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Editorial message

Dear Colleagues,

JIIM is an international, multidisciplinary, blind peer-reviewed electronic open-access journal that publishes research efforts on all aspects and issues regarding Information Science and Integrated Information Management. For many years JIIM was hosted at the Uniwersity of West Attica (UNIWA), http://ejournals.uniwa.gr/index.php/JIIM/, portal. Now, a major transition took place. JIIM will be available through the Greek National Documentation Centre (EKT) ePublishing platform for electronic journals, https://ejournals.epublishing.ekt.gr/index.php/jiim. The JIIM Editorial Team is looking forward for a fruitful collaboration with EKT. It is anticipated that through this new portal, JIIM publications will be delivered to a broader audience accessible by international indexing services.

The current issue publishes research articles about the open and subscription delivered citation indexes, the marketing practices of libraries according to Greek professionals, the COVID-19 response by the French, Greek, Norwegian and Spanish scientific communities assessed through bibliometrics, and the sentiment analysis through lemmatization of tweets by Greek politicians during the 2023 pre-elections period. Also, there is a book review of a multilanguage illustrated glossary of paper conservation in Portuguese, English, Spanish and Greek.

In the beginning, there is an in-depth analysis of four different citation indexes: Elsevier's Scopus, Google Scholar, Dimensions, and OpenCitations. UNIWACRIS platform dataset of publications by UNIWA researchers was investigated through the four different citation indexes to assess their coverage and the degree of match between them through a Python algorithm of citation analysis by the Digital Object Identifier (DOI) of each publication. The results suggested the advantage of subscription-delivered citation indexing services over open access in terms of peer-reviewed selection of works, careful evaluation of academic journals, completeness, coverage depth, and integration. Open citation indexing services are easily accessible by anyone, but they still need further improvements in documentation and publishers inclusion.

The following paper is a survey of Greek library professionals about their libraries' marketing practices in promoting their collections and services. This investigation aimed to assess the perceptions and ideas of the professionals on the importance of library marketing, the skill set required by them to this end, and the challenges faced based on their experiences. The participants recognized the necessity of library marketing, but the administrators did not prioritize this task high enough to invest in this purpose. The lack of planning and strategic thinking among the administrators of public and private libraries in the post-pandemic, port-artificial intelligence era could be a disadvantage for libraries, and integrating marketing education is a critical addition to the curriculum of LIS studies programs.

The third paper is the collective bibliometric and bibliographic investigation of COVID-19 pandemic-related literature according to the country affiliation to assess the scientific response of France, Greece, Norway, and Spain in alphabetical order. COVID-19 represented a severe morbidity and life-threatening worldwide health emergency that changed the way of living, socializing, thinking, communicating, and understanding globally. A rapid scientific shift in research interests was yet another implication of the pandemic to deliver more information on the biology and epidemiology of the disease, to prevent it, to protect vulnerable populations, and to produce vaccines and therapeutics. The bibliometric records indicated that the translation of basic research findings to applied clinical studies for COVID-19 occurred within two years post the pandemic. As hosts and collaborators in international research efforts, the four countries collectively produced a wave of breakthrough scientific output against this threat.

Finally, sentiment analysis was performed based on the lemmatization of tweets posted by the leaders and their spokespersons of the two major political party candidates, New Democracy and SYRIZA, rallying to elect the majority of parliament members that vote for the government of Greece during the latest pre-election period of 2023. The collection of tweet texts was analyzed using the Natural Language Processing (NLP) toolkit for Greeks accessing lemmas from the Institute for Language and Speech Processing (ILSP) lexicon. A sentiment analysis followed the extraction of lemmas through an algorithm assessing words' positive or negative content. The results showed that the degree of positive sentiment in the content of tweets appeared to impact the voters significantly during the 2023 Greek parliament elections. This lemmatization and sentiment analysis of the Greek language text approach will be useful in future investigations of the

impact of sentiment in marketing campaigns in general.

A book review of a recent open-access contribution by Silvana Bojanoski and Marcia Almada entitled "Illustrated glossary of paper conservation: damages and treatments" is presented. In this open-access iconographic scientific terminology lexicon of paper conservation in four languages, Portuguese, English, Spanish and Greek, the common damages and treatments of written, printed or painted paper material are graphically presented.

We welcome special Issue proposals that should be emailed to Associate Professor Dimitrios Kouis (dkouis@uniwa.gr) or Assistant Professor Artemis Chaleplioglou (artemischal@uniwa.gr). Finally, we expect your contribution and active support, as well as remarks and points of improvement.

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Open and closed citations' indexes results: a comparative study

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Abstract:

Purpose *- The following paper is a comparative study of the differences in the results provided by different academic and scholar indexes regarding a sample of DOI-identified articles and papers: with citation metrics being more and more relevant for the evaluation of scholars and their works, it is crucial to understand the differences between different indexes, their results and their functioning, digging into both open and close scenarios.*

Design *- The results of four different indexes (Elsevier's Scopus, Google Scholar, Dimensions, OpenCitations) have been compared through the provided REST APIs, when possible, and Python web scraping libraries. Different features have been considered for drawing the results, such as the easiness for the user to retrieve such metrics and their metadata and the reasons behind the differences in the results.*

Findings *- The study highlights the advantages of open citation metrics indexes and Linked Open Data for the final user. Still, at the same time, it points out how, when it comes to the completeness of the results, traditional indexes still provide more in-depth coverage of the academic literature, identifying the need to keep working to integrate more indexes and sources in the open ecosystem.*

Originality/value *- This study aims to call attention to the strengths and advantages of FAIR approaches in the field of citation metrics, providing a successful example of an open alternative to traditional indexes.*

Index Terms — citations – indexes – FAIR – metrics – LOD

I. Introduction

Regarding citation metrics, it is crucial to understand the reasons behind the differences in the results provided by different indexes and the criteria used to rank scholars, researchers, and their works.

Historically, the landscape has been shaped by a predominance of metrics retrieved from closed indexes managed by commercial publishers, which often don't share the citation data with open environments. In recent years, though, with the advent of open science practices and FAIR principles, efforts have been made to propose an open approach to citation metrics. In this context, the Initiative for Open Citations (I4OC) **[1]** pushes for the availability of data on citations that are structured, separable, and open, offering a disrupting alternative to the predominant scenario composed mainly of subscription-based indexes managed by commercial organizations.

Among the founders of the I4OC is OpenCitations, "an infrastructure organization for open scholarship dedicated to the publication of open citation data as Linked Open Data using Semantic Web technologies" **[2]** managed by the Research Center for Open Scholarly Metadata at the University of Bologna. Since its birth in 2010, it has configured itself as an alternative to traditional scholarship indexes and organizations, both from a technological and ethical point of view.

The non-openness of the references contained in the vast majority of publications leads to difficulty in retrieving metadata from open indexes, which is often the result of combined different causes: either because publishers won't submit to platforms such as Crossref (the DOI provider on which OpenCitations relies the most) the references of their publications, or because they have obtained their DOI through a different organization or, finally, because they publish in plain text/PDF format, preventing the occurrence of the publication in any infrastructure that relies on machine-readable formats. OpenCitations' data model heavily relies on Linked Open Data, the Resource Description Framework (RDF) and the semantic web: this allows to treat citations as first-class data entities, hence with a unique identifier (Open Citation Identifier, OCI), and to convey metadata about the citation itself (which is different from the bibliographic metadata of the citing and cited entity).

In 2022, the Open Citations "Index of Crossref Open DOI-to-DOI Citations" (COCI) reached the number of about 1.3 billion citation records **[3]**, that is to say, 52% of what is provided by Google Scholar, vs the slightly greater 58% of Elsevier's Scopus in comparison. Since then, Open Citations has expanded its indexes with the addition of other sources, such as DataCite, NIH Open Citation Collection, OpenAIRE and Japan Link Center (JaLC). Furthermore, Open Citations allows third parties to submit citation data concerning their publications to fill the gap of the missing citations from some of the biggest publishers not available in Crossref as open material (Elsevier being the main one).

II. Tools

A first comparison between different indexes (in this case OpenCitations, Google Scholar, Elsevier's Scopus, and Dimensions) can be carried out by analyzing the tools they provide to the users to retrieve citation data about bibliographic resources.

Starting from OpenCitations, all the triples that describe the entities, attributes and relations are stored in a triplestore database and can be queried using the SPARQL language. The result would be the set of OCIs that identify the Citations entities with the bibliographic resource identified by the queried DOI as a cited entity, each of which can be explored in the RDF/XML, Turtle, or JSON-LD format.

Furthermore, to allow users who are not experts in the use of the SPARQL language to query the dataset, Open Citations provides, besides a search interface on the website, two REST APIs (respectively for the "Index" **[4]** and "Meta" **[5]** dataset): these have been made available thanks to the development of an open-source software, RAMOSE (Restful API Manager Over Sparql Endpoints) **[6]**. Like the whole data model itself, RAMOSE can be used by developers of any application to provide REST APIs over a triplestore.

Concerning Google Scholar (which indexes metadata of scholarly literature across a vast array of disciplines and publishers), the service per se doesn't provide a way to automatically retrieve data, such as a "Google Scholar API", but independent developers and users have developed tools to do so: in this case, SERP API **[7]** has been used, which allows to extract from "Search Engine Results Pages" various kinds of information, including citations metadata from Google Scholar results.

On the other hand, Elsevier's Scopus, which is a leader in paid services when it comes to citation analysis tools and which includes peer-reviewed publications and metadata from a vast range of publishers, does provide an API to interact with their datasets, but with a paywall that prevents the user to freely extract certain kinds of data, such as citations metadata **[8]**.

The University of West Attica has a subscription to Elsevier's Scopus API, which allows one to visualize the number of citations of bibliographic documents on the UniWaCRIS webpage and which links to the Scopus webpage of that entry. Nevertheless, since, as we'll see, the considered dataset for this project is relatively small and focused on a specific field, to speed up the process, the retrieval of such information has been performed through means of web scraping, making use of the "Beautiful Soup" and "Selenium" python libraries.

Finally, UniWa also has an agreement with Dimensions, a relatively newer service in this landscape but which still indexes metrics concerning a vast range of bibliographic resources: to lean towards open access, a significant portion of its content is free of charge, but still some content is protected by paywalls. For this reason, only the number of citations per bibliographic entry retrieved from UNIWACRIS (https://uniwacris.uniwa.gr/) has been used for this study **[9]**.

III. Methods

The sample dataset used for this study, in .xls format, comes from the UniWaCRIS infrastructure, and it includes records from 879 bibliographic resources describing their metadata, such as the internal "id", the "collection id" and a list of dc-terms fields covering attributes such as the abstract, the responsible agents, the provenance metadata, the type of bibliographic resource and, of course, the identifiers. Among the various identifiers (DOI, ISBN, ScopusID, URL, etc.), DOIs have been chosen as the reference ones: this excluded all the entries that didn't have a DOI, reducing the number of considered resources to 303.

The developed Python software (which is available for consultation and reuse at this link: https://github.com/SleepingSteven/citations-analysis) is composed of different modules that address the following questions:

1. For how many DOIs does Open Citations provide the highest "cited by" value?
2. For how many DOIs does Elsevier's Scopus provide the highest "cited by" value?
3. For how many DOIs does Google Scholar provide the highest "cited by" value?
4. For how many DOIs does Dimensions provide the highest "cited by" value?
5. What is the average difference in the number of citations when using Scopus compared to when using Open Citations?
6. Comparing the results of Open Citations and Scopus, what are the differences in the citation results for each entry? Which citations don't appear, respectively?
7. What is the publisher of each missing citation?
8. What are the most common publishers of the missing citations for Open Citations and Scopus?

Concerning the first five points, the way in which the data have been retrieved differs depending on the index.
Starting from Open Citations, the file that performs the action is "resultsoc.py":
Source code

```
doislist=list()
dois = pd.read_excel('INSERT FILE NAME(e.g. filtered.xlsx)', usecols = 'COLUMN LETTER')
for i, row in dois.iterrows():

        doislist.append(row["dc.identifier.doi[en_US]"])

listaocindex=list()
for i in doislist:
    API_CALL = "https://opencitations.net/index/api/v2/citation-count/doi:"+i
    HTTP_HEADERS = {"accept": "application/json"}

    try:
        listaocindex.append(int(get(API_CALL, headers=HTTP_HEADERS).json()[0]["count"]))
    except Exception as e:
        listaocindex.append(0)

listaocindex.insert(0,"cited_by_oc")
workbook = xlsxwriter.Workbook('INSERT EXCEL OUTPUT FILE NAME HERE')
worksheet1 = workbook.add_worksheet()
worksheet1.write_column('A1', listaocindex)
workbook.close()
print (listaocindex)
```

The algorithm first retrieves all the DOIs from the filtered

Excel file through the “read_excel()” method of the “Pandas” Python library. Then, it proceeds to call the “Index” dataset REST API with the “/citation-count/” operation, providing as an argument each one of the DOIs through the “.get()” method of the “Requests” Python library. The result is a .json output (whose format was specified in the HTTP headers) with a single object and with a single key-value association: “count”: “number of citations”.

e.g.:

```
[
    {
"count": "5"
    }
]
```

The retrieved list of “cited by” values is then loaded into an output Excel file through the “xlsxwriter” Python library. It is then ready to be further treated (in this case, being added as a new column with the name “cited_by_oc” to the “filtered.xslx” file, available on the GitHub page of the project).

For what concerns Scopus, what follows is a section of the “resultsscopus.py” file, which was written keeping in mind what is stated in the “tools” section concerning Scopus API:

Source code

```
    # Check if the request was successful (status code 200)
    if response.status_code == 200:
        # Parse the HTML content of the webpage
        soup = BeautifulSoup(response.text, 'html.parser')

        # Extract the value based on HTML structure and tags
        try:
            value_to_extract = soup.find('div', class_="metric-counter-scopus").text
            listascopusindex.append(int(value_to_extract.replace('\t', '').replace('\n',
''')))
            # Print the extracted value
            print(int(value_to_extract.replace('\t', '').replace('\n', '')))
        except Exception as e:
            listascopusindex.append(0)


    else:
        print(f"Failed to retrieve the webpage. Status Code: {response.status_code}")

print (listascopusindex)
listascopusindex.insert(0,"cited_by_scopus")
workbook = xlsxwriter.Workbook('INSERT EXCEL OUTPUT FILE NAME HERE')
worksheet1 = workbook.add_worksheet()
worksheet1.write_column('A1', listascopusindex)
workbook.close()
```

Slightly differently to the previous point, the first thing to do was retrieve the UNIWACRIS URIs (instead of the DOIs) from the Excel file: with them it was possible to generate HTTP get requests and to obtain the .html content of the web page, from which it was possible, thanks to the “BeautifulSoup” library, to extract the section related to the Scopus banner, identified by the class=”metric-counter-scopus”.

After retrieving the values, they are again stored in an output file.

The algorithm for retrieving Dimensions’ indexes in the “resultsdimensions.py” file is similar, with the change that also the “Selenium” Python library is used since a script generates the Dimensions’ banner and the library allows to read the .html code dynamically:

Source code

```
        # Access the HTML content of the embedded element
        embedded_element_html = embedded_element.get_attribute('outerHTML')
        soup=BeautifulSoup(embedded_element_html, 'html.parser')
        try:
            value_to_extract = soup.find('div', class_="__db_score_normal").text
            listascopusindex.append(int(value_to_extract.replace('\t', '').replace('\n',
''')))
            print (int(value_to_extract.replace('\t', '').replace('\n', '')))
            print ("ok")
        except Exception as e:
            listascopusindex.append(0)
            print (0)
            print("no")


    finally:
        # Close the browser
        driver.quit()
```

Finally, coming to Google Scholar, to facilitate the use of the SerpAPI, the “SerpApiGoogleScholar” **[10]** Python library has been used to retrieve then the .json output, which included the number of citations for each queried DOI.

