Social media presence of scholarly journals

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Social Media Presence of Scholarly Journals

Abstract

Recently, social media has become a potentially new way for scholarly journals to disseminate and evaluate research outputs. Scholarly journals have started promoting their research articles to a wide range of audiences via social media platforms. This paper aims to investigate the social media presence of scholarly journals across disciplines. We extracted journals from Web of Science and searched for the social media presence of these journals on Facebook and Twitter. Relevant metrics and content relating to the journals' social media accounts were also crawled for data analysis. From our results, the social media presence of scholarly journals lies between 7.1 percent and 14.2 percent across disciplines; and it has shown a steady increase in the last decade. The popularity of scholarly journals on social media is distinct across disciplines. Further, we investigated whether social media metrics of journals can predict the Journal Impact Factor (JIF). We found that the number of followers and disciplines have significant effects on the JIF. In addition, a word co-occurrence network analysis was also conducted to identify popular topics discussed by scholarly journals on social media platforms. Finally, we highlight challenges and issues faced in this study and discuss future research directions.

Keywords: social media, scholarly journals, Facebook, Twitter, altmetrics

1. Introduction

The communication and dissemination of research outputs is a challenge for researchers, as it is no longer sufficient to disseminate research works solely to an academic audience (Schnitzler, Davies, Ross, & Harris, 2016). Research output is said to have impact when it creates tangible and measurable benefits and is recognised outside of academia. For instance, changes to the quality of life, changes to public policies, and improvements to health care could be made based on research impact (McKenna, Daly, Davidson, Duffield, & Jackson, 2012). Thus, gaining valuable insights from research findings is of great significance to the general public, government agencies and business organizations. Therefore, proactively driving research to benefit society is essential. However, there seem to be some factors hindering policy makers and businesses from assessing research outputs directly from academic literature, including lack of knowledge of scholarly journals, lack of time to read long articles, lack of access to academic papers, complexity of research papers, as well as lack of opportunities to communicate with authors (Burke-Garcia & Scally, 2014; Eysenbach, 2011; Jackson, Waine, & Hutchinson, 2015). Hence, the low uptake and dissemination of research findings outside of academia.

To address this gap, social media platforms show the potential of facilitating researchers to share their findings with a wider audience. Today, the use of social media to communicate with friends and relatives has become increasingly popular in nearly everyone's daily life. Organizations embark on building their brand's image as well as connecting with clients to enhance customer relationships with the help of social media. In the same vein, recently, scholarly journals have started using social media as a communication platform to inform their readers about the latest articles they have published. Interested readers are thus provided with current and timely information with regards to published articles in various journals and might find it easier to communicate directly with authors on social media platforms, thereby bolstering the understanding of research findings. The social media presence of scholarly journals, to a large extent, could therefore facilitate the communication and dissemination of research outputs to a wider audience.

Furthermore, altmetrics, indices based on social media, such as the number of tweets, number of likes, and comments would be an alternative means to measure the impact of scholarly journals on the general public, compared to traditional metrics such as the Journal Impact Factor (JIF) (Haustein et al., 2014). Altmetrics are considered an interesting alternative to understand the societal impact of research by assessing the public engagement with research outputs (Piwowar, 2013). Most altmetric indicators are accessible and freely available on clearly defined social media platforms through Web APIs; however, their accuracy is still a concern for users (Cronin & Sugimoto, 2014).

Earlier studies on social media in an academic context have included the use of social networks on university websites (e.g. Greenwood, 2012), academic library websites (Chua & Goh, 2010), and in research workflows (Nicholas & Rowlands, 2011). Also, there have been studies using social media to disseminate journals within just one academic realm (e.g. Boulos & Anderson, 2014; Nason et al., 2015; Alotaibi et al., 2016). However, few studies have systematically analysed the social media presence of scholarly journals from a holistic perspective, and although altmetrics and social media data sources are increasingly applied as indicators in evaluation studies (Mahrt, Weller, & Peters, 2014), little is yet known about the use of altmetrics to predict the impact of scholarly journals.

This study aims to map the landscape of scholarly journals' presence on social media across disciplines. This is of particular value for gaining a quantitative understanding of the interactions of scholarly journals on social media platforms and drawing insights on the influence of social networks on journals across academic disciplines.

2. Literature Review

Typically, social media platforms were thought to be used for personal purposes, such as maintaining friendships, having informal conversations, and sharing daily leisure activities, especially among the young generation (Schnitzler et al., 2016). However, this is not the case as professionals have increasingly used social networking platforms to create and share their own content, to exchange knowledge with one another, to promote their products and services, and to build their brand images. Facebook and Twitter are said to be the most widespread social media platforms as they offer new ways of communication across geographical distances, especially in times when people's social circles become more international and face-to-face conversations would be too expensive (Boyd & Ellison, 2010; Ventola, 2014).

The academic field is continuously changing due to the emergence and development of new knowledge, which has made it increasingly difficult for the general public to find relevant information. Hence, social media is indeed attractive to users from academia as a platform to help them diffuse valuable research findings within and outside their fields of specialisation. It also provides opportunities for scholars to share their expertise and to exchange information on an international level, transcending geographical boundaries (Whitburn, Walshe, & Sleeman, 2015). In recent years, social media platforms, especially Facebook and Twitter, have been gradually adopted by academic professionals as a means of communicating and promoting discussions about research outputs. Consequently, scholarly journals have started to realize the potential of these novel platforms as a powerful marketing and promotion channel. They have started using social media to promote their publications and to increase the visibility of their research outputs (Zedda & Barbaro, 2015).

Social media platforms could enable journals and their users to provide information resources that are relevant, current, and also entertaining. Generally, social media is used by journals to announce new articles, to serve as discussion forums, and to disseminate knowledge. In the study of Kortelainen and Katvala (2012), 100 top scientific journal web sites across multiple academic fields were investigated to find out the extent of the application of social media networks on their web sites, and to examine the altmetrics data that these journals received. They found out that 78 of the journals used social media networks, and RSS was the most commonly used social web tool. Thus, from this study, it seems social media does play an important complementary role to the traditional communication channels used by journals.

In previous literature, efforts were mostly made to investigate the adoption of social media of scholarly journals by focusing on individual subject areas. In the sciences discipline, the social media presence of medicine and environmental science journals had received much attention from researchers. A study by Eysenbach (2011) demonstrated that tweets could be used to measure the uptake of research findings by the general public and to evaluate the popularity of research outputs in a timely manner. Boulos and Anderson (2014) studied the use of Facebook and Twitter by peer-reviewed medical journals. They selected the top 25 general medicine journals from the Journal Citation Reports (JCR) list, analysed their presence on Facebook and Twitter, and scanned their websites for any Facebook and Twitter features. They found that 20 of the 25 journals had some sort of Facebook presence, while 11 also had a Twitter presence. The number of features such as "likes" and "followers" differed across the journals, and this could be argued to be seen as a proxy indication of the amount of social media attention or online popularity of the journal. Zedda and Barbaro (2015) examined the use of social media networks by 76 publishers specialized in the biomedical field. Their results show that science publishers are interested in new web technologies and are experimenting with social media with the aim of creating a closer relationship with their audiences.

The social media presence of scholarly journals in certain subspecialties of the field of medicine (i.e., urology, neurosurgery, dermatology, and public health) has also been explored in some studies. The European Association of Urology created guidelines on good practice and standards for using social media among urologists, including the methods of defining online profiles, managing accounts, protecting the reputation of the author and his organization, protecting privacy, and creating honesty (Rouprêt et al., 2014). Nason et al. (2015) analysed the emerging use of Twitter by urology journals and pointed out that social media has become a new way to assess the quality of research outputs owing to user-friendly and convenient platforms. Twitter has also been used by an increasing number of leading urological journals to highlight significant articles of interest to their readers.

Furthermore, Alotaibi et al. (2016) investigated the relationship between social media metrics and academic indexes of neurosurgical programs and journals. The results from this study showed that for neurosurgical journals, there is an association between the presence of social media and academic bibliometric profiles, while the impact of social media metrics on indexes of scientific impact is not known. Amir et al. (2014) evaluated the presence of various dermatology journals on Facebook and Twitter and found that the usage of social media by journals tends to significantly lag behind that of patient-centred dermatology organizations. It seems that although some dermatology journals are active on social media, most have yet to recognise the potential benefits of these new technologies in academia.

