

Terminological recommendations for improving the visibility of scientific literature on martial arts and combat sports

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Abstract

Background and Study Aim:

Martial Arts and Combat Sports (MA&CS) terminology is diverse and heterogeneous, limiting the research visibility and information retrieval. This study points out the different terms related to MA&CS names included in the scientific literature. From this basis, a set of recommendations are offered for improving publication visibility.

Material/Methods:

Web of Science (WOS) databases SCI-EXPANDED, SSCI, A&HCI for the period 2000-2009 were used for generating the data. A list of 278 searching terms was compiled, each of them enter individually in WOS databases. Results were collected in reference management software and filtered manually. Statistical analysis was focused on precision, noise factor, recall and snobbery ratio indexes.

Results:

As far as 53.2% searching terms showed no result, 14.0% obtained some result but not related to MA&CS, and 32.7% showed results related to MA&CS. Specific terminology is quite standardized, although there are some MA&CS showing different names. Generally, a preferred and most common term is used by authors. Precision values vary between 1 and 0.02 (noise factor values vary inversely) while recall values vary between 1 and 0.04 (snobbery ratio values vary inversely).

Conclusions:

MA&CS terminology used in scientific literature is quite varied and can cause diverse problems and slow down researcher's bibliographic data collection. Romanization, popularization of some terms, names given to MA&CS by different organizations and terms syllable separation are the main problems for the lack of standardized terms in this area of knowledge. A group of seven recommendations are provided for enhancing the visibility of MA&CS researches.

Key words:

scientific databases • information retrieval • precision • indexing • documentary analysis

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BACKGROUND

The exponential character of the scientific production development described by scientometrics father Derek John de Solla Price (1922–1983), and recently reviewed by Fernández-Cano, Torralbo and Vallejo [1], nowadays leads to a reality where users and researchers may be surprised by the huge amount of information available about a specific topic. This is not a strange experience for Martial Arts and Combat Sports (MA&CS)

researchers, as this field of study has been rapidly growing during last decades [2–5].

Scientific databases, as resources that collect most of the published works in the academic sphere, are the main tools for searching and extracting relevant information for research. In addition, databases have become more and more important tools for countries, institutions, journals and researchers' scientific evaluation both in local and global levels [6,7]. Therefore, most scientists

Scientific database – A large, regularly updated file of digitized information related to a specific subject or field, consisting of records of uniform format organized for ease and speed of search and retrieval and managed with the aid of database management system software [19].

Information retrieval – The process, methods, and procedures used to selectively recall recorded information from a file of data [19].

Precision – In information retrieval, a measure of search effectiveness, expressed as the ratio of relevant records or documents retrieved from a database to the total number retrieved in response to the query [19].

Indexing – Describing and characterizing a document using the representations of the concepts included on it, aiming to facilitate the effective search of information contained on a document collection [12].

Documentary analysis – A group of operations applied to the form and content of a document [20].

attempt to publish their researches in journals and other document types (e.g. proceedings papers, meeting abstracts, etc.) indexed in the most important scientific databases such as Web of Science (WOS), SCOPUS, MEDLINE, etc.

Nevertheless, the indexation process *per se* does not guarantee the highest visibility for an article. Document retrieval from databases mainly operates through words search, and this can be problematic for MA&CS researchers. MA&CS terminology is very diverse and heterogeneous due to the amount of different styles, schools and martial practices or sports that exist all around the world [3]. Also, romanization of Eastern Martial Arts terms and their adaptation to each cultural context have further extended the diversity and heterogeneity of MA&CS terminology. Therefore, researchers may easily find in scientific literature different terms for the same martial art, such as *Taekwondo*, *Tae-kwon-do*, *Taekwando*, *Taekwandoo*, etc.

