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Comment on the article: The state of social science research on COVID-19

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Abstract
A well-written and interesting article was published on November 21, 2021. Future relevant studies, however, may be improved by implementing (1) a framework that outlines the overall research; (2) an author-weighted scheme (AWS) that accurately quantifies the contributions of entities to articles; and (3) a more appropriate size for the nodes representing the proportional counts for each entity in social network analysis (SNA). VOSviewer was used to construct and visualize the scientometric networks and the relation-based analyses included three categories: (1) citation relations, (2) word cooccurrences, and (3) coauthorship relations. Nevertheless, the counts for each topical entity have not been consistently integrated. As a result, the nodes of the keyword co-occurrence network are large when compared to the number of connections between the entities or terms (i.e., the total number of relationships between co-occurring terms or entities). Additionally, all weighted counts in keywords (or the total link strength of a country/region) should equal the total number of documents (e.g., $n=9954$ in that article). This would lead to biases in the calculation of publications (or citations) for entities, as is common in traditional SNA. This node illustrates a study framework and a couple of AWSs (i.e., equal and nonequal AWSs) to improve the article, and discusses the need to understand the requirement that the total centrality degree in SNA equals the total number of documents (or citations).

Keywords Publication · Citation · Social network analysis · Author-weighted scheme · Study framework · VOSviewer

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Several major concerns have been raised in the article "The State of Social Science Research on COVID-19" (Liu et al., 2022): (1) no framework was used to highlight the overall research; (2) author weighted schemes (AWS) (Chien et al., 2019; Kan et al., 2020) were not applied to fairly quantify the contributions made by entities to articles; (3) the size of nodes in social network analysis (SNA) was inconsistently defined in keyword co-occurrence relations and coauthorship relations. A node's size, for example, represents both the occurrence counts in the keyword co-occurrence network (or the number of links between terms) in Figs. 1 to 3 of the study (Liu et al., 2022).

A study framework

In the study (Liu et al., 2022) relation-based analyses were employed, including three categories of analysis: (1) citation relations, (2) word co-occurrence, and (3) coauthorship relations (Li et al., 2021). Table 1 illustrates a framework excluding the parts indicated by the ■ symbol, but √ representing the existence in this article (Liu et al., 2022). Due to the lack of quantification of the credits in article bylines, we assumed that the original analyses were based on the first author in countries/institutions.

The AWS applied to bibliometrics

Using the AWS, Table 2 illustrates four articles with ten connections, including one single author (#1) and three coauthors (#2 to 4). The size of the nodes represents the number of occurrences in the keyword (replaced by country here) co-occurrence network defined in the study (Liu, Yuan, & Zhu, 2021). In this case, there are 3, 2, 2, and 2 occurrences in the US, China, UK, and India. Based on the size of the nodes, the total number of links for the US, China, UK, and India is 4, 6, 5, and 5, respectively; see Table 3. It appears that the results of the two computations are different.

Table 1 Study structure of methods and representations for each topical entity

Entity	Publication	Citation	1st element	Connection[a]	Equal AWS	AWS	Representation
(1)Citation relations							
Country	√	√	√			■	Table
Institute	√	√	√			■	Table
Journal	√	√	√		■		Table
Article	√	√	√		■		Table
(2)Word co-occurrence							
Keyword	√			√	■		SNA
(3)Coauthorship relations							
Country	√			√		■	SNA
Institute	√			√		■	SNA

[a]Connection: the size of the nodes represents the occurrence counts (or the total link strength) of the entity; ■: proposed scheme; √ represents the existence in this article (Liu et al., 2022)

Table 2 Author-affiliated countries in four articles

#	1st	2nd	3rd	4th	Relation
1	US				
2	US	China			1
3	China	UK	India		3
4	China	UK	US	India	6
Total					10

Table 3 Relations on the traditional SNA

#	Country A	Country B	Relation
1	US	China	2
2	China	UK	2
3	China	India	2
4	UK	India	2
5	UK	US	1
6	US	India	1
Total			10

Total CD = 2 × 10 = 20

Table 4 Weights on the equal AWS

#	1st	2nd	3rd	4th	Relation
1	0.5	0.5			1
2	0.5	0.5			1
3	0.33	0.33	0.33		3
4	0.25	0.25	0.25	0.25	6
Total					11

Table 5 Relations on the Equal AWS

#	Country A	Country B	Relation
1	US	China	0.58
2	China	UK	0.25
3	China	India	0.25
4	UK	India	0.25
5	UK	US	0.08
6	US	India	0.08
Total			1.50

When the Equal AWA, defined in Eq. 1, is applied, the weights are endorsed in Table 4 and the co-occurrences are shown in Table 5. Total centrality degree (CD) equals 3 (i.e., the number of articles excluding the single-author article (#1).