In the public health field, Grande et al. (2014) pointed out that social media is a new and potential communication channel that could help to narrow the gap between the academic field and policy makers. Thereby, optimal strategies could be identified to ensure journals and researchers can best use and adapt this new technology to promote their findings to policy makers with the aim to improve public health services. Wilkinson and Weitkamp (2013) conducted an empirical study to examine the use of traditional and social media to disseminate research outputs by environmental researchers. They found that in the environmental field, few researchers were using social media actively to promote research outputs, while many still preferred to publish papers in journals and attend academic conferences to communicate their findings to the public.

Prior research works have also investigated altmetrics and their impact on scholarly journals, as well as on research outputs (e.g., Alotaibi et al., 2016; Boulos & Anderson, 2014). Peoples, Midway, Sackett, Lynch, and Cooney (2016) estimated the relative effects of Twitter activity on the JIF by collecting 1,599 research articles from 20 ecology journals published between 2012 and 2014 from Web of Science. They concluded that there is a strong positive relationship between Twitter activity (e.g. the number of unique tweets about an article) and the number of citations. However, it should not be expected that research works will become highly cited solely based on social media promotion. Cardona-Grau, Sorokin, Leinwand, and Welliver (2016) propose a novel metric called *Twitter Impact Factor* (TIF) to measure the impact of urology journals on Twitter. A journal's TIF is calculated based on the number of retweets per original relevant tweet, which is similar to the concept of the traditional JIF. In future, with the increased use of social media by scholarly journals, the TIF might well become a promising new metric, albeit with the uncertain quality of tweets and retweets as a measure of impact, especially considering the implications of automated Twitter "bot" accounts (Haustein et al., 2016).

In the social science field, Kranz (2013) proposed that the readership and article citations of law journals might increase alongside an increased social media presence. The author elaborated on how a social media plan could be implemented into a law journal's strategic plan. The strategy suggested was to make all journal articles freely accessible online, to blog about current news related to the articles, and to use social media platforms like Twitter to drive the impact of the research papers. Botting, Dipper and Hilari (2017) explored the association between the promotion of research outputs on social media (blogging and tweeting) and the impact of the research (citations and downloads). They conducted an experimental study to compare three groups of papers in the area of speech and language science. They found in communication science, that the dissemination of research outputs on social media led to an increase in downloads and citation counts.

Altmetrics and traditional metrics might well be related, but they are definitely not identical, both however could be useful complementary metrics for measuring research impact (Peoples et al., 2016). Recent literature reviews of altmetrics works have already detected a growing importance of this emergent application area of social media and altmetrics for research evaluation, although it is still in its infancy (Erdt, Nagarajan, Sin, & Theng, 2016; Sugimoto, Larivière, & Haustein, 2017). The coverage of altmetrics on academic social networks however seems to be rather low and it is not clear if they are prevalent enough to be of practical use for valid research evaluation (Thelwall, Haustein, Larivière, & Sugimoto, 2013).

These previous studies provide some insights into understanding the state of the art of the social media presence of scholarly journals. These studies have however focused on evaluating the extent of involvement of scholarly journals within one subject area, which lacks the analysis of the social media presence of these journals from a comprehensive perspective across multiple disciplines. To fill this gap in the literature, the present study investigates the social media presence of scholarly journals across multiple disciplines by conducting quantitative analysis.

3. Objectives

This paper explores the extent to which scholarly journals using social media, notably Facebook and Twitter, disseminate their research findings and communicate with their readers. The specific objectives of this study are:

1) To investigate the social media presence of scholarly journals indexed in the Web of Science and the extent of their activity on Facebook and Twitter;
2) To investigate the relationship between social media metrics and the JIF;
3) To examine the most popular topics discussed among scholarly journals on social media platforms.

Specifically, the following research questions (RQs) are addressed in this study:

RQ1: To what extent are scholarly journals using Facebook and Twitter?

RQ2: What are the differences in metrics of scholarly journals' social media account profiles across disciplines?

RQ3: What are the relationships between age of profile, number of tweets, number of likes, number of friends, and number of followers on Twitter profiles of scholarly journals?

RQ4: What are the popular words that scholarly journals post on social media within a certain scientific domain?

4. Method

In this study, the Arts & Humanities Citation Index (A&HCI), the Social Sciences Citation Index (SSCI), and the Science Citation Index Expanded (SCIE) of Web of Science –

Clarivate Analytics[1] have been used to extract journals for data analysis. All the journals in the three indexes were downloaded on 25 February 2016. In total, 13,826 relevant journals were retrieved, including 1,769 journals from A&HCI, 3,230 journals from SSCI, and 8,827 journals from SCIE respectively. However, in the process of data cleaning, we found that there were some duplicate journals which were categorized and stored in more than one index. As such, we added a new category "Multidisciplinary (MULTI)" in our study to distinguish these 1,010 journals from those belonging to only one index.

Data Extraction

To examine whether the extracted journals had their own social media accounts on Facebook[2] and Twitter[3], we searched directly for the journals' names using the search engines on Facebook and Twitter. Only the profiles of journal accounts themselves were considered. Other profiles such as publishers' profiles, or editors' profiles were excluded from the study. Data collection of the journals' social media accounts was completed in August 2016. Thereafter, we collected data from the journals' Facebook and Twitter accounts for further analysis. Using Python, we extracted data from the Facebook API and from the Twitter API. For Facebook journal accounts, detailed information related to profiles (account name, number of likes, etc.) and posts (time of post creation, post content, number of likes, number of shares, number of comments, etc.) were retrieved. The time of account registration could not be extracted for Facebook accounts, thus the time of the first post was used as an indication of when the journal's account was first actively used. For Twitter accounts, data about profiles (account name, time of account registration, number of tweets, number of friends, number of followers, number of likes, etc.), friends (friend name, friend location, friend description, etc.), and tweets (time of publishing tweets, tweet content, number of retweets, number of likes, etc.) were extracted.

In the next stage, we analysed the data collected from the two social media platforms with the aim of investigating how active the journals are on social media. We excluded all data from the SSCI journal account *Forbes*[4] [5], since *Forbes* is more likely to be a business magazine rather than a scholarly journal, although it is indexed in SSCI. In addition, due to the large number of comments, likes, posts, etc. on *Forbes'* very popular social media accounts, most of its data could be outliers in the dataset which would influence the analysis.

Network Analysis

To investigate the posting behaviour of journal accounts on Facebook and Twitter, we performed a word co-occurrence network analysis to examine which keywords were the most popular among posts or tweets. A keyword that often co-occurs with other keywords, will have more links in the network, thus indicating a more influential role among all posts or tweets in the network (Peng, Zhang, Zhong, & Zhu, 2013). In this study, we used packages "quanteda" and "igraph" from the statistics tool R (Benoit & Nulty, 2016; Kamada & Kawai, 1989) to conduct the word co-occurrence network analysis. For our analysis, we selected the top-10 keywords to be representative of the most popular words used by a journal.

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[1] http://wokinfo.com, retrieved 25 April 2018
[2] https://www.facebook.com, retrieved 25 April 2018
[3] https://twitter.com, retrieved 25 April 2018
[4] https://twitter.com/Forbes, retrieved 25 April 2018
[5] https://www.facebook.com/forbes, retrieved 25 April 2018

5. Results

The results of the data analysis are presented in this section addressing the research questions RQ1- RQ4 raised in Section 3.

Results of RQ1

To assess the social media presence of journals, 1,235 journals were found to have Facebook accounts, comprising 251 from AHCI, 679 from SCIE, 232 from SSCI, and 73 MULTI journal accounts. The number of Twitter accounts was 1,337 in total, comprising 159 from AHCI, 857 from SCIE, 249 from SSCI, and 72 MULTI journal accounts.

