.62, p=0.000, R^2=0.38; grade 2: r_s=0.53, p=0.000, R^2=0.28; grade 3: r_s=0.15, p=0.203, R^2=0.02; grade 4: r_s=0.43, p=0.000, R^2=0.18).

There was also a significant and moderate relationship between posttest scores and the academic grades in general, except in the third grade, where a lower correlation was obtained, although it was also significant (grade 1: r_s=0.57, p=0.000, R^2=0.32; grade 2: r_s=0.63, p=0.000, R^2=0.40; grade 3: r_s=0.33, p=0.004, R^2=0.11; grade 4: r_s=0.46, p=0.000, R^2=0.21). We should highlight the coefficient of determination in the second grade, which allows us to infer that the posttest scores account for up to 40% of the variance of the overall academic grades.

Depending on the classes (Table 5), we can also notice, in general, a significant and moderate-high relationship between the posttest scores and the school grades, except for a number of specific groups in the third grade (A7, A8 and A9) and in the fourth grade (A12). Several coefficients of determination stand out which indicate that more than 50% of the variability of the grades in mathematics and of the overall academic grades can be accounted for by their relationship with the posttest scores.

Table 5. Correlation between the posttest scores and the academic performance of the students by class						
	Grade in mathematics			Overall grade (all subjects)		
	r_s	Sig.	R^2	r_s	Sig.	R^2
A1 posttest score	0.54	0.007	0.29	0.61	0.002	0.37
A2 posttest score	0.67	0.001	0.45	0.55	0.008	0.30
A3 posttest score	0.74	0.000	0.55	0.71	0.000	0.50
A4 posttest score	0.56	0.006	0.31	0.72	0.000	0.52
A5 posttest score	0.75	0.000	0.56	0.72	0.000	0.52
A6 posttest score	0.56	0.005	0.31	0.55	0.006	0.30
A7 posttest score	0.33	0.111	0.11	0.28	0.173	0.08
A8 posttest score	0.20	0.360	0.04	0.22	0.299	0.05
A9 posttest score	0.31	0.138	0.10	0.40	0.050	0.16
A10 posttest score	0.45	0.030	0.20	0.46	0.027	0.21
A11 posttest score	0.42	0.043	0.18	0.53	0.008	0.28
A12 posttest score	0.39	0.065	0.15	0.35	0.099	0.12

4. Discussion and conclusions

The purpose of this study was to investigate the impact of the use of serious games on the work carried out at primary education levels. Our study provides scientific evidence of the improvement in mathematical contents through the use of serious games. These results are consistent with the work of Clark et al. (2016), Carvalho et al. (2018) and Wouters et al. (2013). Our study reinforces this line of research with evidence of the benefit that serious games can provide in real-life contexts. Specifically, substantial progress in mathematics fluency can be seen in all four grades analyzed, in all 12 classes involved, and for all the participating students. These data are consistent with previous studies that used much smaller samples (Cozad, 2019) and students with learning difficulties (Sarrell, 2014). There is a statistically significant difference of great magnitude between the baseline situation and the situation that was seen after the serious gaming experience. We should bear in mind that there is an apparently limiting factor in these data: the fact that a piece of software designed for a US curriculum was used. This did not determine its potential. Additionally, greater progress in mathematics fluency as well as more intensive use of the program and a higher number of activities solved were observed in the classes that used the gamification strategy. This leads us to confirm the impact of the use of these strategies on the domain of motivation, clearly in line with previous studies (Filella et al., 2017; McGonigal, 2011; Zagal & Altizer, 2014), and to associate its use with an improvement in students' performance (Fernández-Robles et al., 2019; Pires et al., 2019).

A significant and moderate relationship is also found between the scores obtained in the performance tests applied after the serious gaming experience and the students' grades, with similar percentages of variation, which exceed 50% for some classes. In this regard, we should point out that this relationship between the different variables does not necessarily imply causality but refers to the degree of relationship. These data reveal the explanatory power of this type of curricular contents in relation to the work carried out in the classroom, which serves to update previous studies on the matter and highlights the potential influence of this sort of proposals on students' general performance (Duncan et al., 2007). The evidence of improvement shown by these data allows us to question the studies that suggest the existence of generational barriers against the potential use of this software by teachers (Kaufman, 2013) owing to a lack of previous positive experiences (Marín-Díaz et al., 2019). Adherence to work with serious games and the process to implement this in the classroom requires modulation by teachers. Rather than being a problem, as suggested by previous literature, age is seen here as an opportunity that complements the work carried out with the software, banishing the image of novice teachers as being more sensitive and inclined to the use of these programs. Experienced teachers utilize them with a level of intensity that is similar to that of novice teachers, and under equal conditions significant differences can even be found in favor of experienced teachers compared to younger ones. These results seem to indicate that these teachers value the use of serious games and gamification according to the perceived benefits, which drives them to reinforce this proposal by facilitating the conditions to carry out the tasks suggested, with knowledge

and experience that lead to even better results. This situation opens up the possibility of investigating the elements that these teachers bring into play, and highlights the need to conduct research studies focused on core areas of schoolwork that have a high value for educational centers.

Everything suggests that contextual elements are determining factors in the study of serious games and gamification, and may lead to disparate results. The selection of contents that are relevant to teachers appears as a key factor when it comes to having an impact on schoolwork, bringing different skills—particularly mathematical and digital skills—into play. Additionally, students, who are clearly motivated and involved in this proposal, are offered digital gaming experiences with a high degree of isomorphism compared to the usual experiences of their leisure time, which helps to bridge the gap between the reality of the school and social reality and to add value to the role played by educational centers. This situation allows us to conclude that the use of serious games and gamification specifically designed for school environments has potential in relation to students' performance.

Nevertheless, this work has some limitations. We should highlight the fact that it only included students and teachers from one single educational center, so the results should be used with caution in any potential generalizations beyond the context in which the study was carried out. Additionally, the reasons for the different forms of appropriation by teachers are unknown, especially in the case of experienced teachers, who, quite unexpectedly, joined the proposal with great intensity.

Author Contribution

Idea, F.F.V.; Literature review (state of the art), F.F.V.; Methodology, E.V.C., E.M.P.; Data analysis, E.V.C., E.M.P.; Results, E.V.C., F.F.V., E.M.P.; Discussion and conclusions, F.F.V., E.V.C.; Writing (original draft), F.F.V., E.V.C.; Final revisions, E.V.C., E.M.P.; Design project and sporsonship, F.F.V.

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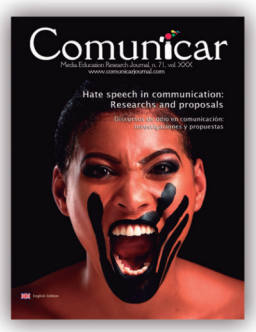

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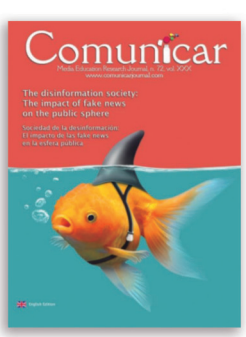

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