The huge amount of scientific literature on MA&CS together with the increasing number of terms related to the MA&CS canopy may cause a limited research visibility and the retrieval of documents. General recommendations for writing and publishing scientific papers are usually provided by different institutions, journals and researches in order to achieve a standard level [e.g., 8–10], but there is a lack of specificity and depth in the use of keywords. These problems as well as the progressive academics' interest about MA&CS were fundamental for exploring the information retrieval based on MA&CS terms and spellings.

The aim of this study is to point out the different terms related to the widespread MA&CS terminology included in the scientific literature. From this basis, a set of recommendations for authors, reviewers and journals publishing MA&CS researches are offered for improving publication visibility.

MATERIAL AND METHODS

Article or review documents published from 2000 to 2009 in Web of Science (WOS) databases such as Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI) and Arts & Humanities Citation Index (A&HCI), were under the scope of this research. WOS databases were selected as world leading scientific databases, indexing the top journals in all areas of the sciences, social sciences, and arts and humanities [11].

A list of 278 searching terms was made up, including the names of different MA&CS (e.g., *Judo*, *Karate*,

Taekwondo), the varied names found for a specific martial art (e.g., *Tai Chi*, *Taichi*, *Tai Ji*, *Taiji*, *Taijiquan*, etc.), and the different generic names used for MA&CS (e.g., *Martial Arts*, *Fighting Arts*, *Martial Sports*, *Martial Ways*, etc.), according to Moreira-Gonzalez's recommendations [12]. This list was created from different sources, such as Green and Svinth's martial arts encyclopaedia, Pérez-Gutiérrez and Gutiérrez-García's MA bibliography or Brakel's MA thesaurus [3,13,14]. Also, new MA&CS names found while searching were added to the list of searching terms.

Terms were entered individually in "Topic" search field of selected databases for data mining. Databases searching rules were carefully considered for improving data retrieval [11]. Results were exported and classified in the reference manager Endnote X3 programme. Two classifications were made, the first based on the same term used for each search (278 categories in this list), and the second grouping the different names of a specific MA or CS in the same category (e.g., *Karate*, *Karatedo*, *Karate-do*, in "Karate" category). This latter categorization was based on Gutiérrez-García, Pérez-Gutiérrez and Calderón-Tuero's work [15], although "Generic" category was adapted for the present research purpose.

Total number of references in each category were exported to SPSS (v. 19) programme for descriptive statistical analysis. The analysis focused on:

1. Precision: the fraction of retrieved documents that are relevant to the search (Precision = relevant retrieved documents / total retrieved documents). In this way, the 1527 relevant results and categories obtained in Gutiérrez-García, Pérez-Gutiérrez and Calderón-Tuero's analysis of the scientific production on MA&CS in the Web of Science databases (SCI-EXPANDED, SSCI, A&HCI) for the period 2000–2009 were taken as reference [15].
2. Noise factor: the fraction of retrieved documents that are not relevant to the search (Noise Factor = non relevant retrieved documents / total retrieved documents).
3. Recall: the fraction of the documents that are relevant to the search that are successfully retrieved (Recall = relevant retrieved documents / total relevant documents).
4. Snobbery ratio: the fraction of the documents that are relevant to the search that are not successfully retrieved (Snobbery ratio = relevant not retrieved documents / total relevant documents) [16].

RESULTS

A group of 148 of the 278 searching terms (53.2%) showed no result. Another 39 searching terms (14.0%)

obtained some result but they were not related to MA&CS. Finally, 91 searching terms (32.7%) showed results related to MA&CS.

Table 1 shows the total and relevant results achieved for related MA&CS spellings (queries without results are not included). As it can be observed, 17 MA&CS spellings with relevant results were unique (e.g., *Aikido*, *Archery*), while 14 had two or more different spellings with relevant results (e.g., *French Boxing* and *Savate*). Normally, there exists a preferred term when appearing different names for the same MA or CS, that is, the term that shows the highest number of relevant results (e.g., *Jujitsu*). Also, there exists an important diversity related to generic terms for MA&CS.