The findings suggest that the social media presence of journals in the dataset is very low since scholarly journals with Facebook accounts from AHCI, SCIE, SSCI, and MULTI only account for 14.2 percent, 7.7 percent, 7.2 percent and 7.2 percent, of the total number of journals in their own discipline respectively. In addition, only 9.0 percent, 9.7 percent, 7.7 percent, and 7.1 percent of the scholarly journals from AHCI, SCIE, SSCI, and MULTI respectively, had their own Twitter accounts. Furthermore, the journals that had both Facebook and Twitter accounts were very few across all four indexes. Only 6.4 percent of AHCI journals had both Facebook and Twitter accounts, and only 1.8 percent of MULTI journals had accounts on both social media platforms. Across all indexes, the clear majority of the journals had neither Facebook nor Twitter accounts. The findings are shown in Table 1.

TABLE 1. Social media presence of journals for each index.

Index	Number of journals in each index	Journals with Facebook accounts	Journals with Twitter accounts	Journals with both Facebook and Twitter accounts	Journals without neither Facebook nor Twitter accounts
AHCI	1,769	251 (14.2%)	159 (9.0%)	114 (6.4%)	1,473 (83.3%)
SCIE	8,827	679 (7.7%)	857 (9.7%)	358 (4.1%)	7,649 (86.7%)
SSCI	3,230	232 (7.2%)	249 (7.7%)	145 (4.5%)	2,894 (89.5%)
MULTI	1,010	73 (7.2%)	72 (7.1%)	18 (1.8%)	883 (87.4%)

To further understand the extent to which scholarly journals are using social media, we investigated their posting and tweeting behaviours on social media. Table 2 and Table 3 display journals' posting and tweeting information by index on Facebook and Twitter platforms respectively. For Facebook, the total number of posts in the SCIE index (n = 258,703) was much higher than for the other three indexes. Across all four indexes, only a small proportion of posts had URLs, ranging from 1 percent to 1.8 percent of the total number of posts. Similarly, only around 1 percent of the posts had direct links to research articles. To further investigate the direct interaction of journals with their audiences on Facebook, we identified posts with user-mentions (i.e., posts with the character '@' in their texts). We found that again, only a small portion of posts had user-mentions, ranging from 3.3 percent of SCIE posts to 5.9 percent of MULTI posts having user-mentions.

TABLE 2. Scholarly journals' posting behaviours on Facebook for each index.

Metric	AHCI	SSCI	SCIE	MULTI
Total number of posts	60,465	49,181	258,703	65,078
Posts with URLs	728 (1.2%)	572 (1.2%)	4,651 (1.8%)	620 (1.0%)
Posts with links to articles	523 (0.9%)	387 (0.8%)	2,944 (1.1%)	524 (0.8%)
Posts with user-mentions	2,739 (4.5%)	2,798 (5.7%)	8,575 (3.3%)	3,823 (5.9%)

With regards to Twitter, SCIE accounts, similar to the Facebook posts, had the highest number of tweets (*n* = 953,253). 27.7 percent of the tweets of MULTI journals had received retweets, while SCIE tweets had the lowest retweet rate of 20 percent. Unlike Facebook posts, almost all tweets of the journals contained URLs (above 86 percent across the four indexes); however, only a small proportion of the tweets had direct links to research articles, hovering around 5 percent to 14 percent across the four indexes. In addition, we assumed that a tweet had an interaction with the audience if it contains a user-mention of any Twitter account, which could be the journal's friend or follower. Table 3 shows that 71 percent of AHCI tweets had user-mentions, followed by SSCI tweets (68.9%) and MULTI tweets (68.1%). The tweets of SCIE journals had the lowest level of interaction with other Twitter accounts (53.4%). According to the results, it seems that scholarly journals were more engaged in interacting with users on Twitter than on Facebook.

TABLE 3. Scholarly journals' tweeting behaviours by index on Twitter.

Metric	AHCI	SSCI	SCIE	MULTI
Total number of tweets	145,419	175,675	953,253	67792
Retweets	32,002 (22.0%)	41,096 (23.4%)	190,510 (20.0%)	18,757 (27.7%)
Tweets with URLs	126,172 (86.8%)	157,918 (89.9%)	860,474 (90.3%)	60,164 (88.8%)
Tweets with links to articles	7,240 (5.0%)	19,370 (11.0%)	90,770 (9.5%)	9,271 (13.7%)
Tweets with user-mentions	103,181 (71.0%)	121,099 (68.9%)	509,062 (53.4%)	46,170 (68.1%)

In addition, we also investigated the types of activities that journal accounts showed on Facebook and Twitter platforms. First, we randomly selected 400 Facebook posts (100 for each index) and 400 tweets (100 for each index) from our dataset. Subsequently, we classified them into five broad categories, namely, general updates, general promotion, research updates, research promotion, and interactive posts/ tweets. General updates referred to information or updates about general themes. General promotion were non-research related information or news promoting a particular event or topic. Research updates were research-related information or news about research activities, but not mentioning any particular research paper. Research promotion referred to the dissemination of (mostly recently published) research articles by journal accounts, whereby the post or tweet might have included author names and a short abstract of the research work. Interactive posts/ tweets were posts or tweets in which a journal attempted to get a response or comment from its audience. Examples of posts and tweets of each of the five categories are shown in Table 4 and Table 5.

TABLE 4. Types of activities scholarly journals had on Facebook.

Facebook activities	Number	Example
General updates	86 (21.5%)	A post from SSCI: "*To receive automatic alerts about the future issues and content, please send an email to journals@e-elgar.co.uk.*"
General promotion	84 (21.0%)	A post from AHCI: "*BBC Radio 4 is broadcasting a play about Frederick Ashton next week.*"
Research updates	68 (17.0%)	A post from SCIE: "*Since its implementation in 2007, declines in varicella incidence and outbreaks ranging from 67% to 76% have been reported.*"
Research promotion	139 (34.8%)	A post from MULTI: "*Measuring Self-care in Patients with Hypertension: A Systema...: Journal of Cardiovascular Nursing.*"
Interactive posts	23 (5.8%)	A post from SSCI: "*now is present on Facebook with information of new and forthcoming issues. We also encourage comments and discussion on relevant topics.*"
Total number	400 (100.0%)	

TABLE 5. Types of activities scholarly journals had on Twitter.

Twitter activities	Number	Example
General updates	110 (27.5%)	A tweet from SCIE: "*Line Dancing Bacteria wins #uTAS Video Competition http://t.co/6GeRVYdPOc @utwente_en.*"
General promotion	81 (20.3%)	A tweet from AHCI: "*In just a few hours our Emerging Writer's Contest will be open for submissions! Read last year's winners here: https://t.co/6vMCDITvsL.*"
Research updates	80 (20.0%)	A tweet from MULTI: "*Genetic and environmental elements may influence children's #mentalhealth https://t.co/XQeoQQY36A #twins.*"
Research promotion	89 (22.3%)	A tweet from SSCI: "*RT @CardozoLaw: CA Court of Appeals medical malpractice decision relies on Prof. Alex Stein's @IowaLawReview article http://t.co/lHcEorYH9X.*"
Interactive tweets	40 (10.0%)	A tweet from SCIE: "*RT @BioMedCentral: Routinely collected data can predict #dementia risk - but would you want to know?*"
Total number	400 (100%)	

On Facebook, we found that 34.8 percent of the posts were related to research promotion. General updates and general promotion took up 21.5 percent and 21.0 percent of the sampled posts respectively, indicating that journal accounts not only promote research articles or findings, they also update on academic news, and promote academic events. It should be noted that a very small portion of posts (5.8%) in the sample were interactive posts. Similarly on Twitter, general updates and general promotion constituted a high proportion of the sampled tweets, namely, 27.5 percent and 20.3 percent respectively. Only 22.3 percent of the tweets aimed to promote research outputs, and 10 percent of the tweets were interactive tweets with the audience. Although more than half of the tweets had user-mentions across indexes (see Table 3), based on the sampled tweets, we found that user-mentions existed in all types of activities, and only 36.3 percent of the user-mentions (58 out of 160 user-mentions in the sample) were related to research activities (research updates and research promotions).