SerpApi, though, can be used to make 100 searches a month on its basic plan: so, for the remaining 204 entries left to be queried, another custom backend of the same “SerpApiGoogleScholar” library was used, which allows to retrieve data from Google Scholar without the need of an API but at a lower rate.

Here’s the code from the “resultsgooglecustom.py” file:

Source code

```
for i in doilist:

    try:
        data = parser.scrape_google_scholar_organic_results(
            query=i,
            pagination=False,
            save_to_csv=False,
            save_to_json=False
        )
        try:
            citationcountd[i]=data[0]["cited_by_count"]
            citationcountl.append(data[0]["cited_by_count"])
```

Since, as expected and as it will be shown, Google Scholar results are greater than double the ones provided by the other three indexes, respectively, the focus was shifted exclusively on the comparison of Open Citations with Scopus and Dimensions, referring to Google Scholar only for further information retrieval.

Also, being Scopus cited multiple times in the Open Citations documentation as a “competitor” and being the automized retrieval of data much smoother when dealing with Scopus, the following analyses are focused solely on the differences with Elsevier’s infrastructure.

Points 6, 7, and 8 have been addressed through the development of the “analysis.py” file: the algorithm first checks the differences in the citations count between Open Citations and Scopus through the previously retrieved data, to then proceed to retrieve the list of citations from both Open citations and Scopus, to find the ones appearing only in one of the two indexes.

Concerning Open Citations, the “Index” dataset API call “https://opencitations.net/index/api/v2/citations/doi: + DOI” allows retrieval in JSON format the list of Citation objects that have as a cited document the one identified by the submitted DOI.

After sliding the list of objects and retrieving the DOIs of the citing documents, the “Meta” dataset API call

"https://opencitations.net/meta/api/v1/metadata/doi: + DOI" can be used to retrieve bibliographic metadata about that document, including the name. This was needed because, as we will see, the comparison between the citations listed in Scopus and Open Citations had to be done by name: for the same reason, the names were uniformed and brought to lowercase.

The retrieval of the Scopus list of citing documents' names for each DOI was, on the other hand, once again impossible to perform through Elsevier's API on the basic developer plan. The result was nevertheless achieved through the development of the "find()" function: after setting up "Selenium" with the browser profiles, it was possible to retrieve the dynamically generated .html code of the Scopus "results" pages submitting at each iteration a get-request function having the following URL as argument: "https://www.scopus.com/results/citedbyresults.uri?sort= plf-f&cite= + SCOPUSID", where SCOPUSID is, for each of the excel entries, the value of the "dc.identifier.scopus;" column.

In fact, Scopus allows users to visualize information of the citing documents for a submitted Scopus-ID on a "read-only" page:

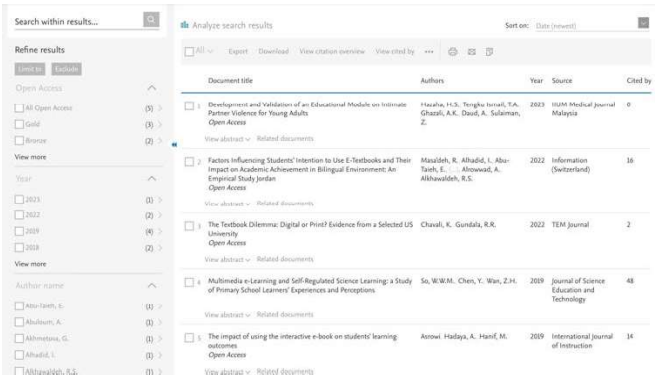

Fig 1. Scopus web page providing information of the citing documents

As it is visible from this screenshot, only the names of the citing documents are provided as a form of identification (the reason why the names were retrieved through Open Citations "Meta" API as previously explained): all of them are hence stored in a list for each iteration, thanks to the retrieval through "BeautifulSoup" of the HTML section concerning the elements under the class "docTitle".

Once the list of citing documents both from Scopus and Open citations for each entry is retrieved, the algorithm checks for missing elements in both and stores them in a list to recover their publication information:

Source code

```
print ("Difference for DOI: "+dois.loc[i]['dc.identifier.doi[en_US]']+": ")
        print(result)
        for i in result:
            successful=False
            while not successful:
                try:
                    parser = CustomGoogleScholarOrganic()
                    data = parser.scrape_google_scholar_organic_results(
                        query=i,
                        pagination=False,
                        save_to_csv=False,
                        save_to_json=False
                    )
                    if "publication_info" in data[0]:
                        try:
                            print((data[0]["publication_info"].split(" - "))[1])
                            successful=True

publishersnotinscopus.append((data[0]["publication_info"].split(" - "))[1])
                            print (publishersnotinscopus)
                        except Exception as b:
                            successful=True
                            print("Ok but formatting error")
                    elif data:
                            successful=True
                            print("Ok but formatting error")
                except Exception as e:
```

These instructions obtain information from Google Scholar through the previously used "Custom Google Scholar" backend, including the information data of each citing publication.

The information is retrieved once again in the form of a "key-value" pair in a list of JSON objects, which usually follows this pattern:

```
[
  {
    ...
    "publication-info": "The Electronic Library, 2020 - emerald.com"
    ...
    }
]
```

The first part of the string identifies the publication venue, and the second one, divided by a dash, is the publisher.

The goal was then to obtain, for both Open Citations and Scopus, the list of publishers of the citing documents appearing (and missing) exclusively in their results, also using the "countpublishers()" function to obtain a percentage of how many times a specific publisher is present.

Finally, the "counttypes()" function counts the percentage of the type of documents (conference papers or articles) that present a higher "cited-by" count either in Open Citations or Scopus.

IV. RESULTS

The results are depicted in the following figures:

• Total number of citations with the provided DOIs as cited document according to different indexes:

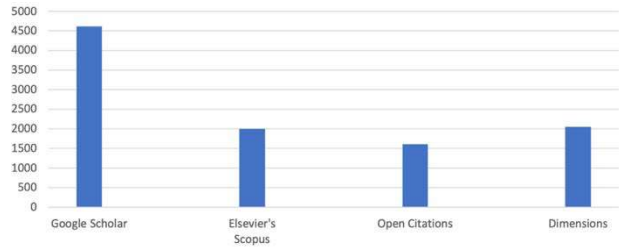

Fig 2. Total number of citations with the provided DOIs as cited document according to different indexes

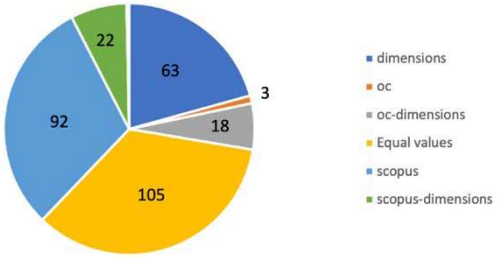

Fig 3. DOIs for which different indexes provided the highest "cited-by" value (excluding Google Scholar)

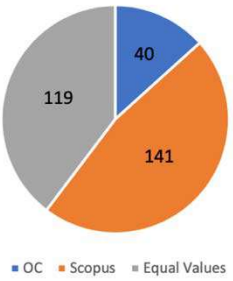

Fig 4. DOIs for which different indexes provided the highest "cited-by" value (considering only Open Citations and Scopus)

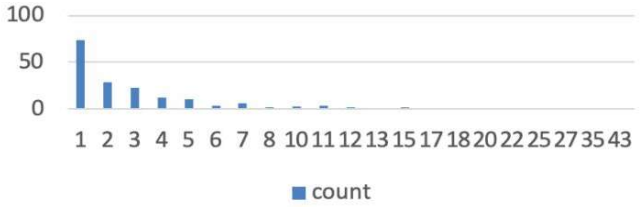

Fig 5. Average difference in the number of citations per DOI between Open Citations and Scopus (2,15, standard deviation = 4,89)

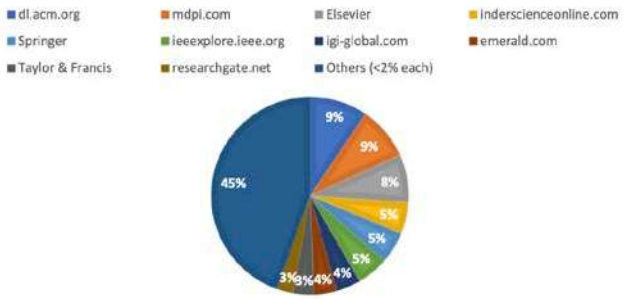

Fig 6. Publishers of citing documents listed by Scopus and not by Open Citations

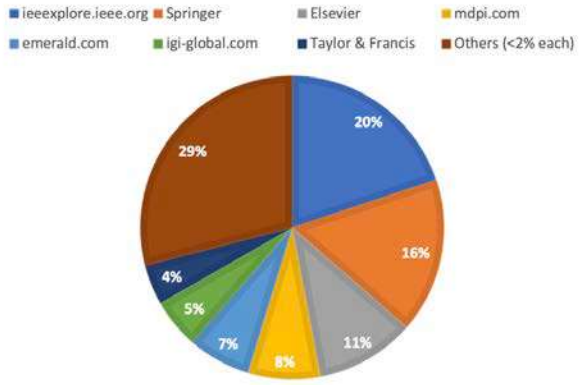

Fig 7. Publishers of citing documents listed by Open Citations and not by Scopus

The results seem to have confirmed, in the first place, the numbers proposed by the Open Citations' documentation, with Google Scholar providing a total number of citations twice as large as those offered by the other indices.

The reason for this might lie behind the Google Scholar indexing criteria, which guarantees comprehensive coverage, indexing a diverse array of sources such as preprints, conference papers, and institutional repositories.

As a matter of fact, being listed on Google Scholar for a citation entry is a smoother process since the infrastructure relies on powerful crawling technologies (similar to the ones used by the same Google Search engine) and in-text citation recognition, which make it easier even for independent or smaller publishers to be listed among the results. There are just a few prerequisites, like the documents being readable in at least .pdf or .html format, being of course, scholarly articles, and divided into sections (abstract, title, author, references, bibliography): if these features are matched, and if the websites on which the documents are hosted do not present anti-crawling features or do not use uncommon protocols, the bibliographic and citation metadata will most likely appear on Google Scholar **[11]**.

On the contrary, Elsevier's Scopus (as well as other academic indices) focuses more on selecting peer-reviewed works and submitting academic titles, which is subject to stricter selection standards and a longer process.

Also, Scopus evaluates annually the performance of every work within its database. Each work must meet specific citation metrics and benchmarks: should a journal fall short of these benchmarks for two consecutive years, it would be flagged for re-evaluation, potentially leading to its removal from the corpus **[12]**.

When looking at the direct comparison between Scopus and Open Citations, we observe that for 141 DOIs, Scopus provided more citation results, versus the 40 where Open Citations turned out to be more comprehensive, with an average difference of 2,15 citations per document.

Digging into the results, it is observed that among the citations which were "exclusive" to Scopus, 55% of them referred to the publisher of the citing document, a well-known one, but with a maximum individual percentage of 9% of the results (the top ones being ACM - Association for Computing Machinery publishing, MDPI, Elsevier, Springer,

IEEE, Emerald, Taylor & Francis). The remaining 45% was represented by publishers who published less than 2% of the citing documents, and the reason might be that they were mostly smaller independent ones, universities, specific repositories, etc.

On the other hand, the same well-known publishers represented 71% of the publishers of citations being listed only by Open Citations, also presenting higher individual percentages (e.g., 20% for IEEE, 16% for Springer), with the "smaller ones" representing only 29%.

There could be many reasons for these disparities. For those that appear only in Scopus, looking at how the percentages tend to have fewer peaks throughout the results compared to the Open Citations ones, the reason might lie behind the general functioning of Open Citations, which relies mostly on publishers submitting the citation metadata of their publications to Crossref, the primary source of Open citations indexes **[13]**. At the same time, Scopus, as we've seen, is built upon the publishers' submission of peer-reviewed works to the platform. This might be seen as a priority by both smaller and bigger publishers in this case, compared to the submission of open metadata to a platform such as Crossref (which may also not be the provider of the DOI of the document), given the advantages that the listing of work in the Scopus network might bring to a publisher in terms of visibility.

Also, this kind of citations-metadata submission may not even be considered a required step in the publication flow and be ignored by smaller publishers who only include them as plain text, the reason why their percentage might be so high compared to the Open Citations results (45% vs 29%).

Concerning publishers of citing works appearing only in Open Citations, the less smooth percentage distribution, with peaks of 20%, 16% and 11% for single "big" publishers (respectively IEEE, Springer and Elsevier), and the smaller percentage of "little" ones, might imply in the first place the presence of citing documents whose publishers are accustomed to the good practice of submitting citation metadata to open platforms (or to platforms which agreed to provide their citations indexes to Open Citations for inclusion in their platform).

On the other hand, it may also imply the presence of works that were not accepted by Scopus (either because not peer-reviewed, because of low relevance, or because they didn't keep up with the recurring benchmark checks). Lastly, they may also not have been submitted to Scopus in the first place.

V. Discussion

The results match the ones proposed by a previous similar study that compared Elsevier's Scopus with other indexes, including Crossref, from which "57% of the citation links in Scopus cannot be obtained" **[14]** for reasons compatible with the above listed.

At the same time, though, the technical advantages of relying on Open Citations should be evident, at least when it comes to the data retrieval operations: the semantic Linked Open Data infrastructure, on which the whole infrastructure is built, ensures a faster, smoother, customizable, and cheaper process in comparison to other paywalled indexes, reason why the RDF structure and the ethics that support Open Citations data model should be taken into account and not be underestimated when it comes to a direct comparison with more comprehensive indexes.

Finally, this study suggests a reflection on the use of citation-based metrics as the sole indicator of a work's impact: restricted access to citation data due to paywalls and limited accessibility does not align with FAIR principles. In fact, such restrictions pose a threat to the transparency, replicability, and verifiability of research assessment, and data such as citation-based metrics may open up to all kinds of peculiarities and all kinds of issues may arise when collecting the related information (e.g. the different periods in which citations are accumulated and the related availability of such citations, the time that passes between a work and its first citation which affects the h-index, the "strategic" use of citations from the scientific community to gain advantage by citation-based metrics etc.).

For these reasons, Open Citations is working toward new implementations that guarantee more in-depth coverage of the academic literature. This means expanding its coverage to encompass references from publications using non-Crossref DOIs, references extracted from PDF documents, references provided by preprint repositories, and references related to data citations, views, savings, online discussions, and other non-textual research outputs to offer "altmetrics" **[15]** capable of monitoring impact beyond the academic landscape.