Some MA&CS terms retrieved a high amount of results but with scarce or even no relevance, like *Ati* (551), *Sumo* (1593), *KI* (3624) or *MMA* (4630). On the contrary, other related terms just retrieved a scant number of documents and with several grades of relevance. Precision and recall analyses would explain in depth those results.

According to the most relevant MA&CS terms shown in Table 1, Table 2 illustrates the results of precision and recall analysis. Noise factor is directly related to precision and varies in inverse proportion, observing the highest rates in those terms with the lowest precision. In the same way, snobbery ratio varies in inverse proportion to recall.

The highest precision (value = 1) was achieved by 13 MA&CS terms. Another 16 terms achieved values equal or over 0.50 but <1, while 1 term achieved values between 0.20 and 0.50, and 5 terms achieved a lower precision (value <0.20).

Regarding recall, 11 MA&CS terms achieved perfect values (recall =1, snobbery ratio =0). 21 terms achieved values equal or over 0.50 but <1, while one 1 term achieved values between 0.20 and 0.50, and 2 terms lower than 0.20. It is interesting to note here that some other categories depicted in Gutiérrez-García, Pérez-Gutiérrez and Calderón-Tuero's work [15], referred to Canary Islands martial practices, *Kenjutsu*, *Kyudo* and *Ninjutsu* did not obtained any result.

DISCUSSION

According to the methodology used and WOS databases production and functioning rules, some generic considerations should be taken into account. Firstly, quick, general or advanced search within the "Topic" field, the most inclusive one, is carried out in each paper title, keywords, abstract and keywords plus. As WOS

workbook details [11, p. 10], foreign language abstracts (not English) are not indexed and author keywords are indexed when provided. In that respect, authors and journals should provide always keywords and English abstract for their papers in order to reach the maximum visibility of their results.

For example, in the journal *Archives of Budo* (indexed and abstracted in: Science Citation Index Expanded, Journal Citation Reports/Science Edition since 2009 – including the publications since 2005) has not been exhibited among keywords UNIFIGHT [17]. It is a modern combat sport (a combination of different ways of unarmed combat, fought rounds system, with the first round is an obstacle course) with Olympic aspirations – Winter UNIFIGHT version. Also, probably omitting in the keywords many publications of the *Krav Maga* is the reason that this popular martial art (not only in Europe), did not appear in this analysis.

Secondly, WOS workbook suggests searching a range of years for complete retrieval since the year selection refers to the processing year [11, p. 17]. Therefore, users of WOS databases should be aware of this limitation, choosing a broader time range for their searches even though the number of retrieved documents would be higher. Later, filtering options according to publishing year could solve the high number of retrieved documents problem in most of the cases.

And finally, when a search is composed by two or more words, quotation marks should enclose them for a straight retrieval since an implied "AND" connects entered terms as a phrase by default [11, p. 20]. Moreover, there are some words defined as "stopwords" that are useless if they are not connected with other term. For instance and in close relation to MA, "Do" term (meaning "Way" in Japanese), referred in several martial arts as "*Karate-do*" or "*Aiki-do*", is included in the stopwords list. Also the term "Way" is included in this list, and this is the reason why "Martial Way" search shows a large results list but not very precise (the databases only look for the term "Martial"). Therefore, future users or academics should avoid those "stopwords" and familiarize with search and truncation rules.

In respect to obtained results, 53.2% of the terms listed were not used by the authors, since they refer to MA&CS works that have not been indexed in the studied databases yet (e.g., *Aikijutsu*) or to MA&CS terms that have not been utilized (e.g., *Kenpo*). Since MA&CS research has been increasing its productivity and visibility in the last years, it is likely that some terms that do not retrieve any documents at present will do so in a short period of time. Therefore, it is recommended that authors

Table 1. Total and relevant results achieved for related MA&CS spellings.