Results of RQ2

Firstly, we present the results for Facebook. The number of Facebook likes received by the journals' profiles varied a lot within each discipline. For example, the two most popular AHCI journals received 2 million and 1.38 million likes respectively, while a few AHCI journals received less than 100 likes on their Facebook profiles. Similarly, *Science* and *Physics Today* were the two most famous journals in SCIE, with each of them receiving as many as 3 million likes on their Facebook profiles; however, more than half of SCIE journals' Facebook profiles had less than 1,000 likes. Figure 1 illustrates the distribution of the number of likes received by journals on their Facebook profiles across the indexes. We can see that the median number of likes that each journal received is comparable across all four indexes. The range of likes for SCIE journals is much wider than for the other three indexes, indicating that the popularity of individual SCIE journals is quite varied.

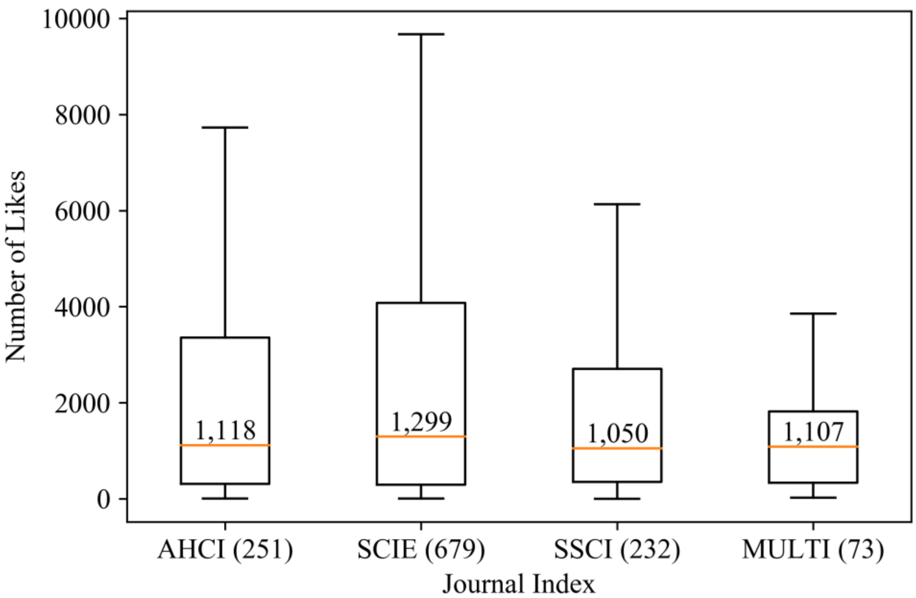


FIG. 1. Number of likes on Facebook profiles for each index.

Facebook posts from 2004 (the year of Facebook's launch) to 2016 were extracted. According to Fig. 2, there were only a few posts during the initial 5 years, probably due to the low social media presence of the journals on Facebook at that time. However, the years from 2009 to 2016 witnessed a strong increase in the number of Facebook posts of SCIE journals, while other indexes had only a slight rise in number during this period. More specifically, the total number of Facebook posts of SCIE journals was more than 70,000 in 2016, whilst the total number of posts of AHCI, SSCI, and MULTI journals were still between 5,000 and 25,000 in that year.

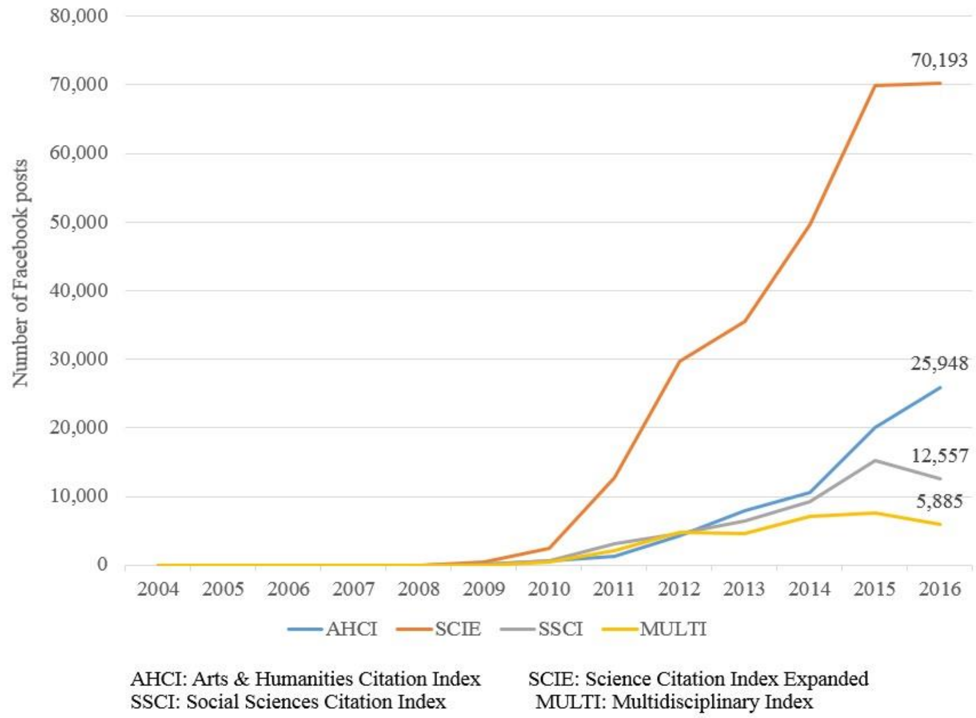


FIG. 2. Total number of Facebook posts posted by year for each index.

In addition, it should be noted that although SCIE journals had the largest number of posts on Facebook (270,801 in total), AHCI journals' posts were very popular as they received the highest mean number of shares, comments, as well as likes for their posts (see Fig. 3).

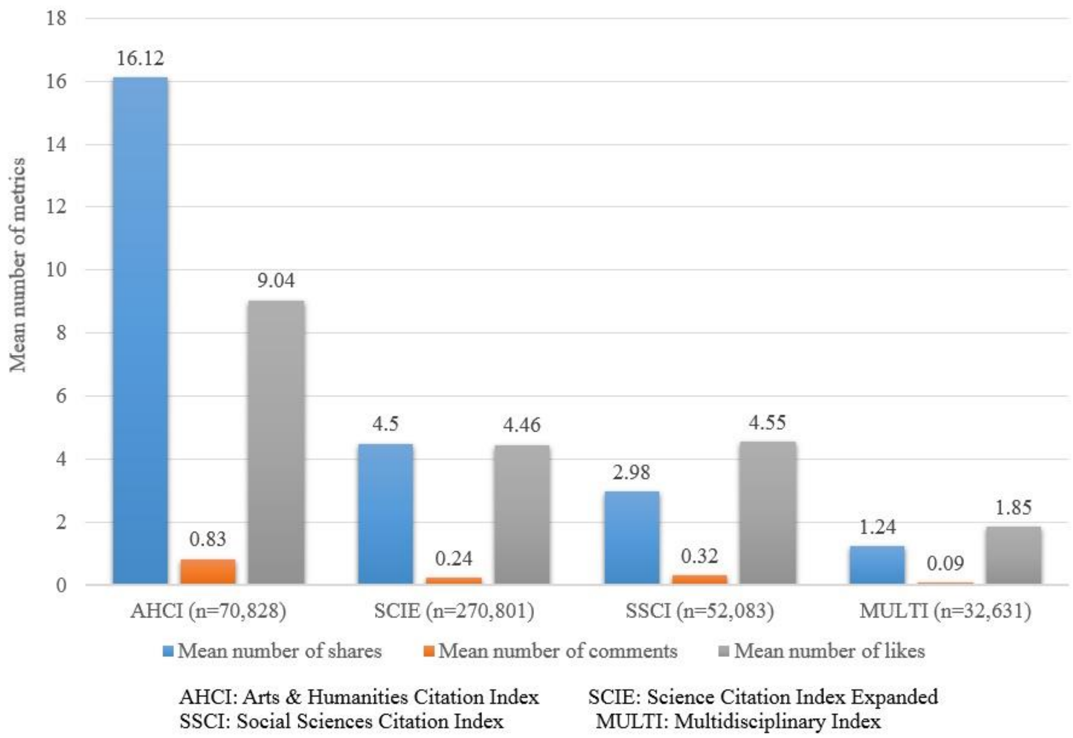


FIG. 3. Mean number of shares, comments and likes on Facebook posts for each index.