Table 6 Weights on the non-equal AWS

#	1st	2nd	3rd	4th	Relation
1	0.73	0.27			1
2	0.73	0.27			1
3	0.67	0.09	0.24		3
4	0.64	0.09	0.03	0.24	6
Total					11

Table 7 Relations on the non-equal AWS

#	Country A	Country B	Relation
1	US	China	0.61
2	China	UK	0.31
3	China	India	0.37
4	UK	India	0.14
5	UK	US	0.02
6	US	India	0.04
Total			1.50

Total CD = 2 × 1.5 = 3

$$W_i = \frac{1}{L}, \tag{1}$$

In Table 4, L represents the number of elements in the article, and Wi represents the weight assigned to each element.

Similar to the above, if the nonequal AWA is applied, the weights are endorsed in Table 6, and the co-occurrences are shown in Table 7. As a result, the total centrality degree (CD) equals 3 (= the number of articles, excluding the single-author article (#1)).

A consistent scheme applied to bibliometrics

According to Table 8, the total centrality degree (CD) will equal 4 (the number of articles) if the single-author article (#1) is included using the nonequal AWS. According to Table 9, if each article contains ten citations, the total centrality degree (CD) equals 40 (= the total number of articles).

Discussions

All weights equal article number

Traditionally, CD is defined by the number of co-occurring entities in an article. It is possible that the sum of CD across all entities in all articles is not equal to the number of articles in the study. In order for all weighted CD (WCD) in Eq 2 to equal the number of articles via Eq, a specific adjustment must be made via Eqs. 1, 2, 3.

Table 8 Publications on the Non-Equal AWS including one single-author article (#1)

#	Country A	Country B	Relation
1	US	US	1.00
2	US	China	0.61
3	China	UK	0.31
4	China	India	0.37
5	UK	India	0.14
6	UK	US	0.02
7	US	India	0.04
Total			1.50

Total CD = 2 × 1.5 + 1 = 4

Table 9 Citations on the non-equal AWS including one single-author article (#1)

#	Country A	Country B	Relation
1	US	US	10.00
2	US	China	6.13
3	China	UK	3.11
4	China	India	3.74
5	UK	India	1.38
6	UK	US	0.20
7	US	India	0.45
Total			15.00

Total CD = 2 × 15 + 10 = 40

$$\begin{aligned} WCD\ in\ an\ article &= \left(\sum_{i=1}^{L-1}\sum_{j=i+1}^{L}(W_i + W_j)\right) \div (L-1) \\ &= 2 \times W_i \times \frac{L \times (L-1)}{2} \div (L-1) \\ &= 2 \times \frac{1}{L} \times \frac{L \times (L-1)}{2} \div (L-1) = 1, \end{aligned} \tag{2}$$

In an article byline, L indicates the number of co-occurring entities (e.g., authors or countries). The Wi is the equal weight for an entity in an article byline; see Eq. 1 (or the unequal weight in Table 5) (Chien et al., 2019; Kan et al., 2020). According to Eq. 2, Wi equals Wj. For each entity in an article, the WCD is equal to 1.0. In contrast to traditional SNA, which ignores the WCD equal to the number of articles, the total WCD is equal to the number of articles (see the panel IV in Fig. 1). The network would look similar to that shown in Fig. 2 when SNA was performed using Pajek with codes in Fig. 2.

For instance, there are two keywords A and B in an article. The $WCD = 2 \times \frac{1}{2} \times \frac{2\times(2-1)}{2} \div (2-1) = 1$. In a similar manner, WCD equals 1 if L exceeds 2. For a specific keyword k, the WCD is the sum of Wi in all articles in Eq. 3.

$$WCD_k = \sum_{j=1}^{n} W_j, \tag{3}$$

whereas $n = 4$ in our study. The WCD_k is thus sized by a bubble in SNA.