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Marketing for Relevance, Visibility, and Sustainability: Exploring the Views of Greek Library Professionals

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Abstract:

Purpose *- Libraries worldwide are struggling with issues of relevance and necessity. Despite substantial transformations, especially due to the COVID-19 pandemic, their services often fail to meet users' needs or remain largely unknown to the public. This study aims to examine the attitudes, activities, challenges, and competencies related to marketing among Greek library professionals to enhance the relevance, visibility, and sustainability of their libraries.*

Design/methodology/approach *– This research involves surveying Greek library professionals to gather data on their perceptions and practices regarding marketing. Using a quantitative research design, the study evaluates their recognition of marketing's importance, self-assessed marketing skills, and the extent of marketing activities and planning in their libraries.*

Findings *- The findings reveal that while library professionals acknowledge the importance of marketing and believe they possess the necessary skills to promote their collections and services, there is a significant lack of prioritization and investment in marketing from library management. Additionally, marketing efforts are often unplanned and sporadic. The study discusses the practical implications of these findings for leadership within libraries and the education provided in Library and Information Science (LIS) programs.*

Originality/value *- This study provides valuable insights into the marketing practices and challenges faced by Greek library professionals. It underscores the need for better planning and investment in marketing initiatives and highlights the importance of integrating marketing education into LIS programs to prepare future librarians for these crucial tasks.*

Index Terms **—** Library marketing, library professionals, new critical skills, relevance, sustainability, Greek libraries.

I. Introduction

The day the World Health Organization **[1]** announced that the COVID-19 outbreak had turned into a pandemic marked a pivotal moment for Galleries, Libraries, Archives, and Museums (GLAM), fundamentally altering their operations in unforeseen ways. During the global lockdowns, information organizations had to adapt rapidly to new circumstances and transform their operations **[2]**.

The pandemic highlighted existing skill gaps and library infrastructure deficiencies, necessitating an accelerated evolution in two major areas. Firstly, maintaining a competitive edge in the digital realm became crucial **[3]**. To stay relevant to their stakeholders, libraries introduced new services, including access to electronic resources, streaming media, virtual programming, health literacy initiatives, and virtual reference services **[4], [5], [6]**. Secondly, the role of libraries as physical spaces was re-evaluated **[7]**, **[8]**. Traditionally linked with community engagement **[9], [10], [11]**, libraries are now challenged to rethink the value and sustainability of their physical spaces.

As librarians navigate the balance between physical and digital presences, the discussion on leveraging marketing tools to enhance service value has become more pronounced **[12]**. A robust customer-service orientation that enhances user experience should be a strategic priority for every library **[13]**. However, many libraries still struggle to market their collections and services effectively [14]. Given this context, it is essential to investigate the attitudes, skills, and challenges library professionals face regarding marketing.

In this regard, the current study aims at assessing the perceptions of the Greek library professionals concerning:

- the importance of library marketing,
- the skill set required to navigate a competitive landscape, drive change, and demonstrate the value of their library and
- the marketing challenges faced to build better library user experiences.

II. Literature Review

Library and Information Science (LIS) literature has increasingly highlighted the multifaceted roles of libraries.

They act as crucial community centers **[15], [16]**, enhancing community development by offering access to information and improving neighborhood stability, safety, and quality of life. Massis **[17]** emphasizes the importance of libraries maintaining their focus on community service and addressing their relevance through strategic marketing efforts. Library usage is strongly tied to community engagement **[9], [10], [11]**. In the post-pandemic world, libraries must continually reassess their marketing strategies and re-evaluate their visions, missions, goals, and objectives. This re-evaluation should emphasize social and ethical values such as sustainability, inclusion, equality, long-term viability, strategic flexibility, and meaningful social responsibility in a transformed marketing landscape **[18]**.

It's a common misconception that marketing is only about promotion **[19]**. In truth, "*marketing is an organizational function and a set of processes for creating, communicating, and delivering value to customers and managing customer relationships in ways that benefit the organization and its stakeholders*" **[20, p. 28]**. In a library setting, marketing involves identifying community needs, providing tailored products and services to meet those needs, promoting library collections and services to increase library use, outreach and advocacy, and building long-term user relationships via rich experiences **[21], [22], [23], [24].** In essence, library marketing is an ongoing conversation with all target audiences and can be effective if implemented in a continuous cycle **[25]**.

A. Marketing Attitudes

Marketing is a powerful tool that can help libraries manage all critical internal and external challenges related to developing and promoting collections and programs [26]. Notwithstanding, the planning and implementation of successful marketing strategies, library professionals need a set of marketing skills and a positive attitude **[27]**.

The perception of marketing within the library profession has historically been mixed. Earlier literature highlighted that librarians have hesitated to adopt and implement marketing strategies, often believing that such activities were unsuitable and possibly unnecessary for libraries **[28]**. Later studies have generally indicated more favorable attitudes toward marketing **[29], [30], [31], [32]**, but with significant variations among individual libraries and library specialties. For example, Aharony **[33]** found that school librarians tend to have more positive attitudes toward marketing compared to their counterparts in public and academic libraries. In contrast, the Parker et al. **[34]** study found public librarians to be more positively inclined. Other research has highlighted that librarians with some marketing training exhibit more favorable marketing attitudes **[31]** and that these attitudes are influenced by the overall marketing culture within their libraries **[35]**. Attitudes also varied based on demographic characteristics and personality variables **[33], [36]**.

B. Marketing Competencies and LIS Education

The knowledge and skills required in the LIS field entail a tremendous number of competencies **[37],** including technical, IT, and managerial skills **[14], [38], [39], [40], [41]**. Acquiring, organizing, retrieving, collecting, and disseminating information are the order of the day in the library world **[42]**. Data analysis, database planning and designing, data visualization, machine learning, data integrity, and communications skills are among the essential skills library professionals working with data should have **[43]**. Adopting AI in library services is also increasingly important **[44], [45], [46]**. Soft skills **[47], [48]**, skills to better serve the emerging Communities of Practice **[49]**, curriculum skills **[50]**, and leadership skills **[51], [52], [53]** are also highlighted in the LIS literature.

Among this highly diverse skillset, marketing competencies are important for contemporary information professionals **[54]**. And, while advocacy and outreach abilities are deemed foundational for entering the library profession, according to the 2022 'ALA's Core Competences of Librarianship **[55]**, marketing is not explicitly mentioned. Polger **[19]** suggests that library professionals sometimes confuse advocacy, communication, and outreach initiatives with marketing strategies. Crowley **[56]** indicates that both are essential to the education of library professionals, as marketing is necessary for assessing and meeting users' needs, while advocacy helps libraries secure the resources required to meet those needs.

However, Singh **[57]** argues that 'ALA's prioritization of advocacy over marketing, which has also been embraced by those who previously resisted incorporating marketing techniques and terminology in information organizations, has affected the development of LIS curricula, leaving students without sufficient marketing skills because they are not provided with a solid theoretical foundation in marketing. To address this shortcoming, it's necessary not only to update LIS curricula but also to dedicate training to equip working professionals with skills not just in traditional marketing but also in digital marketing strategies, essential for keeping pace with the changing landscape.

C. Marketing Practices and Challenges

Libraries employ a diverse range of traditional and digital marketing practices to increase awareness of their collections, services, and physical spaces. From newsletters, book displays, tours, and events to branded merchandise and engaging social media content, libraries strive to effectively demonstrate their value within their communities **[19]**. Digital marketing has been advocated to be of special value to libraries **[58]**, with studies indicating its greater effectiveness compared to traditional approaches in enhancing services and resource utilization **[59]**.

Notwithstanding the potential advantages that marketing can confer upon libraries, they encounter numerous challenges in its implementation. The deficiency in marketing competencies among library professionals, stemming from both inadequacies in LIS education and a lack of training, has been identified as one of the most significant obstacles to the effective utilization of marketing strategies

[60], [61], [62]. Other obstacles identified are associated with budget constraints, staff shortages, and lack of management support and marketing dedication **[60], [63]**.

III. Research Methods

A. Sampling and Data Collection

The target population of the current study comprised personnel working in Greek libraries of all types. A web-based structured questionnaire was distributed via electronic mailing lists and social media to collect primary data. The institutional ethics committee approved the survey, and all participants gave informed consent before participating. Altogether, 181 questionnaires suitable for analysis were collected. The demographic profile of respondents is presented in **Table I**.

Table I. Profile of Respondents

		Frequency	Percentage
Gender	Male	27	14.9
	Female	153	84.5
	Other	1	0.6
Age	23-65	Mean: 49.18	SD: 6.96
Education	Lower/Upper Secondary	2	1.1
	Post-secondary non-tertiary	2	1.1
	Bachelor's degree	82	45.3
	Master's Degree	81	44.8
	Doctoral Degree	14	7.7
Specialty	Librarian	161	89
	Administrator	9	5
	Teacher	11	6
Position	Staff member	118	65.2
	Head officer	44	24.3
	Director	18	9.9
	Intern	1	0.6
Experience (years)	Organizational tenure	Mean:17.33	SD: 10.66
	Job tenure	Mean:20.63	SD: 9.93
Library type	Public	86	47.5
	Academic	59	32.6
	Special	34	18.8
	School	2	1.1
Number of employees		Mean: 8.8	SD: 15.83

Table II. Questionnaire Constructs

Constructs	Number of items	References
Attitudes toward Marketing	19	[31]
Marketing Activities	12	[31]
Marketing Challenges	9	[64]
Marketing Competencies	20	[65], [66]

B. Research Instrument and Data Analysis

The questions utilized for the research are based on previous studies (**Table II**). Responses to closed-ended questions were given on a seven-point Likert-type scale, and an additional free-text response option was also included. The collected data were analyzed using descriptive statistics, namely frequencies, median, and interquartile range (IQR), as they constitute the most appropriate tools to analyze and interpret ordinal data **[67], [68]**. Questionnaire pre-testing, in which two academics and three LIS professionals participated, was carried out to ensure the instrument's content validity.

IV. Results and Discussion

A. Marketing Attitudes

Initially, participants were asked to indicate their agreement with 19 statements that assessed their attitudes toward marketing. **Table III** shows that most respondents view marketing as crucial for libraries' relevance and survival. Many agreed that libraries should adopt business-like marketing practices, reflecting a shift towards a marketing culture. Additionally, respondents believe marketing aids in developing new services, setting appropriate charges, promoting services, and discovering innovative ways to serve patrons. This indicates a move towards a comprehensive marketing approach. However, despite their involvement in marketing, many respondents feel they need more knowledge and training in marketing techniques. Therefore, proper and continuous marketing training is necessary for library professionals to face new challenges, as acknowledged in LIS literature **[65], [66], [69]**.

B. Marketing Activities

Participants were asked to assess the importance of 12 marketing activities, with cumulative results shown in **Table IV**. Most respondents indicated that advertising and promotion are essential for raising awareness of library services. Communicating through email and newsletters was deemed very important for providing the public with relevant information, aligning with marketing experts' views on email as an effective communication tool **[70]**, and the widespread use of newsletters for coordination and awareness **[71]**.

Respondents also emphasized the importance of website design, maintenance, and social media content creation for effectively informing and attracting different user groups. The significance of a well-designed library webpage **[72]** and social media presence **[73]** is well-documented. Ashiq et al. **[51]** found that during the COVID-19 pandemic, tools like library websites, social media, and emails were effective and remain so in the post-pandemic era.

Attracting new patrons and developing new services were crucial, and maintaining a patron database was essential. The findings also highlighted the importance of patron surveys for collecting data to assess service satisfaction and develop user-centered services, moving away from librarians' assumptions about user needs **[21]**. Events, exhibitions, and educational programs were also identified as strategically important.

In an open-ended question, respondents suggested additional activities such as educational programs, seminars for search skills, library tours, reading clubs, joint events, and community building. All these activities emphasize the library's role as a living cultural hub where people learn, work, and play together, reinforcing the role of libraries as cultural hubs **[74]**.

Table III. Attitudes toward Marketing

	1	2	3	4	5	6	7	Median	IQR
Marketing is relevant to the needs of libraries	1.1	0.0	2.2	4.4	11.6	30.9	49.7	6.0	1.0
I am knowledgeable about marketing techniques	2.8	8.8	13.8	27.6	21.5	14.4	11.0	4.0	3.0
Libraries should market themselves as businesses do	2.2	2.2	6.6	11.0	15.5	26.5	35.9	6.0	2.0
Development of new library products & services is important	0.0	0.0	2.2	3.9	12.7	22.1	59.1	7.0	1.0
Determining how much to charge for some library services is important	2.8	3.9	1.1	16.0	20.4	21.5	34.3	6.0	2.0
Effective promotion of library services is important	0.0	0.6	1.1	3.3	10.5	25.4	59.1	7.0	1.0
Finding new ways to deliver services to patrons is important	0.0	0.0	1.1	2.2	9.4	27.1	60.2	7.0	1.0
I have been personally involved in marketing library services	10.5	12.2	7.2	17.1	21.0	14.4	17.7	5.0	3.0
Marketing is too costly for most libraries	5.0	6.1	13.3	27.6	20.4	20.4	7.2	4.0	2.0
Knowing more about marketing techniques would be helpful to my work	2.8	4.4	7.2	9.9	23.2	24.3	28.2	6.0	2.0
Good public relations activities are important for a library	0.0	0.0	1.1	3.9	11.6	30.4	53.0	7.0	1.0

Marketing tries to satisfy people's wants & needs while also achieving the goals of the organization	0.0	0.6	2.8	11.6	13.8	30.9	40.3	6.0	2.0
Marketing is inconsistent with the professionalism of a librarian	38.1	23.8	12.2	17.7	5.0	1.1	2.2	2.0	3.0
Libraries need marketing to survive in an increasingly competitive environment	2.2	1.1	3.9	9.4	21.0	23.8	38.7	6.0	2.0
Library school programs should require a course in marketing	3.3	1.7	2.2	10.5	14.4	23.2	44.8	6.0	2.0
It is important to constantly monitor the wants and needs of potential patrons	0.0	1.1	0.6	3.3	6.6	23.8	64.6	7.0	1.0
Libraries don't need marketing because people already know what services we offer	38.7	33.1	13.8	8.8	2.8	1.7	1.1	2.0	2.0
Marketing is not a high priority in my library	17.7	18.2	14.4	19.9	12.2	9.9	7.7	3.0	3.0
Library marketing does not require a dedicated marketing officer, as its staff can do it	11.6	19.3	19.3	23.8	13.3	10.5	2.2	3.0	3.0

***Notes**: Results are given in percentages*
1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neither agree nor disagree, 5=Somewhat agree, 6=Agree, 7=Strongly agree

Table IV. Importance of Marketing Activities

	1	2	3	4	5	6	7	Median	IQR
Advertising/ promotion	0.6	1.1	3.9	7.2	13.3	34.3	39.8	6.0	2.0
Mailings	0.6	1.1	1.1	2.2	8.8	31.5	54.7	7.0	1.0
Newsletters	0.6	0.6	1.7	2.8	14.4	36.5	43.6	6.0	1.0
Patron surveys	0.6	0.0	3.3	6.1	16.0	27.1	47.0	6.0	2.0
Attracting new patrons	1.1	0.0	0.6	1.1	8.3	21.0	68.0	7.0	1.0
Developing new services	0.6	0.0	0.0	1.1	5.5	23.8	69.1	7.0	1.0
Maintaining a patron database	0.6	1.7	0.6	6.1	11.0	30.4	49.7	6.0	1.0
Website design and maintenance	0.6	0.0	0.0	1.7	4.4	19.3	74.0	7.0	1.0
Events	0.6	0.0	0.0	3.9	7.7	28.2	59.7	7.0	1.0
Exhibitions	0.6	0.0	1.1	8.3	13.8	29.8	46.4	6.0	1.0
Educational programs	0.6	0.0	1.1	1.7	6.6	25.4	64.6	7.0	1.0
Content creation for social media	0.6	0.0	0.0	5.5	10.5	27.6	55.8	7.0	1.0

***Notes**: Results are given in percentages*
1=Not at all important, 2=Low importance, 3=Slightly important, 4= Neutral, 5=Moderately important, 6= Very important, 7= Extremely important

C. Marketing Competencies

Participants were asked to rate their agreement with 20 items regarding skills and abilities necessary for effectively marketing library services and collections. Data analysis in **Table V** reveals a consensus on the need for a broad range of skills, particularly in soft skills, ICT, marketing, and communication, as supported by previous research **[42]**, **[75]**, **[76]**. Respondents specifically identified communication skills, critical thinking and problem-solving, web page development and maintenance, and event organization as essential for marketing their libraries.