Next, we present the results for Twitter. The mean age of the journals' Twitter accounts across the four indexes was about 4 years. Figure 4 depicts the mean number of likes, tweets, followers and friends on Twitter profiles across the 4 indexes. The mean number of each metric varies a lot across disciplines, with Twitter profiles of AHCI journals having a much higher mean number of metrics than the other three indexes. SCIE journals had the second highest mean number of tweets and likes, while SSCI journals had the second highest mean number of friends and followers.

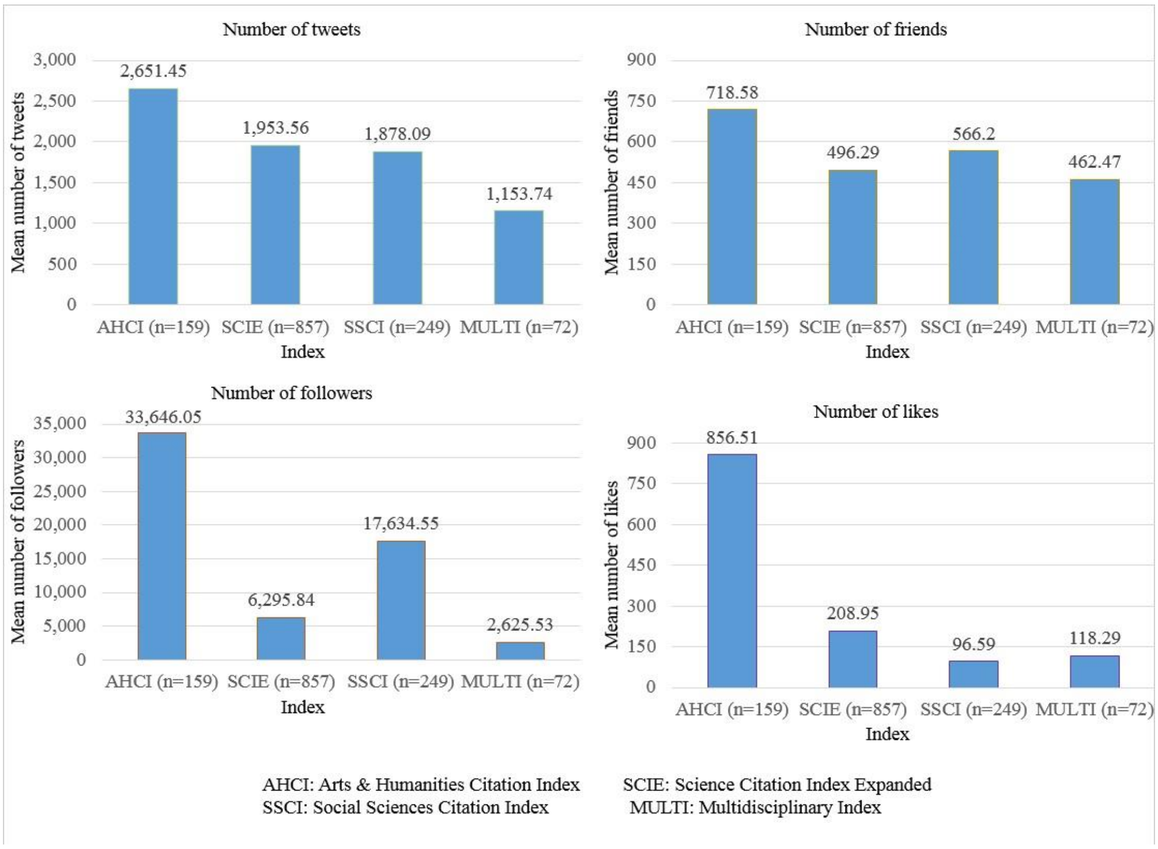


FIG. 4. Mean number of tweets, friends, followers and likes on Twitter profiles for each index.

Similar to the trend for Facebook posts, there was a sharp increase in tweets for SCIE journals from 2008 to 2016, whilst the other three disciplines showed a rather steady rise over the years (see Figure 5). The number of tweets for SCIE journals had reached 272,899 in 2016, which was a much higher number than the number of tweets for AHCI and SSCI journals, with only around 60,000 tweets for both indexes. Furthermore, the mean number of retweets for each tweet across all disciplines is also quite varied: AHCI (10.47), SCIE (8.24), SSCI (13.78), and MULTI (11.47). The results show that SSCI journals' tweets received the most number of retweets per tweet on average among the four indexes. AHCI journals received the highest mean number of likes for their tweets (4.88), while journals in other indexes received a much lower mean number of likes for their tweets: SCIE (1.17), SSCI (2.94), and MULTI (0.68).

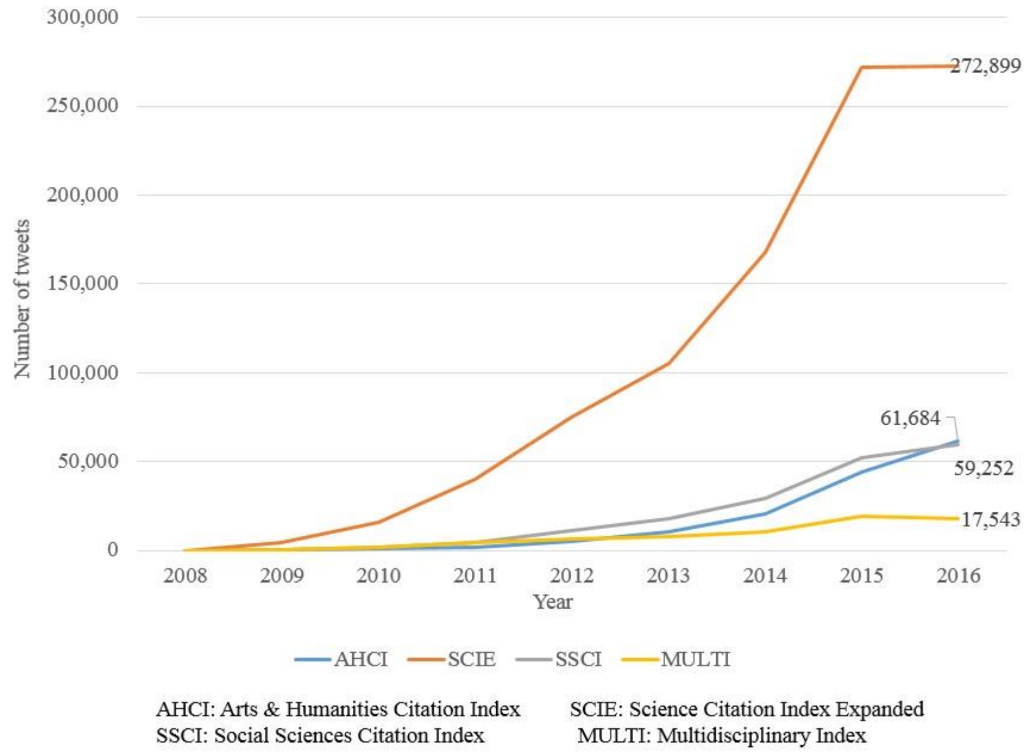


FIG. 5. Tweets posted by year for each index.

Results of RQ3

To examine the association between metrics on Twitter profiles of scholarly journals, the Spearman correlations between account age, number of tweets, number of followers, number of friends, and number of likes were analysed. Spearman correlation was chosen since the data was not normally distributed. The statistical significance levels were taken at $^{**}p < 0.01$ and $^{*}p < 0.5$. As can be seen in Table 6, the correlations between metrics of AHCI Twitter profiles ranged from medium to large, and the correlation between number of followers and number of tweets was the largest ($r = 0.85$, $p < 0.01$). For the other three indexes, most of the correlations between metrics were small to medium. SCIE and SSCI Twitter profiles also had the largest correlation between number of followers and number of tweets ($r = 0.71$, $p < 0.01$; $r = 0.62$, $p < 0.01$). Finally, the most significant correlation of MULTI Twitter profiles was between number of friends and number of likes ($r = 0.65$, $p < 0.01$), and the correlation between number of followers and number of tweets was also significant at $r = 0.61$, $p < 0.01$. Hence, there is a strong association between number of followers and number of tweets on Twitter profiles of journals across disciplines.