Term	Results	Relevant	Term	Results	Relevant
Aikido	18	18	Mixed Martial Arts	13	12
Aiki do	2	0	Grappling	227	0
Archery	66	7	K1	3624	0
Arnis	1	0	MMA	4630	5
Ati	551	0	Shooto	1	0
Bagua	2	0	Street fighting	9	0
Bando	35	0	UFC	257	1
Boxing	312	176	Vale todo	1	1
Pugilism	3	2	Vale tudo	1	1
Capoeira	31	19	Muay Thai	6	6
Chausson	1	0	Muay Thay	1	1
Combat Sports	59	57	Muaythai	1	1
Combative sports	5	5	Thai boxing	3	3
Fighting sports	5	5	Mukumbusu	1	1
Martial sports	1	1	Pakua	6	0
Dambe	4	0	Pancration	1	1
Fencing	462	51	Professional wrestling	18	18
French boxing	3	2	Pro wrestling	5	4
Savate	1	1	Catch as catch can	58	0
Full contact	126	0	Qigong	173	139
Gumdo	1	0	Chi gong	1	1
Hapkido	1	0	Chi gung	1	1
lai do	165	0	Chi kung	6	3
Indian wrestling	1	1	Qi gong	22	13
Jailhouse Rock	1	0	Rough and Tumble	50	1
Jeet kune do	1	1	Sambo	13	0
JKD	2	0	Self defense	481	29
Jodo	7	0	Self defence	113	6
Judo	224	195	Sereer wrestling	1	1
Jujitsu	10	6	Silat	5	4
Jiu jitsu	4	2	Pencak silat	3	3
Ju jitsu	3	2	Soo bahk do	2	2
Ju jutsu	1	1	Ssireum	1	0
Jujutsu	1	1	Stick fighting	1	0
Kalapariyatt	1	1	Sumo	1593	18
Kalarippayattu	1	1	Taekwondo	55	48
Kali	170	0	Tae kwon do	23	10
			Taekwando	2	2
			Tae kwan do	1	0

Table 1 continued. Total and relevant results achieved for related MA&CS spellings.

Term	Results	Relevant	Term	Results	Relevant
Kapap	1	0	Taekwando	1	1
Karate	189	107	Taekwon do	12	12
Kempo	1	1	Tai chi	404	299
Kendo	17	12	Tai Chi Chuan	70	63
Kickboxing	15	11	Tai ji	7	7
Kick boxing	5	2	Taiji	25	10
Kobudo	1	0	Taijiquan	5	5
Kung Fu	32	25	Taiqi	1	0
Gong fu	1	0	Wrestling	364	165
Wushu	9	7	Yawara	1	0
Kyu do	21	0	Yongchun	2	0
Martial Arts	215	205	Yongmudo	1	1
Budo	16	9			
Bugei	2	0			
Bujutsu	1	1			
Martial Ways	555	238			
Fighting arts	2	2			

and editors should be aware of the preferred terms related with their works and articles at international level in order to standardize them in scientific literature as was observed in the above mentioned 17 MA&CS spellings. Other related terms may also be included despite this suggestion, for example, authors or editors may consider the indexation of pinyin romanized term “*Taijiquan*” instead of the usual “*Tai Chi*”, or “*Budo*” before “*Martial Arts*”, for their own reasons. The preferred term used in scientific literature (e.g., *Tai Chi*, *Martial Arts*) should be included, at least, in some of the most common databases indexing fields (i.e., title, abstract, keywords).