Table V. Marketing Competencies

	1	2	3	4	5	6	7	Median	IQR
Generic Soft Skills									
Communication	0.6	0.0	0.6	3.9	7.7	32	55.2	7	1
Critical thinking and problem-solving	0.6	0.0	1.1	7.2	10.5	29.8	50.8	7	1
Professional initiative	0.6	0.6	1.7	4.4	13.8	35.9	43.1	6	1
Change implementation flexibility	0.6	1.1	1.7	5	15.5	34.8	41.4	6	1
Resourcefulness	0.6	0.0	1.7	3.9	11.6	34.8	47.5	6	1
Networking	0.6	0.6	1.7	8.3	10.5	30.9	47.5	6	1
Time management	1.7	0.6	5.5	8.8	17.7	28.7	37	6	2
ICT Skills									
Web page development and maintenance	0.6	0.6	1.1	5.5	9.9	30.4	51.9	7	1
Social media management	1.1	0.6	1.1	7.7	11	30.9	47.5	6	1
Search engine optimization	1.7	0.6	1.7	9.9	12.7	34.8	38.7	6	2
Analytics	1.7	0.0	2.2	8.8	20.4	28.2	38.7	6	2
Marketing and Communication Skills									
Events organization	0.6	0.0	0.6	6.1	12.7	29.3	50.8	7	1
Services evaluation	1.1	1.1	2.2	8.3	14.4	31.5	41.4	6	2
Complaints handling	1.7	1.1	6.1	9.4	16.6	26	39.2	6	2
Marketing plan development	1.1	2.2	2.8	9.9	17.1	28.7	38.1	6	2
Communication strategy development	1.1	0.0	1.1	7.2	19.3	31.5	39.8	6	2
Library brand development	2.8	1.1	5.5	14.9	20.4	22.1	33.1	6	2
Promotional material creation	1.1	1.1	1.7	7.2	17.7	28.7	42.5	6	2
Writing	1.1	1.1	2.2	11	13.8	30.9	39.8	6	2
Storytelling	3.9	2.2	8.3	12.2	20.4	24.3	28.7	6	3

***Notes**: Results are given in percentages*
1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neither agree nor disagree, 5=Somewhat agree, 6=Agree, 7=Strongly agree

D. Marketing Challenges

To assess employee perspectives on marketing challenges, respondents were asked to indicate their level of agreement with nine statements, with results presented in **Table VI**. Consistent with previous research **[64]**, over half of the participants indicated that their lack of knowledge about marketing concepts is a major barrier to applying marketing, with many expressing confusion about the term. Additionally, more than half noted that marketing is not taught in library schools, a finding that may reflect the age of respondents, as marketing was not typically included in the curriculum when older respondents attended. Many participants also cited a lack of staff and senior management support as significant obstacles to library marketing, corroborating previous studies **[14], [26], [77], [78]**.

Table VI. Marketing Challenges

	1	2	3	4	5	6	7	Median	IQR
Ignorance of marketing concepts	6.1	6.1	6.1	23.8	14.9	20.4	22.7	5.0	2.0
Library management does not support marketing library services	2.0	12.7	13.8	14.4	14.4	18.8	16.6	4.0	3.0
Marketing is costly for academic libraries	11.6	15.5	8.8	24.9	17.7	12.7	8.8	4.0	3.0
Libraries do not deal systematically with attracting new users	8.3	11.0	7.2	16.0	23.8	17.1	16.6	5.0	3.0
Librarians are not taught marketing in library school	4.4	4.4	7.7	26.5	15.5	16.0	25.4	5.0	3.0
Librarians do not have the necessary skills to market library services	14.9	16.6	11.6	21.5	14.4	10.5	10.5	4.0	3.0

Librarians do not know how to communicate what they do	18.2	23.2	12.2	16.0	14.4	7.7	8.3	3.0	3.0
Marketing is difficult because some librarians do not want to part with information	21.0	28.2	9.4	18.8	8.8	8.8	5.0	3.0	2.0
Librarians feel awkward towards marketing because they are afraid of commercial publicity	18.2	26.0	8.8	16.0	17.1	8.8	5.0	3.0	3.0
Librarians are confused about the term marketing	11.0	18.2	11.0	21.5	17.1	12.7	8.3	4.0	3.0
Libraries do not engage in marketing due to lack of staff	3.3	5.5	5.5	20.4	16.6	21.5	27.1	5.0	3.0

***Notes**: Results are given in percentages*
1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neither agree nor disagree, 5=Somewhat agree, 6=Agree, 7=Strongly agree

V. Conclusions

In the aftermath of the pandemic, libraries face the challenge of maintaining their relevance amidst an avalanche of disruptive technologies, fierce competition, and budget cuts. To survive in this highly competitive environment, libraries must embrace marketing to effectively respond to user demands, demonstrate their impact, and ensure sustainability.

This research provides insights into how libraries can leverage marketing to maintain relevance. The findings highlight the library staff's recognition of the critical need for marketing. Effective library marketing requires significant time and effort **[79]**, encompassing the development of mission statements **[21]**, informing patrons about relevant products **[80]**, and building meaningful long-term relationships **[3]**. Sustainable success in library marketing cannot be achieved through sporadic efforts. The findings also show that library staff understands the transformation of libraries into hubs of knowledge and recreation in the post-COVID era, serving as places for gathering **[81]**, learning **[82]**, working **[74]**, connecting **[9]**, and creating **[49]**. Despite having the necessary skills, library professionals often lack a solid marketing plan and rely on ad hoc efforts. Libraries should focus on identifying community needs and developing new services, using data gathered from social media and websites **[4], [14]**. As visibility drives relevance, libraries must transform into valuable institutions and adopt a marketing mindset. Library leaders and professionals should collaborate with marketing experts and develop strategic marketing plans to elevate their services. Enhanced communication, cooperation, and knowledge exchange among library leaders can accelerate this transition.

The staff is crucial for maintaining the relevance of libraries in the evolving information landscape. The need for library professionals to understand and respond strategically to digital transformation is increasingly urgent, as described by Vial **[83]**. In line with literature in library marketing and management, continuous capacity building and up-skilling of library staff are essential **[34], [48], [84], [85], [86]**. This ensures that knowledge workers remain relevant by meeting user needs and empowering digital equality **[87]**. Library professionals should enhance their skills and competencies, and LIS schools should make marketing a central part of their curricula. As Cherinet **[88]** describes, the future librarian's mindset will include a blend of old, emerging, and future skills.

This research has some potential limitations. Firstly, self-report data may offer biased estimates of marketing attitudes, challenges, and skills. Comparing the perspectives of library staff with those of users could provide more comprehensive insights. Secondly, this study does not differentiate between the public and private sectors, so examining potential differences in perceptions and practices would be valuable. Lastly, as the study sample is from one country, including library professionals from multiple countries would enable cross-cultural comparisons of library marketing practices.

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The COVID-19 Pandemic and Scientific Community Response in France, Greece, Norway, and Spain

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Abstract:

Purpose – *COVID-19 pandemic claimed millions of lives and changed everyday life for billions of people worldwide. Europe was severely impacted in health, social and economic aspects. Research efforts reallocation was a necessity to battle against this threat.*

Design/methodology/approach – *The scientific community responses against COVID-19 were assessed in terms of country paper productivity indexed in PubMed, Scopus, Web of Science, Dimensions and iCite databases. This research project was designed and performed in the framework of Health Information and Libraries Erasmus+ course with the participation of information science students from France, Norway, and Spain.*

Findings – *Prior to COVID-19 emergence, coronaviruses related publications accounted for approximately 0.15% of the total research output of more than 800,000 reports affiliated to France, Greece, Norway, or Spain. After COVID-19 pandemic the related scientific output was increased by 60-times to a 7% of the total scientific output of more than 900,000 affiliated reports. Between 2020 and 2022, 21,299 COVID-19 publications were affiliated to France, 6897 to Greece, 5353 to Norway, and 29,195 to Spain accounted collectively for approximately 9% of the global scientific output. The coronavirus related publications involved Medicine, Immunology and Microbiology, Biochemistry, Genetics and Molecular Biology but also humanities and social sciences, and economics and business.*

Originality/value - *COVID-19 spread fast across the globe from Asia to Europe despite quarantines and social distancing measures. International collaborations, space and funding reallocation led to an enormous original research output within months. Lessons from these responses are invaluable in future pandemic preparedness.*

Index Terms — SARS-CoV-2, SARS-CoV-1, influenza, cancer, cardiovascular, bibliometrics.

I. Introduction

Coronaviruses were responsible for the first two major epidemics of the new millennium, the Severe Acute Respiratory Syndrome (SARS-CoV-1) and Middle East Respiratory Syndrome coronavirus (MERS-CoV) **[1-3]**. These outbreaks mostly affected Asia to a total of 11,000 cases with nearly 2,000 fatalities altogether worldwide but with no more than 40 sporadic cases in total in Europe **[4]**. The imprint of SARS and MERS in Southern Asia and Arabian Peninsula respectively, and their high mortality rate were of such a magnitude that coronaviruses were considered as a top potential health risk for a communicable disease pandemic with a greater impact in morbidity and mortality than of the pandemic influenza A strain of the World War I era **[5]**. However, despite the warnings, no effective anti-SARS or anti-MERS vaccines and therapeutics have been well developed two decades after SARS and one decade after MERS outbreaks **[6]**. When COVID-19 (SARS-CoV-2) emerged causing severe pneumonia with a lower than SARS and MERS but significant mortality rate **[7]**, the European population was immunologically naïve and the clinical and biological information available was extremely limited.

Global leaders, civil servants, corporates, private industries, healthcare personnel, and the scientific community worldwide were confronting a viral pandemic communicable disease that could evolve to a catastrophe. Multistakeholder participation in disaster management was necessary in COVID-19 pandemic case. International health organizations proposed public health strategies, the European Union set plans of action, but it was the government officials' responsibility in each country to decide on their own set of policies. Government officials should decide among social distancing restrictions till the availability of proper vaccination, herd immunity, flattening the curve of active cases per time and raising the line of healthcare capacity **[8, 9]**. Reallocation of funding, staff,

equipment, and resources took place among state and non-state actors **[10]**. The aim of this report is to assess the scientific community response in four European countries France, Greece, Norway, and Spain in alphabetical order, corresponded to the nationalities of the student participants and the tutor by applying bibliometrics.

II. Related Work

Most of the existing works based on COVID-19 in relation to specific countries, seldom or investigated in combinations, were focused on cases **[11]** and deaths tracking **[12, 13]**, genetic versus clinical correlations to assess severity **[14]**, international innovation cooperation **[15]**, vaccination programs **[16]**, and policies adoption **[17]**. There are also reports investigated the COVID-19 bibliography burst through bibliometrics including evidence for France, Greece, Norway, or Spain.

In a book chapter in "Data Science for COVID-19" on prioritization of health emergency research, the authors applied a "Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)" methodology in assessing the scientific literature published within the first 3 months of the pandemic indexed in Web of Science or Scopus **[18]**. From the 817 reports found after screening and applying of eligibility criteria, the authors found 12 papers with a corresponding author from France accounting for 1.5% of the total reports, 3 written in French and 2 in English-French, 7 papers from Spain accounting for 0.6% of the total, one written in Spanish. Less than four papers were originated from Greece or Norway, one report written in Norwegian language. However, these reports, 696 out of the 817 from Scopus database, represent less than 30% of the COVID-19 papers indexed and published between January and March 2020 possibly because of publication or indexing delays, which is a drawback for the conclusions extracted.

In a preprint announced early in June 2020 **[19]**, a different approach followed through assessing PubMed indexed reports of the first 5 months of the pandemic. However, the aim of the study was to collectively estimate the scientific community response against COVID-19 when compared to the rest 21st century epidemics, in particular SARS-CoV, MERS-CoV, Ebola, Zika, avian (H5N1), and swine influenza (H1N1) controlled by HIV or AIDS reports during the same period of the epidemic or pandemic outbreak. This work accurately delivered the actual number of COVID-19 related publications of the first three months of the pandemic to a total of 2984 reports which rapidly increased to a total of 16213 by May 2020. This analysis found 43 papers affiliated to France (3.3% of the total), 28 to Spain (2.1%), 9 to Norway (0.7%), and 7 to Greece (0.5%).

Another report by Gong et al **[20]** investigated the early responses of the scientific community in the first two months of the pandemic January and February 2020, the research topics investigated and the scientific collaboration networks. The clinical manifestations of the virus represent the dominant research trend, whilst Chinese articles lead the scientific investigations among 44 countries first responders with 26% international collaboration reports mostly between China and USA and to a lesser extend Europe. France, Greece, Norway, and Spain are presented as collaborative countries in the COVID-19 research scientific networks. The high risk of SARS-CoV-2 transmission to other countries as a 24% for France and 15% for Germany before the implementation of the travel ban in Wuhan, China has been described.

Wang and Hong **[21]** deliver the bibliometrics of more than 27,000 papers five months in the pandemic. USA originated COVID-19 reports surpassed China by May 2020 whilst France and Spain were found in the top ten of productive countries in the 5th and 7th place respectively. The dominant research topics identified were: (a) epidemiology and public health interventions, (b) virus infection and immunity, including vaccine development as a subtopic, (c) clinical symptoms and diagnosis, and (d) drug treatments and clinical studies. The report concludes that vaccine research was lagging during the initial COVID-19 research.

Giannos et al **[22]** presented a bibliometric analysis of the first year in the pandemic of more than 53,000 publications affiliated to the 20 highest-ranked countries according to their gross domestic product (GDP). The authors reported 1,617 publications from France and 1,673 from Spain, but because of study design Greece and Norway were not included. The GDP criterion restrict the research output investigated to the rich countries alone.

Ohniwa et al **[23]** performed a broader coronavirus-related reports analysis by including all data since SARS outbreak in November 2002 till August 2020, 8 months after COVID-19 outbreak. France and Spain were in the top ten of coronaviruses paper contributing countries with reduced reporting during 2007-2012 for France and 2003-2006 and 2013-2019 for Spain. The differences of research prioritization per country were discussed. The major effectors of prioritization were the emergence of disease cases in a certain country, and the existing international collaboration networks between investigators from different countries of the same specialty.

Here we are focused in four countries France, Greece, Norway, and Spain as case studies of scientific community response by combining the bibliometric information and empirical experience to consider priorities, collaborations and research impact.

III. Methodology

In the framework of Health Information and Libraries course for Erasmus+ students (course code: ALIS-ER-11) of the Department of Archival, Library & Information Studies, University of West Attica, Athens, Greece, librarians and information science trainees become familiar with clinical and biomedical information, the research publishing environment, the health information databases and resources, as well as bibliometric analysis. After the introductory description on the methodologies of bibliographic databases interrogation for specific topic of interest during a chronological setting, data extraction,

collection, analysis, and interpretation, the students were assigned to perform case studies on the biomedical research response of their country of origin to the COVID-19 pandemic challenge during 2020-2022. Each case study report for France, Greece, Norway, or Spain should be designed according to the following lines.