TABLE 6. Spearman correlation between Twitter metrics for each index.

AHCI	Account age	No. of tweets	No. of followers	No. of friends	No. of likes
Account age	-				
No. of tweets	0.64**	-			
No. of followers	0.70**	0.85**	-		
No. of friends	0.32**	0.65**	0.69**	-	
No. of likes	0.42**	0.74**	0.70**	0.68**	-
SCIE	Account age	No. of tweets	No. of followers	No. of friends	No. of likes

Account age	-				
No. of tweets	0.51**	-			
No. of followers	0.46**	0.71**	-		
No. of friends	0.15**	0.46**	0.57**	-	
No. of likes	0.02	0.52**	0.55**	0.61**	-
SSCI	Account age	No. of tweets	No. of followers	No. of friends	No. of likes
Account age	-				
No. of tweets	0.38**	-			
No. of followers	0.37**	0.62**	-		
No. of friends	0.07	0.48**	0.51**	-	
No. of likes	-0.01	0.56**	0.44**	0.54**	-
MULTI	Account age	No. of tweets	No. of followers	No. of friends	No. of likes
Account age	-				
No. of tweets	0.40**	-			
No. of followers	0.34**	0.61**	-		
No. of friends	-0.04	0.23	0.41**	-	
No. of likes	-0.19	0.35**	0.42**	0.65**	-

Further, we applied ordinary least squares (OLS) regression to assess whether metrics on journals' Twitter profiles were associated with the JIF. First, due to the highly skewed distributions of the variables, a log transformation was applied to the Twitter metrics (account age, number of tweets, number of followers, number of friends, and number of likes) and the JIF. The results for the regression model are summarized in Table 7. The p-value for the full model was less than 0.001, indicating that the regression model is statistically significant. The model explained 27 percent of the variance in JIF. We could also see that the two independent metrics: log*(no_of_tweets)* and log*(no_of_likes),* were not significant (p value > 0.05), thus these two metrics were excluded from the final model. We found that log(*no_of_followers*) was positively associated with log(*JIF*) (b = 0.27, p < 0.001), while log(*no_of_friends*) and log(*acc_age*) had very small negative effects on log(*JIF*) (b = -0.06, p < 0.001 and b = -0.16, p < 0.01). This indicates that a higher number of Twitter followers for a journal tends to trigger a slightly higher JIF for the given journal. In contrast, a journal's Twitter account with a higher number of friends and older account age may have a slightly lower JIF. In the model, we also found that the academic discipline was positively associated with the JIF, but the coefficients varied across the different indexes. Journals from SCIE had the most impact on the JIF (b = 1.61, p < 0.001), followed by MULTI journals (b = 0.74, p < 0.01), and SSCI journals (b = 0.59, p < 0.05). However, journals from AHCI seemed not to have any significant effects on the JIF.

TABLE 7. Ordinary Least Squares (OLS) regression results.

	Dependent variable: log(*JIF*)	
Independent variables	*b*	SE
(Intercept)	-1.69***	0.25
log(*no_of_tweets*)	-0.03	0.02
log(*no_of_frineds*)	-0.06***	0.02
log(*no_of_followers*)	0.27***	0.02
log(*no_of_likes*)	-0.01	0.02
log(*acc_age*)	-0.16**	0.05
discipline_SSCI	0.59*	0.24
discipline_SCIE	1.61***	0.23
discipline_MULTI	0.74**	0.25
R-squared: 0.27; p-value < 0.001; Observations: 1182		

Notes: *b* is the estimated coefficient, and SE is the estimated standard error.

Significant at *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Results of RQ4

We created a corpus with four academic indexes for both Facebook and Twitter. We cleaned the corpora by removing Internet-related buzzwords and stop words from the built-in language stopword lists in R. In addition, all words were standardized before processing as different words could describe the same concept. For instance, all words in upper case were converted to lower case. We then performed tokenization and stemming, and extracted words from the cleaned corpora to create a feature co-occurrence matrix (FCM). SSCI had the largest number of unique words on Facebook (267,405) and Twitter (374,812), followed by AHCI, SSCI, and MULTI. The top-10 words on Facebook and on Twitter were distinct across the disciplines, while the top-10 words in each discipline were very similar on both social media platforms. For example, AHCI Facebook and Twitter accounts talk more about art-related issues such as 'art', 'histori(ic/ical)', 'film', 'museum'. SCIE journals focus more on medical topics like 'patient', 'cell', 'health', 'cancer' on Facebook and Twitter. In addition, social-related topics such as 'polit(ics/ical)', 'public', 'women', 'state', 'develop', and 'law' are discussed most frequently on SSCI Facebook and Twitter platforms, whereas MULTI journals contain a variety of topics, such as 'health', 'public', 'trauma', 'risk', 'people', etc., in their posts and tweets. Table 8 and Table 9 present the top-10 words and frequencies for each index on Facebook and on Twitter.

TABLE 8. Facebook top-10 words and frequency counts.

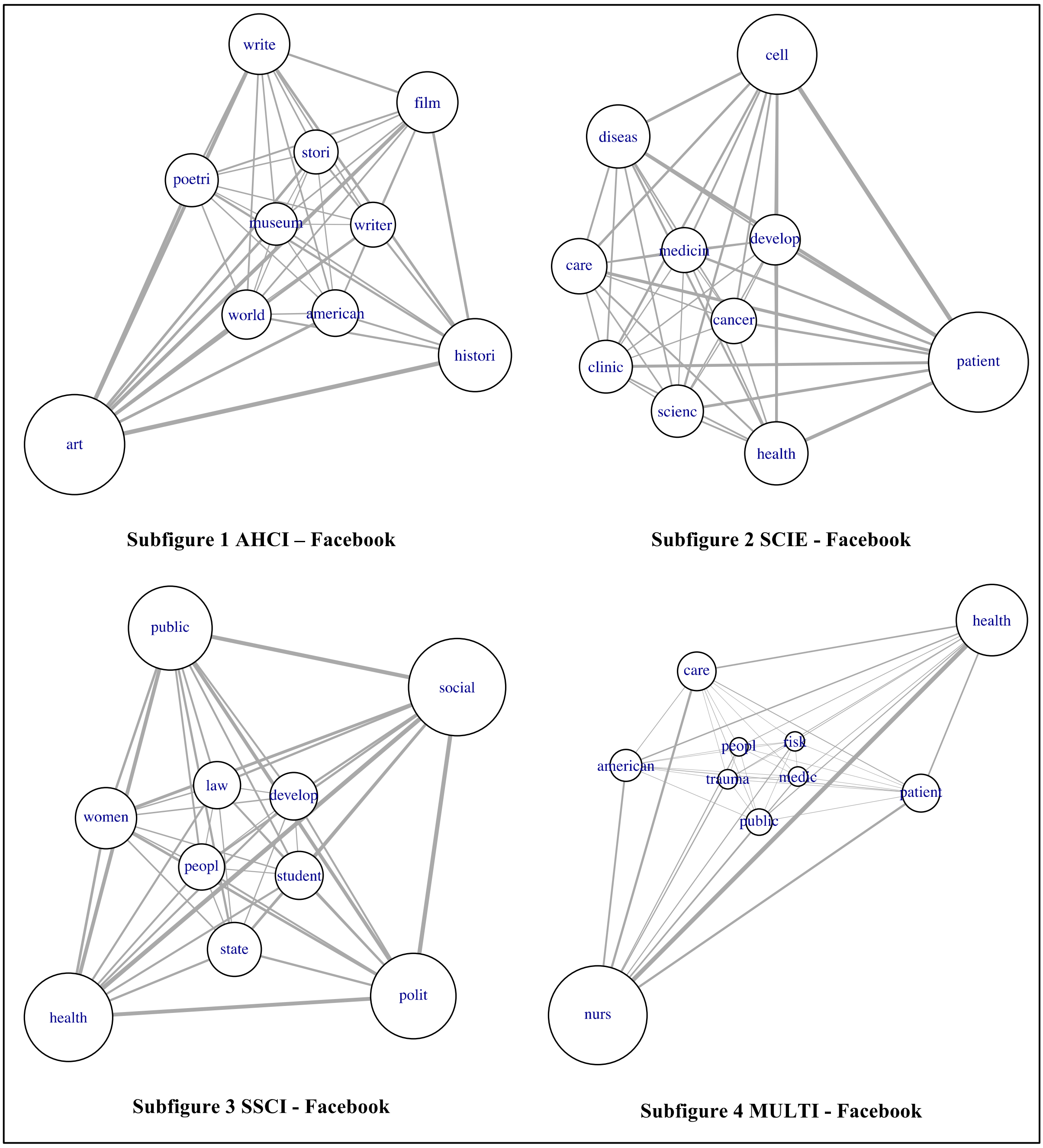
AHCI	art	histori	film	write	poetri	world	american	writer	stori	museum
Frequency	5,330	3,883	3,245	3,225	2,812	2,612	2,474	2,383	2,342	2,255
SCIE	patient	cell	health	diseas	care	clinic	scienc	develop	cancer	medicin
Frequency	21,204	16,892	13,431	13,429	11,755	11,203	11,070	10,668	9,612	9,540
SSCI	social	health	polit	public	women	state	student	develop	law	peopl
Frequency	3,790	3,447	3,333	3,265	2,384	2,102	1,865	1,847	1,833	1,796
MULTI	nurs	health	care	patient	american	public	trauma	medic	risk	peopl
Frequency	12,511	9,044	4,900	4,783	4,040	3,322	2,474	2,465	2,441	2,314