According to precision and complementary noise factor results, *Archery*, *Fencing*, *Rough and Tumble*, *Self Defense* and *Sumo* achieved the lowest results for different reasons. *Archery* is a term widely related with its practice as a competitive sport, as a technique for hunting or as a decorative element in architecture. Moreover, *Fencing* and *Sumo* are polysemic terms that are used in agricultural field and medicine respectively, while *Self Defense* and *Rough and Tumble* are referred to several aspects in a real or metaphorical way not related to MA&CS. Terms with a high amount of retrieved documents, like *Wrestling*, *Boxing* or *Karate*, also achieved a 0.5 precision due to their metaphorical meaning in the first two terms and its use in the agrochemical field for the last one. In these cases, a broader term should be included in the

The same terms separated by a space or a hyphen (e.g., kick boxing and kick-boxing) have been gathered as WOS databases searching rules ignore hyphens (similarly other databases such as SportDiscus or Scopus). Also, WOS databases consider the word “do” as a “stopword”, so a MA or CS term and the same name followed by “do” have been also gathered (e.g., karate and karate-do).

indexing fields for facilitating user’s searches through a combined query of demanded terms (e.g., *Fencing* and *Combat Sports*), avoiding its manual filtering process and improving the collection of information. This recommendation may be applied to those terms included in the general list that did not retrieve relevant documents but a high percentage of non-relevant documents as well (e.g., *Ati*, *Bando*, *Full Contact*, *KI*, *MMA*, etc).

In this point, keywords plus should be explained for better understanding the precision and noise factor measures. Since keywords plus are derived from the titles of the cited references in every article [11], some of the keywords plus terms may be referred to any of the theoretical background studies supporting the present article, and so increasing the noise factor index of that term (e.g., “*Tai Chi*” as keyword plus in relation to studies about balance in older people, even if those studies have nothing to do with *Tai Chi*).

On the contrary, there are some specific terms that achieved the highest precision like *Aikido*, *Kempo*, *Muay Thai* or *Pancration* just for naming a few, so authors and editors should consider these terms as the best ones for their works. Nevertheless, a high percentage of precision does not involve a straight information retrieval of relevant documents about a specific theme (or vice versa); so, recall and snobbery ratio have to be consulted for completely assessing the present results.

Table2. Preferred MA&CS terms retrieval, precision, noise factor, recall and snobbery ratio.

Term	Total relevant results*	Results	Relevant	Precision	Recall
Aikido	19	18	18	1	0.95
Archery	8	66	7	0.11	0.87
Boxing	210	312	176	0.56	0.84
Capoeira	19	31	19	0.61	1
Combat sports	1527	59	57	0.97	0.04
Fencing	55	462	51	0.11	0.93
French boxing	2	3	2	0.67	1
Indian wrestling	1	1	1	1	1
Jeet Kune Do	1	1	1	1	1
Judo	232	224	195	0.87	0.84
Jujitsu	12	10	6	0.60	0.67
Kalaripayatt	2	1	1	1	0.50
Kalarippayattu	2	1	1	1	0.50
Karate	122	189	107	0.57	0.88
Kempo	2	1	1	1	0.50
Kendo	13	17	12	0.71	0.92
Kickboxing	15	15	11	0.73	0.73
Kung Fu	32	32	25	0.78	0.78
Martial arts	1527	215	205	0.95	0.13
Mixed martial arts	15	13	12	0.92	0.8
Muay Thai	7	6	6	1	0.86
Mukumbusu	1	1	1	1	1
Pancration	3	1	1	1	0.33
Professional wrestling	19	18	18	1	0.95
Qigong	162	173	139	0.80	0.86
Rough and tumble	1	50	1	0.02	1
Self defense	35	481	29	0.06	0.83
Sereer wrestling	1	1	1	1	1
Silat	4	5	4	0.80	1
Soo Bahk Do	2	2	2	1	1
Sumo	18	1593	18	0.01	1
Taekwondo	76	55	48	0.87	0.63
Tai Chi	312	404	299	0.74	0.96
Wrestling	173	364	165	0.45	0.95
Yongmudo	1	1	1	1	1

* Based on Gutiérrez-García, Pérez-Gutiérrez & Calderón-Tuero's research data [15].