A. Research Questions

The aim of this study is to address specific questions concerning the COVID-19 pandemic biomedical research response in different countries:

- RQ1: What were the scientific fields of research involved?
- RQ2: What were the most popular subjects of research?
- RQ3: What was the impact of these contributions?
- RQ4: What was the degree of participation in international collaborations of your country's investigators in COVID-19 reports?
- RQ5: Were there any contributions regarding public information by experts versus misinformation?
- RQ6: Can you access and deliver the altmetric impact of major scientific contributions by your country in terms of news outlets, blogs, tweets, Facebook and reddit mentions?
- RQ7: What are your conclusions on the biomedical research interests shift of your country's investigators towards COVID-19 related topics?

B. Search Strategy Design

The keywords of interest were: "COVID-19" or "SARS-CoV-2" in Title, Abstract or Keywords, with or without country affiliation, and when used "France", "Greece", "Norway", "Spain", or combinations, chronological span 2020-2022, 3-year period. Additional keywords for further investigations of other topics were used, in specific: "misinformation" or "fake news" or "conspiracy", "international", "SARS" or "SARS-CoV-1", "vaccine" or "vaccination", "influenza", "cancer", and "cardiovascular". For comparative reasons with the research trends before the COVID-19 pandemic, these bibliographic searches were also performed within the chronological span of 2017-2019, 3-year period. The bibliographic searches were performed on the following databases according to each platform Boolean operators, field codes, and use of auxiliary filters such as publication date range, subject area, document type, keyword, affiliation, or language:

- PubMed (https://pubmed.ncbi.nlm.nih.gov/),
- Scopus (https://www.scopus.com/),
- Web of Science (https://www.webofscience.com/),
- Dimensions (https://app.dimensions.ai/) and
- iCite (https://icite.od.nih.gov/).

All search results were extracted and downloaded as comma-separated values format files. The last time the databases were accessed was November 21, 2023. All searches described were repeated by the tutor.

C. Data Analysis

The data collected were combined and delivered in worksheets for further analysis. All reports were accompanied by a brief text addressing the proposed research questions and discussing the findings by combining bibliometrics with the empirical observations by the authors. All data were recollected and crosschecked versus the students' reports by the tutor.

IV. RESULTS

A total of 11,829,890 scholarly reports were published between 2020 and 2022 worldwide suggesting an increase in global research productivity of 17% when compared with 2017-2019. The publications affiliated to France, Greece, Norway, or Spain were altogether 928,691, approximately 8% of the total reports, 392,259 (3% of global) out of them affiliated to France, followed by 368,369 (3% of global) to Spain, 89334 (0.8% of global) to Norway and 78,729 (0.7% of global) to Greece **[Fig. 1]**. When compared to the 3-year period before the COVID-19 pandemic Greece exhibited a 22% increase in scientific productivity followed by Spain with 20%, Norway with 15% and France with 2%.

Cancer research dominates the research efforts with 12,725 reports or 16% of the total productivity for Greece, 56,978 reports or 14.5% of the total for France, 51,101 reports or 14% of the total for Spain, and 10,912 reports or 12.2% of the total for Norway in 2020-2022 according to Scopus **[Fig. 2]**. Cardiovascular research, another leading cause of morbidity and mortality because of a non-communicative disease in Europe, is accounted for 11.5% of reports for Greece, 8% for Spain, 7.5% for Norway, and 6.6% for France in 2020-2022 Scopus data **[Fig. 3]**.

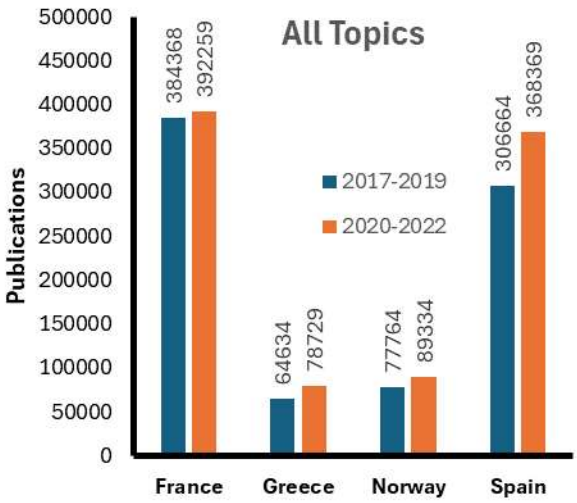

Fig. 1. All topics publications released between 2017-2019 and 2020-2022 affiliated to the countries examined according to Scopus.

COVID-19 pandemic changed the perspective of scientific efforts by bringing communicable diseases into the spotlight of research. This is evident in coronavirus research field when the data of SARS related publications of 2017-2019 compared to the COVID-19 papers, almost all of which include SARS as a keyword, of 2020-2022 **[Fig. 4]**. It is also

evident in influenza research field with an almost doubling of the related reports that exceeds 10-fold the trend of increase of global paper productivity **[Fig. 5]**.

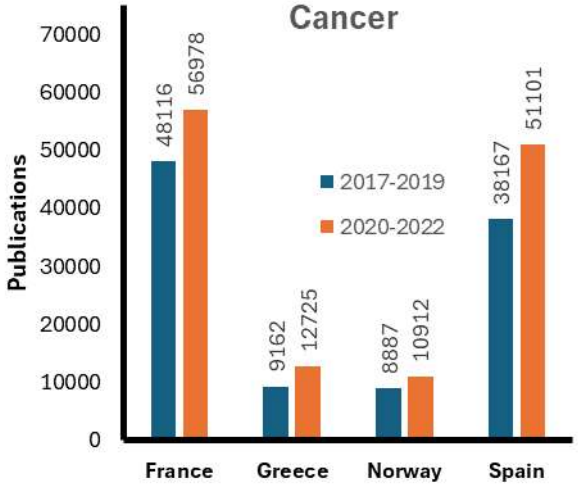

Fig. 2. Cancer research in the four European countries examined released between 2017-2019 and 2020-2022.

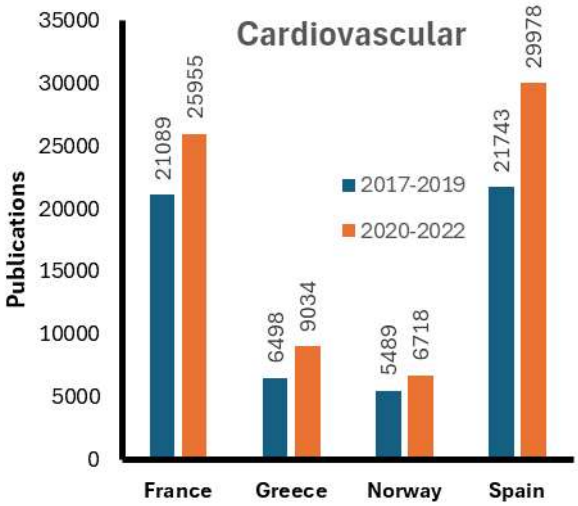

Fig. 3. Cardiovascular research in the four European countries examined released between 2017-2019 and 2020-2022.

The case reports of France, Greece, Norway, and Spain scientific community response against COVID-19 are presented in the following sections.

A. France

France responded to the significant challenges of COVID-19 pandemic by coordinating decisive actions such as increasing the capacity of its healthcare system together with intensify scientific research. The French government responded to the crisis with various policies aimed at controlling the spread of the virus and improving the nation's ability to cope with the pandemic. These included implementing strict lockdown measures, increasing testing capabilities, and launching extensive scientific research initiatives **[24]**. To coordinate the scientific research response, France assigned this task to the REACTing consortium, headed by the French National Institute for Health and Medical Research (INSERM), a preexisting body set up after the 2009 influenza A H1N1 pandemic which had already deal with Zika virus and Ebola virus diseases **[25, 26]**. The consortium has set up French researchers' task forces to collect information on the progress of various fields related to the COVID-19 pandemic such as vaccines, new therapeutic approaches, animal models, epidemiologic modelling, and digital monitoring of active cases through hundred million of diagnostic screenings **[26]**. Another notable project was the French-Covid national cohort, which collected comprehensive data on COVID-19 patients across France **[26]**.

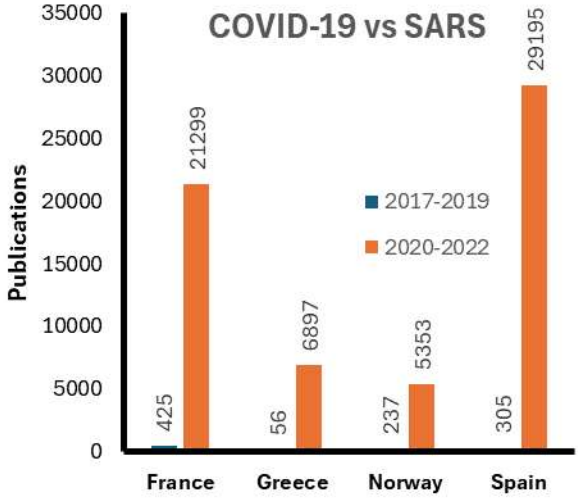

Fig. 4. COVID-19 research output in 2020-2022 versus SARS published between 2017-2019 in the four European countries.

According to Scopus the total COVID-19 research output of scientific reports affiliated to France and published between 2020 and 2022, was 21,299. The scientific fields involved in French researchers' publications were mostly Medicine (58%), Biochemistry, Genetics, and Molecular Biology (13.3%), Immunology and Microbiology (9.6%), Social Sciences (9%), Computer Science (7.1%), Environmental Science (5.7%), Engineering (5.5%), and Business, Management and Accounting (5.5%), according to Scopus. If we take a closer look and add vaccines to research the field of Immunology and Microbiology reports appeared increased when compared to other fields to 25.5%.

The most popular subjects of research for France involved Major Clinical (34%), cases and management reports, Epidemiology (31,7%), Aging (31,1%), as middle-aged and older adults exhibited an increased risk of life-threatening dangerous symptoms, and Severe Acute Respiratory Coronavirus 2 (29,7%). In the results of the research subjects, keywords such as Human (92.9% of research) or COVID-19 (87.8%) prevailed. When "vaccine" was added to the searching query the results were mostly emphasizing on Immunology, Epidemiology, and Prevention and Control research areas. The differences point to the precision of the subjects linked to the vaccine. The need for precision in research on the various subjects related to the vaccine was strong during this pandemic period.

The impact of the French contributions exceeding half a million citations during 2020-2022. The most cited papers,

all at the top 99th percentile of citations in Scopus database with more than 2,000 citations in total, were from basic research on the structure, function, and antigenicity of the SARS-CoV-2 spike glycoprotein with 5,797 citations and an erratum update evidence of the competition stressor of the period **[27]**, from clinical research on the use of hydrochloroquine and azithromycin for the treatment of COVID-19 with 3712 citations **[28]**, from structural biology and pharmacology on an interaction map revealing potential repurposing drugs for COVID-19 with 2,845 citations **[29]**, from clinical research on COVID-19 and thrombotic or thromboembolic disease and the use of antithrombotic drugs for its prevention with 2,164 citations **[30]**, and from clinical research on compassionate use of remdesivir for patients with severe Covid-19 with 2,005 citations **[31]**.

On iCite, the total number of reports of this period and affiliation country is 12,511 receiving 358,378 citations. iCite offers a triangulation of translational research with vertices molecular and cell biology, animal, and human related research. The translational research index indicates a transition of research interest from basic research, molecular and cell biology reports in 2020 to human, mostly clinical reports in 2022 **[Fig. 6]**.

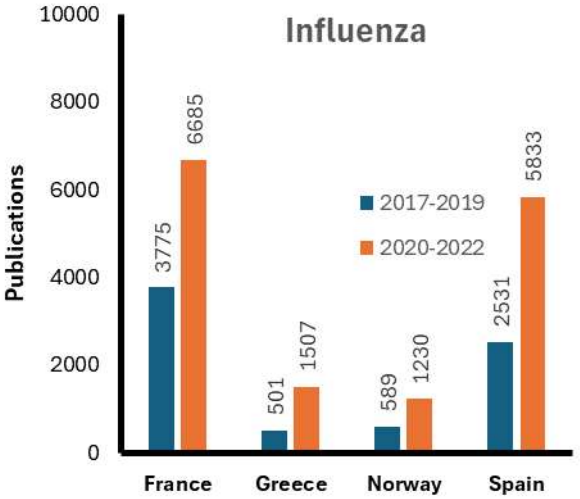

Fig. 5. Influenza scientific productivity in the four European countries before and after COVID-19 pandemic.

Regarding the participation in international collaboration projects of COVID-19 research it appears that France affiliation is associated with European as well as with non-European countries as depicted with VOSviewer **[Fig. 7]**. If "international" is considered as a prerequisite for the global perspective of a report, then it appears that one out of five COVID-19 papers with affiliation to France were performed from international collaborative networks according to Scopus.

A total of 229 reports (1% of the total reports) affiliated to France were about misinformation including subjects such as information overload, confusion, discontinuance intention during the pandemic lockdown, or vaccine hesitation. These reports collectively received 4450 citations. Public trust in scientific announcements and authorities' decisions in many countries. Despite the discussions in social media and news agencies in scientific literature the vast majority of publishing articles was about new biological or clinical information on COVID-19 rather than battling against scientific refuting and misunderstanding theories.

The Dimensions platform was used to assess the altmetric impact of the scientific contributions affiliated to France. The tweets now called the X platform, Facebook, blog or vlog mentions reflect the public response to research and therefore may significantly differ from citations which show the response of the scientific community. Top altmetrics have been recorded by retracted works that gain a big share of the public interest, household transmission of SARS-CoV-2, increase risk of mortality for the elders or reports that criticized the mandatory nonpharmaceutical interventions by the authorities such as the stay-at-home and business closure measures expressing concerns by experts. The public interest for COVID-19 papers was very high but not always in agreement with the citations received by them. It is also evident that certain scientific publications became the center of discussion in social media where they were used as proof of one or the other theory.

Certain subjects of biomedical research gain significant increase of interest during 2020 to 2022. These subjects include viral pneumonia, coronavirus infection, betacoronavirus, middle aged, aged, mortality, intensive care unit, hospitalization, hydroxychloroquine, very elderly, comorbidity, psychology, artificial ventilation, quarantine, or depression as depicted in co-occurrence network **[Fig. 8]** and in overlayed by the publication year representation **[Fig. 9]**.

France encountered difficulties in finding the optimal balance between protecting public health and minimizing economic and social harm. The country experienced criticism regarding its handling of the pandemic, especially during the first wave, where a full lockdown was imposed **[32, 33]**. Nonetheless, France's scientific contributions to the global effort against COVID-19 have been substantial, ranking second among countries in terms of the number of highly cited papers related to SARS-CoV-2 and COVID-19 **[26]**. Overall, France's response to the COVID-19 pandemic highlighted both successes and failures, providing valuable lessons for future pandemics. Strengthening health system capacities and improving collaboration between central and local governments remain critical steps towards achieving a balanced approach to addressing future crises **[34]**.