TABLE 9. Twitter top-10 words and frequency counts.

AHCI	art	museum	write	design	histori	quiz	award	writer	world	read
Frequency	5,418	3,280	2,436	2,301	2,154	1,958	1,909	1,855	1,846	1,819
SCIE	patient	cell	cancer	diseas	treatment	risk	clinic	care	health	develop
Frequency	31,997	29,181	27,947	20,630	16,925	15,936	14,363	13,969	13,570	12,081
SSCI	health	polit	social	care	china	chang	educ	state	nurs	market
Frequency	4,746	4,594	4,235	2,912	2,666	2,651	2,549	2,357	2,357	2,350
MULTI	nurs	health	care	patient	educ	clinic	therapi	student	risk	electroc
Frequency	13,347	7,161	5,104	4,890	3,289	3,227	3,094	2,779	2,647	2,603

To examine the word co-occurrence between keywords, we mapped co-occurrence networks of the top-10 words in each index on Facebook and Twitter (see Figure 6 and Figure

7). The nodes in the network represent the top-10 words, and the thickness of the edges depicts the strength of the co-occurrence relationship between them. The relative size of the nodes represents the words' frequency. In Figure 6 and Figure 7, the word 'art' has the highest frequency and strongest relationships with most of the other words in the AHCI network. The most frequently used word 'patient' strongly occurs with other words in the SCIE networks. Also, for Twitter, in Figure 7, 'cell', and 'cancer' occur strongly with other words in the SCIE network. In both figures, words such as 'social', 'health', 'polit(ics/ical)', and 'public' are strongly related with the other words in the SSCI network. Lastly, in the MULTI networks, the relationships between words are very weak except for the word 'nurs(ing/e/es)', which strongly occurs with most other words. It is quite interesting to see that the results for each index are quite similar for both Facebook and Twitter.



Subfigure 1 AHCI – Facebook

Subfigure 2 SCIE - Facebook

Subfigure 3 SSCI - Facebook

Subfigure 4 MULTI - Facebook

FIG. 6. Facebook top-10 words co-occurrence networks.

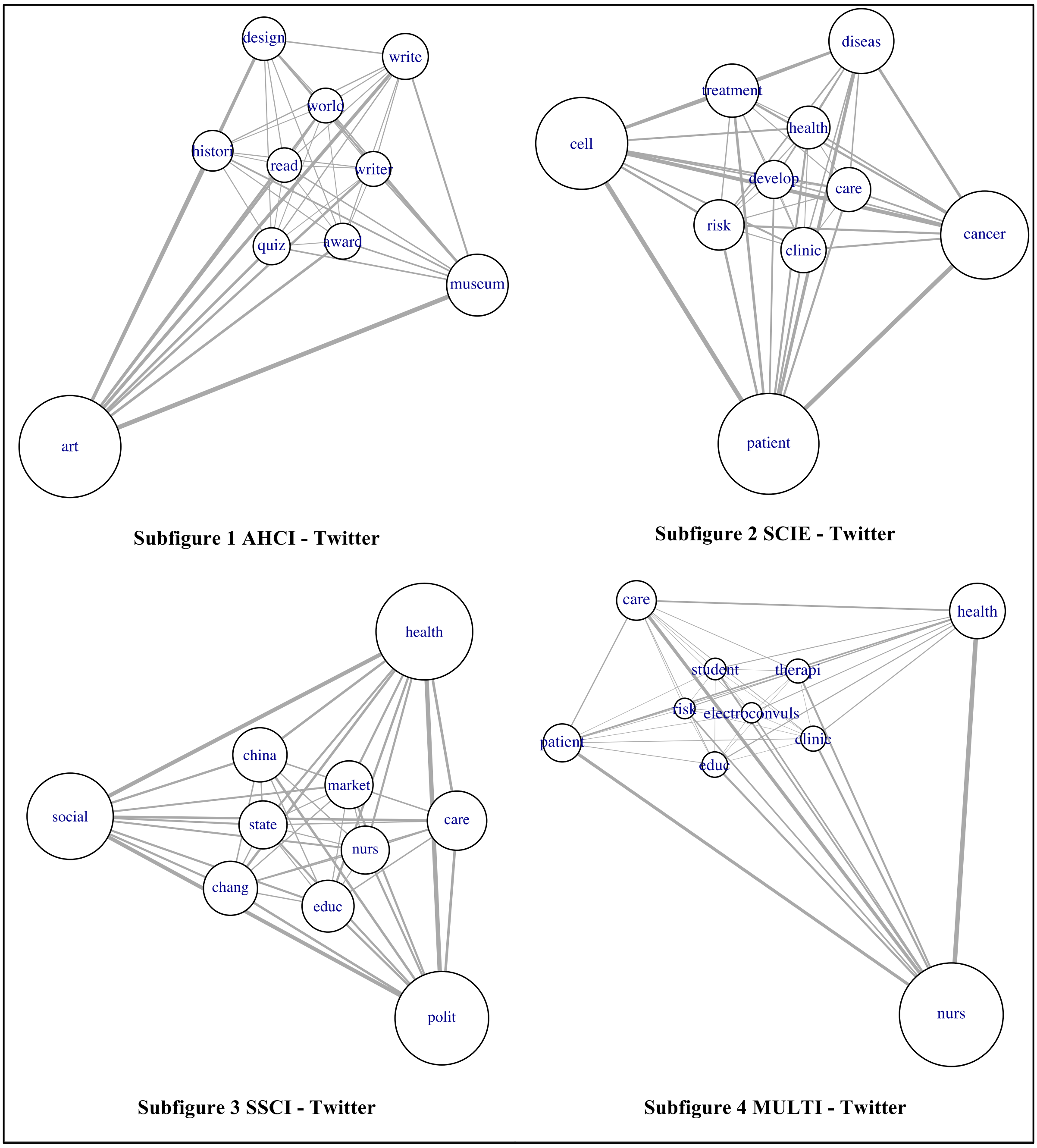


FIG. 7. Twitter top-10 words co-occurrence networks.