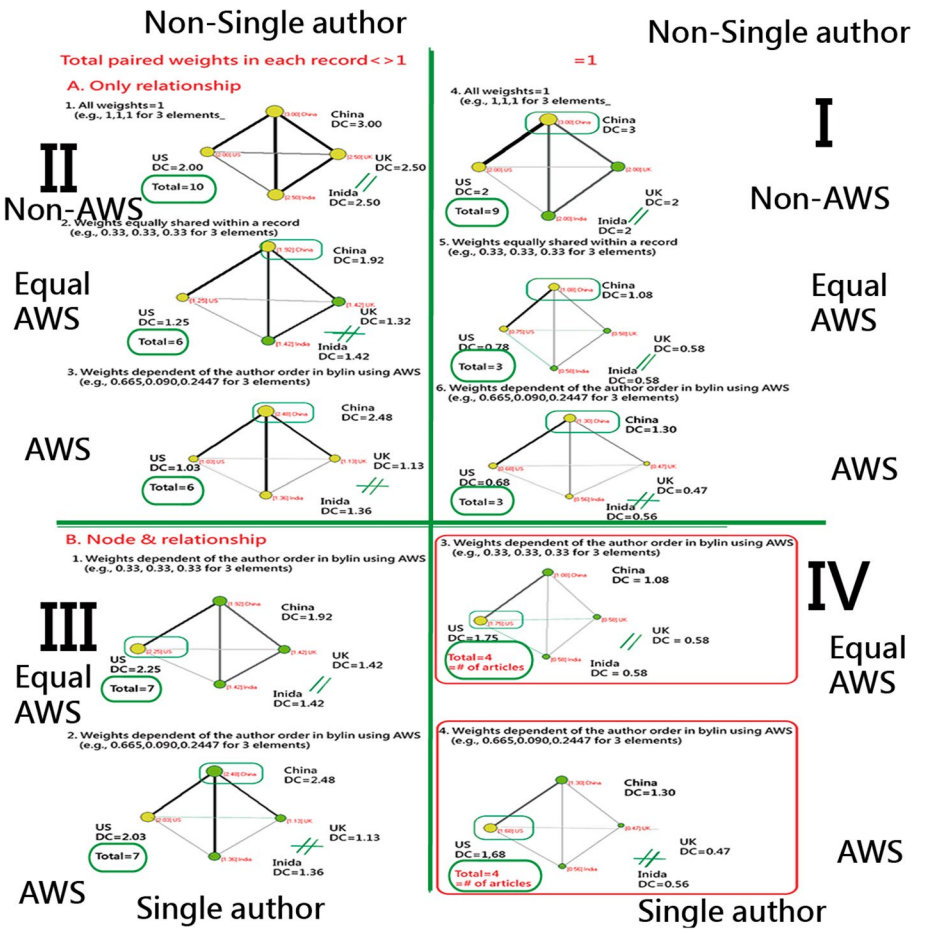

Fig. 1 Four scenarios are visually displayed

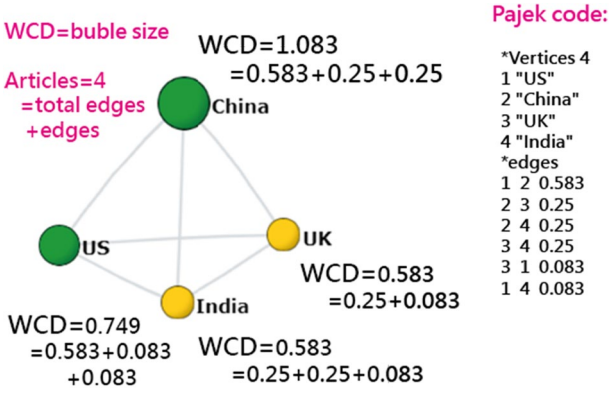

Fig. 2 An example of the scenario with an equal weight assigned to each term based on word co- occurrence in Table 2.

All citation weights equal article number multiplied by citations

In the case of article citations (denoted by the symbol IF), the weights of a specific entity (e.g., WCD in Eq. 2) are combined with IF to calculate the IFWCDk by employing the following equations.

$$\begin{aligned} \text{IFWCD in an article } &= IF \times \left(\sum_{i=1}^{L-1} \sum_{L=i+1}^{L} (W_i + W_L) \right) \div (L-1) \\ &= IF \times 2 \times W_i \times \frac{L \times (L-1)}{2} \div (L-1) \\ &= IF \times 2 \times \frac{1}{L} \times \frac{L \times (L-1)}{2} \div (L-1) = IF, \end{aligned} \tag{4}$$

$$IFWCD_k = \left(\sum_{j=1}^{n} IFWCD_j \right) \div WCD_k \tag{5}$$

$$Citations = \sum_{k=1}^{n} IFWCD_k, \tag{6}$$

where $IFWCD_k$ is the mean IF of entity k. All citations in articles are composed of individual $IFWCD_k$ in Eq. 6. Accordingly, the bubble can be sized by $IFWCD_k$ for each entity.

Conclusion

While VOSviewer (van Eck & Waltman, 2010, 2017) was used to construct and visualize the scientometric networks, the counts within each topical entity were not consistently integrated into a common scheme. Several adjustments should be applied before feeding the relations to VOSviewer (e.g., Tables 3, 5, 7, 8, 9) in SNA, or to other SNA software, such as Pajek (de Nooy et al., 2011) providing the upload files to node sizes and edge values.

If this is the case, all weights in SNA are equal to the number of publications (or citations). Bubbles (or nodes) should be of a reasonable size. With relation-based analyses, the three categories (citation relations, word co-occurrences, and coauthorship relations) could be compared fairly and reasonably more than ever before in traditional SNA.

Authors' contributions JK developed the study concept and design. TWC analyzed and interpreted the data. WC monitored the process of this study and helped respond to the reviewers' advice and comments. TWC drafted the manuscript, and all authors provided critical revisions for important intellectual content. The study was supervised by TWC. All authors read and approved the final manuscript.

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Data availability All data used in this study are available (Chien, 2021a).

Declarations

Competing interests The authors declare that they have no competing interests.

Ethical approval Not applicable.

Consent to participate All data were downloaded from PubMed.

Consent to publish Not applicable.

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