B. Greece

Greece responded quickly and flexibly to the COVID-19 pandemic, declaring a state of emergency on March 3rd, 2020, shortly after the first confirmed case on February 26th, 2020 **[35]**. The government imposed strict measures aimed at containing the epidemic and avoiding the collapse of the healthcare system. The administration of the public health crisis was assigned to Civil Protection Ministry and the coordination between the healthcare system, the Greek Universities and Research Institutions was assigned to the Greek National Organization of Public Health a nearly one-

year old establishment that replaced the Greek Control and Prevention Center of Diseases. Jointly daily briefings by these two organizations and academic experts served the needs of public updating on the pandemic local cases, measures, and overall situation. These actions resulted in a relatively low mortality rate compared to other countries during the first COVID-19 wave, with a mean age of deceased individuals being 75 years old and a death toll representing approximately 0.8% of annual deaths in 2019 **[36]**. However, these successes did not resolve existing challenges such as the country's weakened healthcare infrastructure and ongoing socioeconomic difficulties stemming from previous financial crises **[37]**. Despite the effective implementation of control measures, the Greek public health system experienced significant strains, revealing pre-existing weaknesses and limitations. Stakeholders perceived that the system lacked sufficient resources and failed to address long-term challenges adequately. Economic support measures received mixed reviews, balancing the need to encourage compliance with the lockdown rules without jeopardizing future sustainability. Researchers and scientists played a vital role in supporting the public health effort, providing valuable insights into demographic, social, and geographical factors influencing the pandemic's impact on society **[38]**.

The Greek scientific community was responded by producing a total of 6,897 papers which represent 9% of the total scientific publications' productivity of Greece during 2020-2022. This is a remarkable increase when we consider that only 56 papers of SARS-CoV-1 were published with Greek affiliation during the three-years before the pandemic, 2017-2019 **[Fig. 4]** and strongly suggests that many Greek researchers changed their scientific interests by focusing to coronaviruses whilst there was an excess reallocation of the few funding resources because of the Greek financial crisis and austerity of 2008-2017 **[39]**.

The scientific fields involved in Greek affiliated research were Medicine (51.5%), Social Sciences (14%), Computer Science (14%), Biochemistry, genetics and Molecular Biology (13.4%), Engineering (9%), Environmental Science (9%), Immunology and Microbiology (7.4%), Business, Management and Accounting (5%), and Pharmacology, Toxicology and Pharmaceutics (5%), according to Scopus.

The most popular subjects of research in Greece beside the common keywords Human (54%), COVID-19 (41%), Pandemic (22.5%) or SARS-CoV-2 (22%), were controlled study (11%) and Major Clinical Study (10%), mostly refer to clinical reports, Aged (9.4%), Middle Aged (8.4%), Disease Severity (7.4%), Risk Factor (6.9%), Mortality (6.4%), Vaccination (6.3%), Hospitalization (5.9%), and Viral Pneumonia (5%). The keyword co-occurrences in the top cited scientific contributions of the period are depicted with VOSviewer **[Fig. 8]** as well as overlayed by the year of publication **[Fig. 9]**.

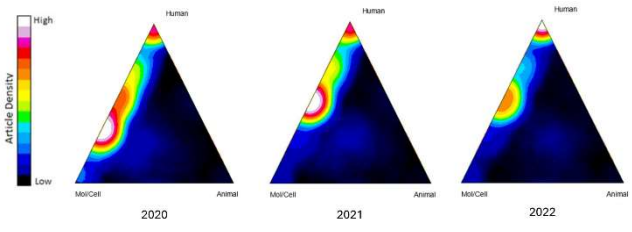

Fig. 6. Translation research on COVID-19 between 2020 and 2022. A transition from molecular and cell biology reports to human, mostly clinical reports, is evident.

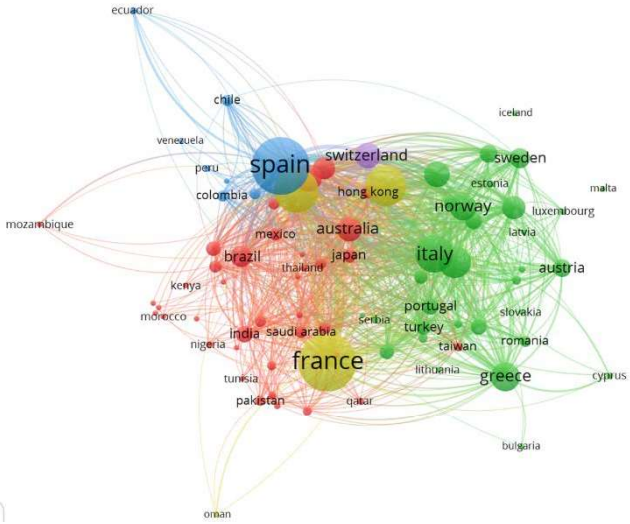

Fig. 7. VOSviewer network of collaborating countries in COVID-19 research based on the top 2,500 mostly cited international reports.

All papers related to COVID-19 affiliated to Greece and published between 2020 and 2022 received a total of 156,044 citations, 22,6 citations/paper on average. Almost one thousand contributions out of them (14.5%) didn't receive any citations by the time of contacting this report. The most cited contribution was the ACTT-1 Study on Remdesivir for the treatment of COVID-19, the prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic, COVID-19 and Thrombotic or Thromboembolic Disease, hypertension and diabetes mellitus as risk factors for COVID-19 infection, and autoantibodies against interferon as a risk factor of life-threatening COVID-19.

There is a significant degree of international collaborations in Greek affiliated reports with co-affiliations to United Kingdom (19%), United States (16.8%), Italy (16.2%), Germany (12.9%), Spain (10.7%), France (9.3%), Netherlands (9%), Switzerland (7.6%), Belgium (6.5%), Canada (5.7%), Cyprus (5.7%), Poland (5.6%), Portugal (5.5%), Turkey (5.5%), Sweden (5.4%), Austria (5.3%), and Australia (5.2%). The country collaborations network of the top cited reports is depicted with VOSviewer **[Fig. 7]**.

There were 88 contributions (1.3%) out of the total affiliated to Greece on fake news, conspiracy, or misinformation, according to Scopus, receiving a total of 1,426 citations, 16.2 citations/publication on average. These papers were about disinformation, substance use disorders, information seeking behavior of the general public, politics and COVID-19 health-protective behaviors, tweets,

nowadays platform X, and medical and health-related misinformation on social media.

Altmetrics found to be increased in retracted reports with few citations retrieved with subjects like immune suppression because of COVID-19 mRNA vaccinations, criticism on the necessity of lockdowns, pharmaceutical administration against COVID-19, estimating mortality due to COVID-19, correlation between mask compliance and COVID-19 infections, and retracted reports of the stay-at-home policy fallacy or whether children vaccination against COVID-19 is necessary. The altmentric behavior clearly demonstrates the differences of the public perception of research papers versus the scientific community. Also, it is evident that the public is attracted by strong titles and controversial data interpretations.

Overall, Greece's response demonstrated flexibility and adaptation to the changing nature of the pandemic, although it exposed deeper flaws in the nation's public health system **[37]**.

C. Norway

Norway's scientific response to the COVID-19 pandemic involved a combination of effective public health strategies, high levels of trust in authorities, and a focus on balancing various aspects of the crisis. Key features of the Norwegian response included: (a) High Trust, according to a survey, 53% of respondents considered COVID-19 a large to very large threat to the population, and trust in the health care system and self-reported compliance with preventive measures was high **[40]**; (b) Strict Measures, on March 12, 2020, Norway imposed stricter measures, closing schools, kindergartens, and nonessential businesses, and instituting quarantine for travelers entering the country **[40]**; (c) Collaborative Decision Making, the Norwegian government employed a consensus-based approach, involving collaboration between political parties, which contributed to the success of the response **[41]**; (d) Communication, effective communication with the public played a role in building trust and ensuring compliance with guidelines **[42, 43]**; (e) Preparedness, factors contributing to Norway's ability to handle the crisis effectively included a highly educated populace, a robust welfare system, and a low population density **[41, 43]**.

Additionally, studies have shown that migrants in Norway faced systemic barriers to healthcare due to language, low socio-economic status, and sociocultural factors, but overall, the Norwegian response was appreciated by migrants for its effectiveness and transparency **[41]**.

The Norwegian scientific community responded to the challenge by contributing 5,353 reports according to Scopus which represent a 6% of the total scientific productivity of this country. It should be noticed that SARS-CoV-1 contributions from Norway between 2017-2019 were four-times more than Greece, suggesting that Norwegian virologists were interesting in coronaviruses research even prior to COVID-19 pandemic.

The scientific field involved in COVID-19 research in Norway were Medicine (45.3%), Social Sciences (21.7%), Computer Science (12.2%), Environmental Science (10.7%), Business Management and Accounting (9%), Engineering (9%), Biochemistry, Genetics and Molecular Biology (7.8%), Psychology (6.4%), and Immunology and Microbiology (5.5%).

The most popular subjects of scientific research on COVID-19 affiliated to Norway were Human (48.7%), SARS-CoV-2 (15%), Controlled Study (12%), Major Clinical Study (9.7%), Epidemiology (8.3%), Aged (8%), Middle Aged (6.4%), Questionnaire (5%), Risk Factor (5%), and Public Health (5%).

Collectively Norway publications received a total of 143,553 citations, 26.8 citations/paper on average. The most cited contributions were guidelines, global burden of disease and risk factors outline, pandemics, tourism and global change, autoantibodies against interferon in patients with life-threatening COVID-19, repurposed antiviral drugs for COVID-19, mental health consequences because of the physical distancing, genome wide association of sever COVID-19 with respiratory failure and the effects of COVID-19 pandemic on business and research.

International collaborations in Norway affiliated reports have co-affiliations to United Kingdom (24%), United States (21.4%), Sweden (14.5%), Germany (14%), Italy (13%), Netherlands (11%), Spain (10.1%), France (10%), Australia (9.8%), Denmark (9%), Switzerland (8.5%), Canada (8.3%), China (7.4%), Belgium (7.2%), India (6.8%), Finland (6.4%), Austria (6.2%), Poland (5.8%), and South Africa (5.3%). The country collaborations network of the top cited reports is depicted with VOSviewer **[Fig. 7]**.

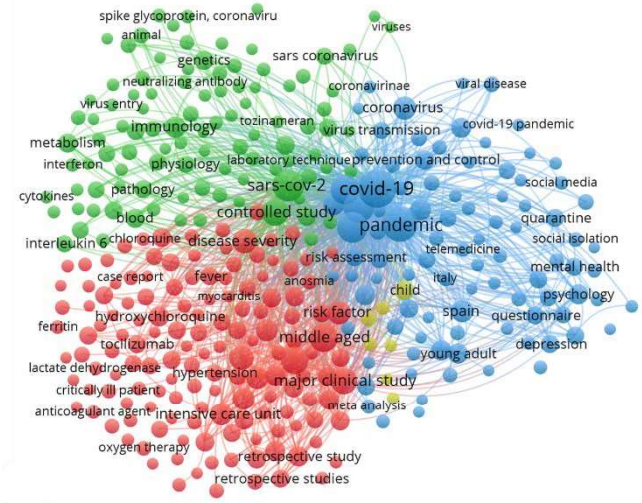

Fig. 8. Top keyword co-occurrences in scientific papers network by VOSviewer

A total of 106 reports (2% of the total) affiliated to Norway concern public information and misinformation issues, collectively receiving 3092 citations, 29 citations/paper on average. The issues described were the unusual consumers' purchasing behavior during the early stages of the pandemic, misinformation on Twitter, now X platform, and food delivery and consumption.

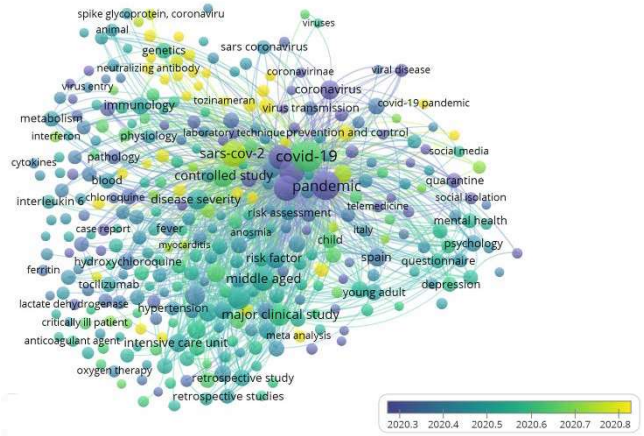

Fig. 9. Top keyword co-occurrences overlayed by publication year of the scientific paper. Newer contributions with yellow, older with blue. The scientific network was generated by VOSviewer.

The publications with the most altmetric receiving interests were on SARS-CoV-2 delta infection risk of vaccinated and unvaccinated people, the fatality rate by COVID-19 in the non-elderly population, vaccine boosters for young adults and benefit assessment for universities, systematic analysis of COVID-19-related mortality, and vaccination-associated myocarditis in children. For the Norwegian affiliated reports, it is evident that highly cited and high altmetrics reports matched well.

During the COVID-19 pandemic, Norway has been involved in various scientific research projects to understand the impact of the pandemic on the population and to develop strategies for managing the crisis.

D. Spain

Spain's scientific response to the COVID-19 pandemic encompassed various facets, including research, governance, and public health initiatives. Initially, the Spanish government's approach was characterized by complacency, focusing on controlling the importation of the virus from foreign travelers instead of addressing domestic transmission. However, when the first locally acquired infection occurred, the government began implementing measures like contact tracing, quarantine, and limiting social interactions. Despite these actions, Spain experienced a significant increase in cases and fatalities, leading to criticism of the government's handling of the crisis **[44, 45]**. In terms of research, Spanish scientists contributed significantly to the understanding of the virus and the development of countermeasures. However, doubts about the reliability of COVID-19 research emerged, with concerns about questionable research practices and the overall quality of work **[46]**. To address this, the Ministry of Science and Innovation established a multidisciplinary working group on COVID-19 **[47]**. Public health experts noted challenges in managing resources, particularly in primary care centers, where many infected individuals sought treatment. Professionals and citizens alike expressed concerns about the inconsistent application of control measures and the lack of transparent communication from authorities **[45]**. Overall, the Spanish experience highlights the importance of effective governance, robust scientific research, and open communication between authorities and the public in responding to pandemics **[48]**.

A total of 29,195 COVID-19 papers published between 2020-2022 were found to be affiliated to Spain. The scientific fields involved in these contributions were Medicine (49%), Social Sciences (21%), Computer Science (11.5%), Environmental Science (11%), Biochemistry, Genetics and Molecular Biology (9.6%), Engineering (7.7%), Immunology and Microbiology (5.7%), and Psychology (5%).

The most popular research subjects among COVID-19 contributions from Spain were Human (40.6%), SARS-CoV-2 (21.5%), Pandemic (21.5%), Controlled Study (13.5%), Major Clinical Study (12.3%), Aged (11.5%), Middle Aged (9.5%), Epidemiology (7.5%), Viral Pneumonia (6.1%), Risk Factor (5.8%), Mortality (5.6%), Complication (5.5%), Disease Severity (5.5%), Cohort Analysis (5.3%), and Hospitalization (5.3%).

Collectively the impact of all COVID-19 contributions from Spain exceeds the 525,000 citations, more than 18 citations per paper on average. Among the most cited works are clinical guidelines, reviews on COVID-19, reports on possible drugs against this disease, symptoms and complications of COVID-19, the administration of systemic corticosteroids and mortality of critical ill patients, inhibition of infections by using soluble ACE2 in vitro, surviving septic shock, and the impact of COVID-19 in cancer patients and in perioperative cases.