6. Discussion

This study has adopted an empirical approach to analyse the presence of scholarly journals on social media. The findings of this study aim to advance our understanding of how journals use social media to disseminate their outputs. Firstly, we found that the usage of social media like Facebook and Twitter to diffuse research findings by scholarly journals has not yet been widely established, with only about 10 percent of journals having social media accounts in each discipline. Our result is in line with Kortelainen and Katvala (2012)'s conclusion, showing that 9 percent of journals had a Facebook account and these journals' presence on Twitter was around 15 percent. Scholarly journals may be gradually becoming aware of the importance of social media in the academic context, but the gap between this awareness and the actual usage of these platforms still needs to be addressed (Rowlands, Nicholas, Russell, Canty, & Watkinson, 2011).

Nevertheless, it should be noted that metrics such as the number of Facebook posts, or the number of tweets relating to scholarly journals have demonstrated a notable increase in the past decade, indicating that more and more journals have recognized the importance of finding new ways to disseminate and evaluate their works by using Facebook and Twitter. For instance, a handful of journals have started requesting authors to create so-called tweetable abstracts that journals can use to promote papers (Darling, Shiffman, Côté, & Drew, 2013). Therefore, the social media presence of journals will probably increase in the near future, owing to the prevalence of social media in scholarly communication. This finding supports the argument that as social media gains popularity, the expectations, as well as opportunities for researchers and research institutions to use social media will increase (Schnitzler et al., 2016). Social media has the ability to diffuse information to a wider society, better targeting specialised audiences, and communicating research findings in a much more efficient manner (Luzon, 2009). Thus, social media could be seen as a complementary research dissemination method in addition to traditional methods such as newspaper releases, attending academic conferences, etc.

We also investigated the interaction of journals' social media accounts with their audience. SCIE journals had much more posts and tweets on Facebook and Twitter than the other three indexes. We found that a very small portion of journals had posts with URLs on Facebook, while most of the journals' tweets on Twitter contained URLs. Interestingly, only rather few journals' social media accounts provided direct links to research articles on both Facebook and Twitter. Retweeting, which represents a citation of another user's content, is one of the major activities of Twitter (Cha, Haddadi, Benevenuto, & Gummadi, 2010). The retweeting rate of scholarly journals is still low across all four indexes. Furthermore, journals seem to have a much lower level of interaction with their audiences on Facebook compared to their level of interaction on Twitter. A few Facebook journal accounts used user-mentions, while the adoption of user-mentions on Twitter was very prominent across all indexes. Journal accounts promoted a variety of activities such as general updates, research promotion, etc. on their Facebook and Twitter platforms.

Another noticeable finding were the differences between social media journal accounts across academic disciplines. As mentioned above, SCIE journals have far more Facebook and Twitter accounts than journals from other indexes. We also found that SCIE journal accounts have the largest number of Facebook posts and tweets among the four indexes. This indicates that the social media presence of SCIE journals is relatively high and they play a more active role on online platforms compared to the other three indexes. However, AHCI journal accounts seem to have gained the most popularity on both social media platforms, since they received the highest number of likes on their Facebook profiles, as well as the largest number of tweets, friends, followers and likes on their Twitter profiles. Similarly, although the number of posts of SCIE journals on Facebook, and the number of tweets on SCIE Twitter accounts both increased dramatically in recent years, AHCI journals had the most likes, comments, and shares for their Facebook posts, and SSCI journals gained the most retweets for their tweets. These findings demonstrate that readers' social media engagement in AHCI is stronger than for the other three indexes. Kousha and Thelwall's (2016) study also supports our findings by showing that AHCI books had proportionally more reviews on Amazon.com. Reader contribution acts as information filters on social media platforms in that likes, tweets, and comments of journal accounts may increase the visibility and use of research findings. Thus, this suggests that the use of social media by journals to promote research works may be a good approach for certain disciplines that have been historically underrepresented in bibliometric databases (Cronin & Sugimoto, 2015). As such, altmetrics could be seen as a complement to traditional metrics for research evaluation.

Similarly, the correlation between account age, number of tweets, number of followers, number of friends, and number of likes is also distinct across disciplines. Most of the correlations between social media metrics range from small to medium for each index except AHCI, where the correlations between metrics are moderately high. We found the correlation between number of followers and number of tweets is high for Twitter profiles of all journals across disciplines, indicating that there is a strong association between number of followers and number of tweets on journals' Twitter profiles. We also investigated whether social media metrics could predict the JIF. Results show that the number of followers has the strongest association with the JIF compared to other metrics. Scholarly journals with a large number of followers on Facebook or Twitter tend to have a high JIF. Meanwhile, academic discipline is also strongly associated with the JIF. Journals in the sciences disciplines have a higher JIF than others. Interestingly, we found that the number of likes and number of friends have a very small negative effect on the JIF. This is supported by the findings from RQ2, that AHCI journal accounts have received more likes and friends, although their JIF is lower than SCIE journals in general.

Lastly, we used word co-occurrence network analysis to find out which topics are popular and often discussed on journals' social media accounts. Results show that scholarly journals talk about similar popular issues on both Facebook and Twitter across disciplines. This indicates that journals show equal preference for promoting their research via both social media platforms. The posts and tweets of scholarly journals on Facebook and Twitter are however distinct across disciplines. Unsurprisingly, AHCI journals talk more about art-related issues, SCIE journals show more interest in health-related issues, and SSCI journals focus more on social and public news, whereas there is a variety of topics discussed in MULTI journals.

As the social media presence of journals has been increasing in recent years, journals are likely in future to become more active in using social media platforms to promote and disseminate information about published articles, which might attract more attention to altmetrics from both scholars and research institutions. However, by posting and tweeting about the articles they publish, journals might intentionally or unintentionally manipulate the number of altmetrics to achieve a higher level of online visibility. Such a systematic manipulation is much easier with altmetrics than with traditional metrics (Bornmann, 2014). For instance, one tweet per article could be considered as marketing or promotion of an article by the journal, whereas multiple tweets per article by the same journal account would probably be considered as an intentional manipulation, especially if the tweets are automatically generated (Haustein et al., 2016). This behaviour could have a serious impact on altmetrics research and also on how altmetrics could potentially be used for research evaluation. As such, rules and policies need to be established to define what is to be considered as a manipulation for altmetrics.

A limitation of this study is the quality of words for the content analysis of the posts and tweets on social media. A very large amount of posts and tweets from all journal accounts was extracted from Facebook and Twitter, and we encountered several challenges in the process of data cleaning. There were numerous online buzz words and commonly used words, which caused difficulties when cleaning and removing irrelevant words. In addition, the journals' posts and tweets were in different languages, and although we attempted to limit our analysis only to English, we cannot claim that all buzzwords were excluded, which could have influenced the data analysis for addressing RQ4.

7. Conclusion

The potential of social media as a new method for disseminating research outputs needs to be explored and harnessed by researchers, publishers, and funding agencies. This study investigated the social media presence of journals in multiple disciplines and analysed how active they are on two social media platforms, namely Facebook and Twitter. These findings may help to reveal the popularity of scholarly journals on social media, thus informing researchers about publication channels that receive a lot of online attention. Moreover, in future, academic collegiality and publication dissemination could be further stimulated by increasing the presence of journals on social media.

In this study, we investigated the extent to which scholarly journals are using social media in a comprehensive manner. However, in future, further in-depth analysis will be necessary to examine more aspects of the social media presence of scholarly journals. For example, the comparison between social media metrics and traditional metrics will be needed based on the findings of our study. For further study, we could choose several popular Facebook and Twitter accounts respectively in each academic discipline based on the mean number of likes on profiles, then examine whether these journals which have gained the most popularity on social media also perform well in bibliometric databases. Also, we could compare the effects of Facebook and Twitter on traditional metrics to investigate which social media platform has a more significant influence on them.

Another important topic will be to investigate the rationale behind the results in this study. AHCI journal accounts are the most popular on both Facebook and Twitter, despite SCIE journals having the largest number of social media accounts. Future study will need to investigate the reasons for this by conducting surveys or semi-structured interviews with researchers from different academic fields. Meanwhile, researchers' online posting behaviour could also be investigated with a survey, which could further supplement the findings of the content analysis in this work.

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