According to recall, most of the preferred terms are higher than 0.80, showing the relevance of their indexation over those related terms listed in Table 1. MA&CS such as *Kalaripayatt / Kalarippayattu*, *Kempo* and *Pancration* should be mentioned due to their recall, but the total number of relevant documents collected in their own categories is very scarce. *Taekwondo* (0.63), *Jujitsu* (0.67), *Kickboxing* (0.73) and *Kung Fu* (0.78) achieve a higher total number of relevant documents, and the information loss showed by recall index may slow down the searching and collection of their related studies. In the same way, a recall rate over 0.80 may depict a great amount of lost of information, especially in those terms with a high number of results, like *Judo*, *Boxing*, *Wrestling*, *Qigong* or *Karate*. For improved information retrieval, researchers should undertake other strategies, such as truncation rules, the use of wildcards (e.g., box* or wrestl*), although these techniques must be used carefully since they may also raise the noise factor), or be aware and introduce the several MA&CS terms regarding their scope.

On the other hand, some spellings collected in Gutiérrez-García, Pérez-Gutiérrez and Calderón-Tuero [15], such as Canary Islands' martial arts, *Kenjutsu*, *Kyudo* and *Ninjutsu* did not retrieve any relevant result in our research, indicating a loss of information and problems related with a proper indexing strategy (i.e., authors did not use the MA names in indexed fields). Thus, MA or CS name should be added in any of the research indexing fields.

Finally, according to MA&CS general terminology, Table 1 results distinguish between those sports-oriented (e.g., *Combat Sports*, *Combative Sports*, etc.) or martial-oriented terms (e.g., *Martial Arts*, *Budo*, *Bugei*, etc.). First examples of both orientations are clearly preferred among the other related spellings, but "*Martial Arts*" achieved a higher rate within scientific literature. Thus, the term "*Martial Arts*" is usually interpreted as referring to Asian martial arts while those Western martial arts such as *Fencing* or *Boxing* used to be classified as *Combat Sports*. Nevertheless, modern literature includes non Asian combative traditions in the Martial Arts concept. For example, Green and Svinth define martial arts as "systems that blend the physical components of combat with strategy, philosophy, tradition, or other features, thereby distinguishing them from pure physical reaction" [3, p. xix]. Considering these circumstances, the "*Martial Arts*" term is proposed for indexing the specific literature under this scope since it is the most relevant and integrative one. At least, both terms should be included in the indexing fields if researchers consider that "*Combat Sports*" term is more accurate to their

goal. According to the great amount of terms related with the *Mixed Martial Arts* and the high noise factor achieved by some of them, "*Mixed Martial Arts*" term should be included always.

CONCLUSIONS

MA&CS terminology is quite varied causing diverse problems and slowing down researcher's bibliographic data collection. Romanization, popularization of some terms, names given to MA&CS by different organizations and syllable separation are the main problems for the lack of standardized terms in this area of knowledge.

From the present study, the next recommendations should be extracted in relation to the terminology used for enhancing the visibility of MA&CS research. These recommendations may be followed by authors/academics but also by those people involved in articles reviewing, editing or indexing processes:

1. Always provide English titles, keywords and abstracts.
2. Databases searching rules, features and limits should be well known and considered.
3. Enter the most common term for each MA&CS (Table 2) in the indexing fields.
4. In those MA&CS terms that have not been used yet, get information and choose the most common term labelling them internationally.
5. Include "*Martial Arts*" and "*Combat Sports*" terms in the indexing fields, but mainly the former. This is especially important in those terms achieving a high rate in noise factor measure or with a low number of results due to its lack of research at present.
6. Choose "*Mixed Martial Arts*" term for designating the several styles practiced regarding this topic.
7. For now, and until MA&CS terms standardization in scientific literature is achieved, be aware and include the several known terms and spellings in relation to each MA or CS in your databases searches.

Finally, authors would like to emphasize that although MA&CS terminology standardization is not claimed in this paper, academics are encouraged to take into account these recommendations for the higher visibility of their publications and subsequent facilitation for the researchers' bibliographic searches as it has been stressed in past events [18].

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