The international collaboration networks of Spanish scientists involved colleagues from Unites States (12.4%), United Kingdom (11.8%), Italy (11%), Germany (7.3%), France (6.9%), and the Netherlands (5.1%). These data suggest that most of the Spanish contributions were performed at the national level.

A total of 642 (2.2% of the total) Spanish contributions on COVID-19 receiving 9792 citations, 15 citations per paper on average, were concerned on public information and misinformation issues. Norway and Spain appeared to have the highest percentage of such contributions when compared to France and Greece, indicating a significant importance of this issue for these countries. Some of the subjects of these contributions, the most cited ones, include the 5G conspiracy theory with COVID-19 in the social media, the impact of the pandemic on the media system and its political consequences, the infodemic as the mass social media distribution of scientific reports, and the disinformation and hoaxes on COVID-19.

The altmetric data suggest a similar to France and Greece effect with an important imbalance between citations and altmetric score. Representative examples are revelations of poor practices of Pfizer's pivotal COVID-19 vaccine trial, drug treatments for COVID-19, questioning the reality of COVID-19 pandemic, adverse effects of COVID-19 vaccination during the randomized trials, questioning the lockdown policy, as well as theories on COVID-19 origins. Some, now retracted, publications that received very few citations, received significant altmetric scores, thus adding to the

confusion of the people regarding the disease, the prophylactic measures, the clinical interventions, the vaccinations, or medications.

Spanish scientific research during the COVID-19 pandemic has been focused on various aspects, including the sharing of research data, assessing the impact of the pandemic on the population, and exploring the credibility of science among Spanish scientists.

V. Discussion

The Lancet Commission on lessons for the future from the COVID-19 pandemic reported that the profound death toll was the outcome of a massive global failure at multiple levels: (a) fail of many governments to adhere to basic norms of institutional rationality and transparency, (b) misinformation influenced too many people against public health precautions, and (c) fail of the world's major powers to collaborate to control the pandemic, including inadequate sharing of funds and medical supplies to low- and middle-income countries **[49]**. However, research was a major contributor in shedding light on this disease nature by identifying the pathogen, describing the infection route, monitoring cases, predicting the epidemiological curves, introducing prophylactic measures, investigating the clinical manifestations of patients, and identifying populations at risk, developing vaccines, testing drugs, and introducing adequate therapeutic approaches **[50]**. Global research networks as well as national and institutional contributors add significantly to the overall effort.

Europe after Wuhan China became the epicenter of the pandemic by March 2020 **[51]**. European countries such as France, Greece, Norway, and Spain declared an emergency and rapidly responding by taking measures to reduce the territorial impact of the pandemic in various dimensions mostly like health, economics, social aspects, and fiscal implications **[52]**. Healthcare systems were reinforced to enhance containment and mitigation, national lockdowns were implemented in response to major outbreaks, and digital infrastructure was utilized to effectively manage the crisis. Research communities were recruited in this effort and produced a multifaceted product encompassing all aspects of the pandemic. Leveraging these experiences and insights will be crucial in future preparedness for such health challenges.

In this bibliometric study we assessed the scientific community response and the contributions output in these four European countries. France, Greece, Norway, and Spain collectively contribute 62,744 papers (8.6% of global) on COVID-19 within three years, 2020-2022, out of the total 725,866 papers produced worldwide. The findings of these contributions were significant in understanding and fighting COVID-19 pandemic. The most prevalent scientific fields involved were medicine, social sciences, computer science, biochemistry, genetics and molecular biology, environmental science, engineering, immunology and microbiology, psychology, and business, management and accounting in all four countries. Most efforts were aimed in fast translational research from bench to bedside. It is evident, according to iCite, that during the three years period after the declaration of the pandemic the research subjects rapidly move from basic research to the clinical arena.

Public trust in science and governments was an important issue in handling the pandemic. Countries that cultivated a high degree of trust in their societies achieved better results in fighting the pandemic versus countries where mistrust and misinformation were dominant effectors. Proper education and information of the public was critical in understanding scientific data as it can be postulated by the altmetric versus bibliometric data. Huge imbalances may appear if the public perceives scientific or pseudoscientific data equally, and these may generate falsified information, hypothesis or theories that could be easily distributed through social media.

VI. Conclusions

The response to the COVID-19 pandemic clearly demonstrated the importance of international cooperation, data sharing, investment in public health infrastructure, the strong association between health and the economy, the need of co-ordination, infrastructure and personnel reallocation, efficient dissemination of scientific information to the public, building of public trust, and partnerships. It is also essential to prioritize early-stage research with emphasis on basic science and facilitate the transition to applied translational technologies to the clinical arena. Digital platform technologies are necessary for monitoring and public support. State preparedness should be built upon specialized organizations responsible for health crisis control. The availability of emergency research funds is of vital importance to rapidly establish new methodologies, diagnostic tests, disease, and epidemiological models. An important lesson of the SARC-CoV-2 viral pandemic is that a reduced threat alert by no means is not equal to zero risk. Preparedness for future unexpected emergencies strongly suggests the continuous research, monitoring, and updating of a communicable or non-communicable health compromising agent.

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Lemmatization and sentiment analysis of Greek political tweets during the pre-election period of 2023

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Abstract:

Purpose – *The present work discusses findings of research on Twitter (now X) data of the two politicians running for Prime Minister, as well as their press secretaries, during the pre-election period of May 2023 in Greece.*

Design/methodology/approach – *We collected the tweets (posts on Twitter/X) posted by the two main candidates running for Prime Minister in Greece, as well as their press secretaries, during the pre-election period of May 2023. The four sets of tweets were lemmatized, and sentiment analysis was performed using SentiStrength for Greek, a sentiment dictionary developed for Greek political short text/ tweets.*

Findings – *Results revealed the importance of positive sentiment when posting on Twitter; they also revealed the different approaches of mentioning people vs. locations of the two politicians who were running for Prime Minister.*

Originality/value – *Writing positive tweets during a pre-election period can lead to victory in Greece. Focusing excessively on the opponent and other political figures is not a way to win voters in Greece in 2023. Instead, making references to geographic locations in Greece is preferred. Furthermore, SentiStrength for Greek is used for the first time.*

Index Terms — political tweets, lemmatization, Greek language, data visualization, sentiment analysis.

I. INTRODUCTION

On 21st May 2023, national elections were held in Greece. Although the pre-election period had started much sooner unofficially, the official date was 22nd April 2023. On this date, the Prime Minister of Greece, Kyriakos Mitsotakis, visited the President of the Republic and requested the proclamation of elections **[1]**. The two political figures that we focused on are Kyriakos Mitsotakis and Alexis Tsipras. Both of them were running for Prime Minister and were the main leading candidates. During the pre-election period, Kyriakos Mitsotakis was running as the then Prime Minister of Greece (2019-2023) **[2]** and as the President of the Nea Demokratia Party. Alexis Tsipras was running as the President of the SYRIZA Progressive Alliance Party, as the former leader of the main opposition during 2019-2023 and as a former Prime Minister (2015-2019) **[3]**. Nea Demokratia won the elections in May, collecting 40.79% of the total votes, while SYRIZA came second with 20.07% of the total votes **[4]**. Besides the two main primary opponents, our research examined two more political figures and their tweets; those of the press secretaries of each party. Popi Tsapanidou was the press secretary of SYRIZA, and Akis Skertsos was the press secretary of Nea Demokratia at the time **[5]**. The addition was thought in case the press secretaries were using different (i.e. harsher) language than their party leaders. The four Twitter usernames/ accounts that we focused on were @askertsos, @atsipras, @kmitsotakis and @tsapanidou. The period of examination was from 22nd April 2023 until 21st May 2023 19:00 when voting stopped. With the help of lemmatization, a process that converts each word into its dictionary-based form, otherwise known as lemma **[6]**, we aimed to compare and research the language used by Kyriakos Mitsotakis and Alexis Tsipras in order to understand the preferences of the voters given the outcome of the 21st May 2023 elections. Our research aimed to extract information from these political texts from the scope of view of information science, not to conduct political analysis.

II. METHODOLOGY

A. Twitter posts and their pre-processing

To compose our corpus of tweets we used our Academic Researcher status **[7]** and collected tweets via Twitter API v2. During the specific timeframe that we set (22/4-21/5) Kyriakos Mitsotakis posted 139 tweets, Alexis Tsipras posted 185 tweets, Popi Tsapanidou posted 6 tweets and Akis Skertsos posted 6 tweets.

Before proceeding with lemmatization, we excluded two tweets from the corpus. One from Alexis Tsipras because the tweet consisted only of a URL, and the other was from Kyriakos Mitsotakis because the tweet had been written in English and therefore did not serve our purpose of Greek

language lemmatization. As for the tweets of the two press secretaries, they were so few that no conclusions could be drawn. However, we will include them in our data findings below to satisfy one's curiosity.

The table below (Table 1) shows the final number of tweets included in the corpus.

Table 1 Number of tweets examined

Politician	No of tweets
Akis Skertsos	6
Alexis Tsipras	184
Kyriakos Mitsotakis	138
Popi Tsapanidou	6

B. Lemmatization

After pre-processing the four sets of tweets, we used a lemmatization service provided by *clarin:el*, the central inventory of language resources and services in Greece. The service is called *ILSP Lemmatizer* and is a language-processing tool for Modern Greek texts **[8]**. One has to create an account first and then run the service by uploading zip files that contain text/plain files. The output is two files, one in .csv and one in .xmi format. *ILSP Lemmatizer* works by segmenting text into paragraphs, sentences and tokens; it then annotates tokens using a Part of Speech (POS) tagger (e.g. *Ad* for adverbs, *PtNg* for negative particles) **[9]**. Past research on lemmatized Twitter data has focused on user tweets during the World Cup Soccer tournament **[10]**.

In order to process the lemmatized data we used Excel spreadsheets and counted the weight/frequency of each lemma in each set of tweets. What the lemmatizer does is return the lemma of each word, for example the word-forms *running*, *ran* and *run*, all return the lemma *run* (verb form in first person). In the case of pronouns, nouns, adjectives, etc., the token returns lemmas in singular number only (not plural), masculine gender and in nominative case (ονομαστική). For example, the phrase «οι εκλογές» (the elections) consists of two tokens: *οι, εκλογές*. Once lemmatized, οι becomes *ο* and *εκλογές* becomes *εκλογή* (*election*). Lemmatization is a good way of discovering words that often come up in a text or classifying verbs, adverbs, etc., of a text. Before moving on to lemma weights we performed one extra step, excluding stop words. Stop words appear too frequently in texts but carry little importance in information retrieval **[11]** or, in this case, political meaning. Based on previous work **[11]**, we expanded the list of stop words. We eliminated numbers, quotation marks, punctuation marks, URLs and the following lemmas in Greek followed by their English translation: ο (the), στου (in the), και (and), με (with), από (from), σε (to), να (to), είμαι (am), εγώ (I), για (for), πως (how), που (that), ότι (that), μου (my), τι (what), πώς (how), ή (or), αυτός (he), ένας (someone), έχω (have), ως (as), πιο (more), μέσα (in), κ. (mr., mrs.). As described earlier, lemmatization returns lemmas in the first person, so this cannot be identified as self-referencing. Auxiliary verbs like *έχω* were used as stop words since they assist in forming past tenses or passive voice.

The remaining lemmas that each politician used in their tweets are intriguing in many ways. First, they show the focus of each politician in terms of politics, and secondly, they show the different methodologies of each politician. Our findings show that Alexis Tsipras focused greatly on Kyriakos Mitsotakis and what the latter said/ did. Alexis Tsipras referred to many people in his tweets whether they belonged to his party or other parties, whether alive or deceased. On the contrary, Kyriakos Mitsotakis did not refer to other people except for very few. What he did instead was mentioned many places and geographic locations. Alexis Tsipras also referred to cities and places, but although his tweets were bigger, he referred to fewer places. The tables below (Tables 2-5) list the people and places mentioned by the two primary opponents. One note that could be made here is that some surnames were lemmatized as nouns during the lemmatization process and therefore were not included in the list of surnames initially. This happened when the surname was identical to a noun (e.g. Λινού, Κεραμέως); in English, the same thing would happen with surnames like Forest or Baker. The top 10 most popular lemmas in Tsipras' tweets were: δεν (not-116), θα (will-109), Μητσοτάκης (Mitsotakis-80), λέγω (say-72), γιατί (why-39), ΣΥΡΙΖΑ (syriza-38), κάνω (do-36), μπορώ (can-35), θέλω (want-33) and αλλαγή (change-32). The top 10 lemmas in Mitsotakis' tweets were: θα (will-72), Ελλάδα (Greece-54), όλος (whole-45), μισθός (wage-38), υγεία (health-32), μεγάλος (big-32), πολύς (a lot-30), χώρα (country-29), καλός (good-28) and σήμερα (today-27).

Table 2 Names of people mentioned by Alexis Tsipras, their frequency and their capacity

SURNAME	FREQUENCY	POLITICAL PARTY / CAPACITY
Mitsotakis	80	Nea Demokratia
Maximou	9	PM Office
Varoufakis	8	MERA25
Karamanlis	7	Nea Demokratia
Androulakis	5	PASOK
Skertsos	5	Nea Demokratia
Georgiadis	4	Nea Demokratia
Kerameos	2	Nea Demokratia
Linou	2	SYRIZA
Papandreou	2	PASOK
Schäuble	2	German politician
Scholz	2	Chancellor
Vlachou	2	Prosecutor
Chatzidakis	1	Nea Demokratia
Gennimata	1	PASOK
Gerotziafas	1	SYRIZA
Glezos	1	SYRIZA

Iliopoulos	1	SYRIZA
Juan Ramón Rocha	1	Football player
Katrougkalos	1	SYRIZA
Katseli	1	PASOK
Koutsoumpas	1	KKE
Nikiforos Fokas	1	Ship
Nikoltsiou	1	Journalist
Oruç Reis	1	Ship
Patsis	1	Nea Demokratia
Plevris	1	Nea Demokratia
PM	1	Nea Demokratia
Pretenteris	1	Journalist
Rammos	1	Judge/President
Santorinios	1	SYRIZA
Savvopoulos	1	Composer
Staikouras	1	Nea Demokratia
Theodorakis	1	Random
Trump	1	US President
Tsakres	1	SYRIZA
Tzima	1	Journalist
Voridis	1	Nea Demokratia

Table 3 Names of people mentioned by Kyriakos Mitsotakis, their frequency and their capacity

SURNAME	FREQUENCY	POLITICAL PARTY / CAPACITY
Papastergiou	1	Mayor
Arnaoutoglou	1	TV Presenter
Beleris	1	Albanian Politician
Karamanlis	1	Nea Demokratia
Gennimata	1	PASOK

Table 4 Geographic locations mentioned by Kyriakos Mitsotakis and their frequencies

GEOGRAPHIC LOCATION	FREQUENCY
Greece	54
Europe	8
Evros	3
Elefsina	3
Thessaloniki	3
Crete	3
Moria	3
Attica	2
Mytilene	2
Perama	2
Skaramagas	2
Chalkida	2
Athens	1
Aegean (sea)	1
Albania	1
Arta	1
Volos	1
France	1
Zografou	1
Heraklion	1
Thebes	1
Thissio	1
Thrace	1
Kastoria	1
Kypseli	1
Lavrio	1
Lesbos	1
Livadeia	1
Makedonia (region)	1
Nikaia	1
Xanthi	1
Patras	1
Piraeus	1
Rethymno	1
Rhodes	1
Schimatari	1
Chania	1
Himara	1
Hersonissos-Neapoli	1

Table 5 Geographic locations mentioned by Alexis Tsipras and their frequencies

GEOGRAPHIC LOCATION	FREQUENCY
Tempi	14
Greece	11
Europe	6
Athens	3
Thessaloniki	3
Crete	3
Serres	3
Turkey	3
Giannena	2
Igoumenitsa	2
Agrinio	1
America	1
Bulgaria	1
Thissio	1
London	1
Patras	1
Pontos	1

Trikala	1
Ymittos	1
Chalkidiki	1

III. DATA VISUALIZATION

Long tables of data that include words and numbers can be wearing on the eyes. Several tools can help visualize data and make them more presentable and more accessible to comprehend. Such tools are maps. Datawrapper [1] is a website that allows one to create maps with added markers based on their data. We used Datawrapper to illustrate the locations mentioned by Mitsotakis and Tsipras in their tweets (fig.1-2), as well as the frequency of name references by Alexis Tsipras (fig.7). The spread of the locations shows that Mitsotakis focused not only on Athens but on more remote locations as well (e.g. Mytilene, Xanthi). This seems reasonable as national elections were at stake. Mitsotakis used the word Greece 54 times and the word Europe only 8. Tsipras, on the other hand, referred to Greece only 11 times and to Europe 6 times. The lemma Tempi also appeared a lot (14 times) in Tsipras' tweets. It is the location of a terrible train accident in 2023 and put much pressure on the government. Mitsotakis did not refer to Tempi. The frequency of references to Europe and Greece from a left-wing and a right-wing politician should be studied in terms of political meaning, but this is not the purpose of the current research.

Word clouds are tools that visualize words with bigger fonts if they appear more times in a text. We used the services of WordArt.com [2] in order to create the word clouds from the most popular lemmas that appeared in the tweets after the elimination of stop words. Figures 3-6 illustrate the most frequently used lemmas in the tweets of the four politicians. Figure 7 illustrates the significant number of attention that Alexis Tsipras placed on the face of his opponent, Kyriakos Mitsotakis, whom he mentioned either as Prime Minister or by using his surname or by using the word Maximou (the location of the PM's office). Almost 60% of name references that Tsipras made were about Mitsotakis. Very few references were made to members of SYRIZA, his party, as illustrated in yellow in Fig.7. Blue indicates the names of people who are/have been candidates of Nea Demokratia.

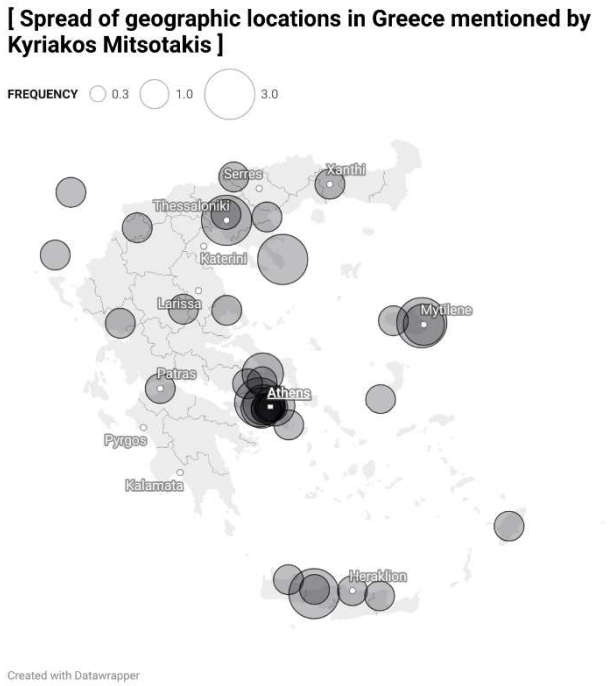

Fig. 1 Spread of geographic locations in Greece mentioned by Kyriakos Mitsotakis

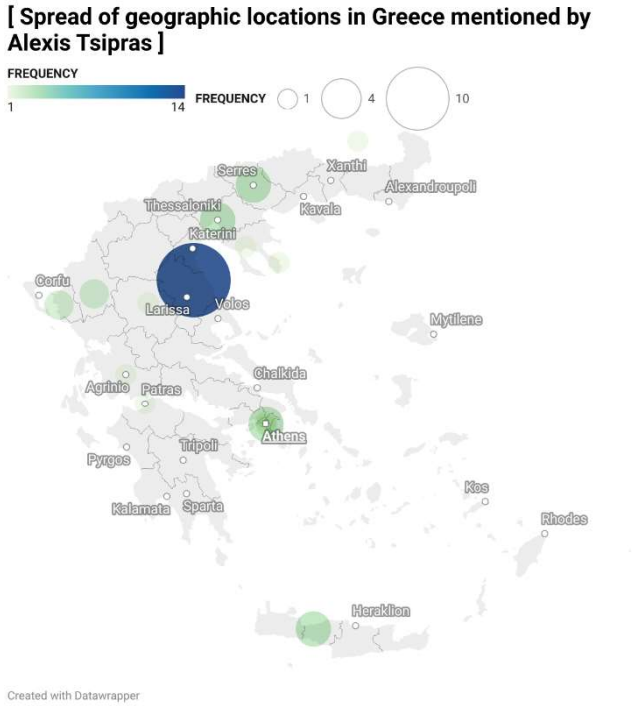

Fig. 2 Spread of geographic locations in Greece mentioned by Alexis Tsipras

1 https://www.datawrapper.de/

2 https://wordart.com/

Fig. 3 Visualization of Mitsotakis' most frequently used lemmas

Fig. 4 Visualization of Tsipras' most frequently used lemmas

Fig. 5 Visualization of Tsapanidou's most frequently used lemmas

Fig. 6 Visualization of Skertsos' most frequently used lemmas

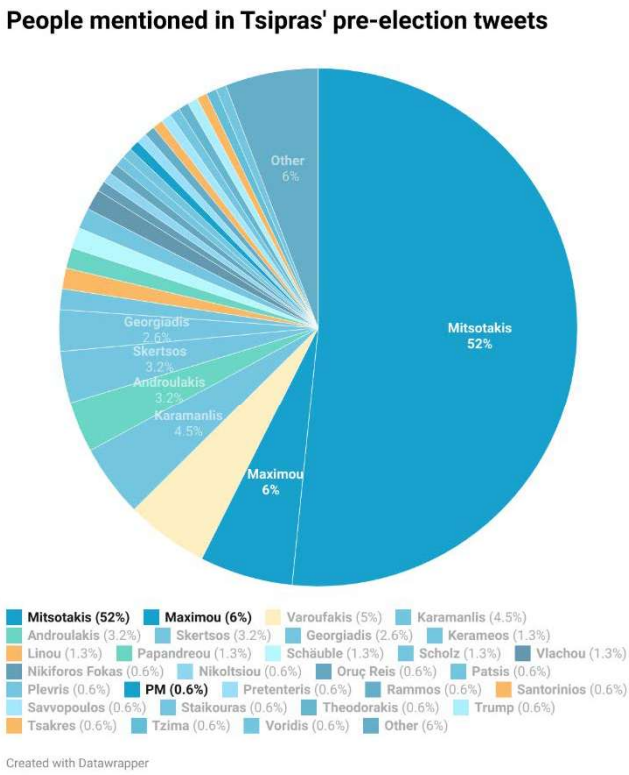

Fig. 7 Visualization of Tsipras' references to other people

IV. SENTIMENT ANALYSIS

At the final stage of our research, we performed sentiment analysis on each of the four sets of tweets. In order to do this, we used the Greek version of SentiStrength[3], an algorithm that relies on dictionaries of subjective words labelled as positive or negative **[12]**. The Greek language files were created/customized by the authors of this research in collaboration with the creator of SentiStrength, Mike Thelwall, and with the help of three human coders. The Greek language files are available to download from Hardmin[4] and use in the Java version of SentiStrength. The Greek version was tested on Greek political tweets from Greece and Cyprus. The current research is the first implementation of the Greek language sentiment dictionaries.

Sentiment analysis for Greek tweets has been performed using a lexicon method where the tweets were evaluated for the following sentiments: anger, disgust, fear, happiness, sadness and surprise **[13]**. Ekman's six basic emotions were also used as a base for the creation of the Greek Affect and Sentiment lexicon **[14]**. In SentiStrength, however, sentiment analysis is performed by estimating both sentiment's positive and negative strength in tweets. SentiStrength has been used to detect sentiment in social media in Spanish **[12]**, German **[15]** and, of course, English **[16]**. In our case, we calculated the average positive and negative strength of each set of tweets during the examination period. Positive strength is measured from 1

3 http://sentistrength.wlv.ac.uk/

4 https://hardmin.heal-link.gr/dataset/73ed006b-571d-41c8-a045-80ac5f875ab8

(not positive) to 5 (extremely positive). Negative strength is measured from -1 (not negative) to -5 (extremely negative). Table 6 shows that Mitsotakis used more positive sentiment than Tsipras and that Tsipras used more negative sentiment than Mitsotakis. The average numbers for Skertsos and Tsapanidou cannot be considered since their tweets were very few.

Table 6 Average positive and negative sentiment of tweets posted between 22/4/2023 and 21/5/2023

Username	Positive Sentiment	Negative Sentiment
@askertsos	1,88	-1,66
@atsipras	1,64	-1,84
@kmitsotakis	2,02	-1,23
@tsapanidou	2,16	-1,83

V. Conclusion

Our research focused on political tweets in the Greek language during a pre-election period in Greece. Twitter, or X now, is used by politicians as a means for campaigning **[17]** or even developing a peace discourse **[18]**. We aimed to extract information from text using natural language processing tools, like lemmatizers, and to perform sentiment analysis on tweets in order to evaluate our Greek version of SentiStrength and to discover if positive or negative sentiment prevailed in the elections. Indeed, lemmatization can help information to surface, not only by uncovering the most frequently used lemmas, which can further be analyzed politically, but also by grouping names of people and places. Lemmatization of Greek political tweets seems to be working sufficiently, perhaps due to the fact that political leaders use correct grammar and syntax. Results could be different if lemmatization was run on user-generated content that involves text normalization for abbreviations, spelling mistakes, etc. **[19]**. *ILSP Lemmatizer* helped us discover that Alexis Tsipras referred to many people from different political parties. His primary focus was his opponent, Kyriakos Mitsotakis, and members of the Nea Demokratia party. It is worth noticing that during the pre-election period Alexis Tsipras did not stress his party's values enough or those of his candidates. Nearly 60% of his references to other people revolved around Kyriakos Mitsotakis. This communication policy did not go well for him, judging from the outcome of the elections. Kyriakos Mitsotakis, on the other hand, hardly mentioned other people. His communication policy included referencing many cities and regions in Greece, which seems reasonable during national elections. Alexis Tsipras referenced Greek cities in his tweets, but on a smaller scale. The conclusion is that personalizing tweets is not a way to win elections –at least in 2023. Approaching voters by referencing their cities is a better communication policy.

One lemmas lemmatization brought to the surface was the negating particle δεν (not). This word was used a lot by Alexis Tsipras and hardly at all by Kyriakos Mitsotakis. Sentiment analysis confirms this negative attitude of Alexis Tsipras since his average score of positive sentiment was smaller than Mitsotakis'. In contrast, his average score of negative sentiment was bigger than Mitsotakis'. SentiStrength's algorithm addresses negating words in a file called NegatingWordList.txt. This file exists both in the English and Greek language version. Words in the file reverse the polarity (+, -) of subsequent words, therefore the phrase "not happy" would be classified as negative. Lemmatization also revealed that both politicians used the future particle θα (will), which makes sense in a time of seeking votes. Sentiment analysis was performed using our Greek version of SentiStrength and this corpus of tweets helped us to evaluate our work positively. Another conclusion is that national elections in Greece are leader-dependent. One person carries the weight of the whole campaign, which can explain why the press secretaries of the two parties did not tweet enough.

We believe that our research and conclusions can benefit future political campaigns and political scientists who can repeat the process for similar corpora.

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Journal of Integrated Information Management electronic journal

Book Review

The Illustrated Glossary of Paper Conservation: a tool for interacting cultures

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In 2021, the "Illustrated Glossary of Paper Conservation: Damages and Treatments" was published digitally in Portuguese, Spanish, English, and Greek. The authors, Márcia Almada and Silvana Bojanoski, are university professors of professional training courses in paper conservation at Brazilian universities.

The idea of publishing an illustrated glossary arose from the need to create a guide that could standardise discourse in a field that still lacks systematic terminology. The four languages were chosen due to academic and professional partnerships established between the authors and collaborators, which aim to expand and strengthen interactions among diverse cultures and facilitate technical communication. The Portuguese version is based on the Brazilian experience; the English version was developed following the terminology used by the American Institute of Conservation and served as a point of convergence for resolving conflicts during translation; the Spanish version was constructed by professionals at the National Library of Mexico, and the Greek version draws on the experience of the Department of Archival, Library & Information Studies, University of West Attica.

The Illustrated Glossary was based on Silvana Bojanoski's PhD thesis, which focused on creating a terminological product for undergraduate students in the field of paper conservation in Brazil. Bojanoski's research began with identifying the characteristics of this professional field, organising a structure of technical knowledge (preventive conservation, damage diagnosis, and treatments), collecting terms from professionals in the area, crafting definitions, and finally, organising and presenting the glossary aimed at professionals in training.

For the multilingual edition of the work, terms were selected and reviewed, and equivalents were translated into the four languages. The foreign language versions started from the original Portuguese spoken in Brazil and aimed to respect each language's linguistic and cultural peculiarities. As the translation process is complex and relates to the specificities of professional experiences, the collaborators and translators were experts in the field and translated to meet international communication needs without disregarding local nuances.

Subsequently, the laborious editorial process of the e-book involved collecting, selecting, and producing representative images for each entry, with generous contributions from colleagues in the profession. The organisation followed the process, strict control of terms in the four languages in spreadsheets, and the development of alphabetical indexes. The editorial project development included a team of designers and editorial producers under the direct supervision of the authors. The concept developed focused on easy navigation among entries in the same language and among the four languages, with a design allowing viewing on different devices.

As a result, the glossary was published in a digital format and is freely available on the publisher's website (see link below). The digital format allows for linear reading of the entire glossary or the consultation of terms in any of the four languages through hyperlinks indicated with distinct colours for each language. Term consultation can be done in three ways: with a numerically ordered hierarchical diagram (the tree diagram), alphabetically, or through a table of equivalence of the terms in the four languages, also organised alphabetically.

It is understood that terminology studies facilitate communication and are essential for the revision, development, and transmission of technical and scientific knowledge in specialised areas. Producing tools such as glossaries, dictionaries, and terminological databases is fundamental to building a repertoire of technical and scientific language, reducing ambiguity in word meanings, and enabling greater transparency and clarity, all required in the scientific field. In this sense, terminological studies are

essential in communication processes among professionals in the specialised field and with related areas. Besides, it is crucial to strengthen communication of specialised knowledge with the general public.

In this regard, the publication of the "Illustrated Glossary of Paper Conservation: Damages and Treatments. Portuguese, Spanish, English, Greek" plays an essential role in disseminating the field of paper conservation, not only because it is a multilingual glossary but also because it serves as a tool for interaction among people, cultures, and nations.

ALMADA, Márcia; BOJANOSKY, Silvana. **Illustrated Glossary of Paper Conservation: Damages and Treatments. Portuguese, Spanish, English, Greek**. Belo Horizonte: Fino Traço, 2021. 586p. ISBN: **9786589011484**

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