Universities' Global Ranking Criteria Modification According to the Analysis of Their Websites

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Abstract:
Global universities are subject to the academic ranking every year. One of the common ranking types that are applied annually is called the Academic Ranking of World Universities (ARWU). It developed by a team of researchers and experts. The ARWU is composed of a set of common criteria related to academic tasks and it does not include any indication or factor relevant to the recent technology, such as the websites of universities. Actually, there is a lack to find out the relationship between universities' global ranking and their website features. Therefore, this research aimed at updating the current ranking model by adding a new criterion reflexing the websites' features related to its contents and structure. This research focuses on universities as two classes; ranked and unranked. This process includes; extract, analyze websites' datasets, visualize the initial results, study the relationship and the significant differences between the two classes if found, and modify the ARWU by updating the criteria list & their weights. A special S/W tool applied to analyze websites and to extract the required data. This research contributes to modify and enhance the ARWU model to be more comprehensive than the current one. The involvement of universities' websites in the ranking process will encourage universities to improve their websites to achieve a higher-ranking level amongst leading universities. Furthermore, it gives a good chance for all universities to participate in the global ranking competition, especially the universities that have excellent outcomes and perfect websites.

Keywords:
Universities Evaluation; Academic Ranking; Ranking Criteria; Hyperlinks Analysis; Data Extraction; Data Analysis; Learning Outcomes.

1. Introduction

This research is focusing on an important topic that is relevant to Internet technology and world universities evaluation criteria. The University website contains a huge amount of data and information, exceeds Gigabytes and Terabytes, which can be employed in many important applications. One of them is to improve the global ranking model of universities that helps both students and research assistants to apply for higher education program acceptance (MSc or PhD) in leading universities. A number of world countries suggest a set of conditions to those students, who plan to get scholarships from the Ministry of Higher Education or any other organizations to continue their studies. One of the more common required conditions directs students to get opportunities for MSc or Ph.D. They request one of the top 100 universities (first 100 ranked universities) in the world, in the field of specialization.

In particular, a number of researchers highlight of this issue for instance, Horstschräer analyzed how high ability students react to various indices of university quality, when applying for a university and answered to the following question: are expected students influenced by quality factors of a university ranking or by an excellent status awarded within a national competition? The results show that the ranking adds more related information[1]. On the other hand, Pintar et al. Carried out an important study performed in this regards to analyzing the most popular websites that are offering E-learning courses of currency trading or foreign exchange[2].

Some universities may not care much about their website structure, design, and content. Some of these websites are weak and have a limited functionality and features. This, in turn, is affecting the university level, quality, marketing of educational services, facilities provided to students and researchers, local and global society. The research problem concentrates on the lack of employing the recent technology as a contributor in the Global ranking with other factors. The research aims to modify and enhance the ARWU model accuracy based on an analysis of a set of universities' websites, to improve the global ranking model. A special software tool applied for website analysis to extract the required data, based on the contents and structure of Hyperlinks, which represent a treasure of Datasets, consisting tens of thousands of links, sub-links, data items, millions of components, etc. The main idea of this work established according to the perspective reported by[3] to extend his research work. The significance of this research comes from the results, that show a new level of knowledge discovery and reflect the real relationship between a university rank and its website' attributes. The proposed criteria will improve the ranking method of global universities help universities to accomplish high rank, and to provide a competitive learning through improvement of its official websites on the internet. This stimulates university to develop, revitalize and compete in their

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official websites with other local, regional and international universities.

2. Literature Review

Many universities in different areas of the world are subject to ranking process every year. There are a number of methods used for universities classification and ranking. A few of these methods concentrate on the educational achievement and the services provided for the academic teaching in all domains [4]. One of the common ranking types applied annually is the ARWU in Shanghai Ranking Centre at Jiao Tong University in China. Usually, accomplishes depends on a number of standard criteria previously identified by a team of professionals. The focus in this type of ranking is on universities' learning outcomes, research harvest, books and literature, community service, support industrial, technical, scientific awards, and other aspects.

The ARWU model consists of four basic criteria and six indicators, with six evaluation values/scores, which assigned to rank any university. The indicators include; total number of alumni, winning Nobel Prizes, Medals, awards, highly researchers citation number, and a number of indexed & published papers in the leading journals' databases [5], [6], and [7], as shown in Table 1.

Table 1. Current Indicators and Criteria for ARWU [7]

Criteria / factor	Indicator	Code	Weight
Per Capita Performance	Per capita academic performance of an institution	PCP	10%
Research Output	Papers published in Nature and Science*	N&S	20%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	20%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	20%
	Highly cited researchers in 21 broad subject categories	HiCi	20%
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	10%
Total			100%
* For institutions specialized in humanities and social sciences such as London School of Economics, N&S is not considered, and the weight of N&S is relocated to other indicators.			

The ARWU depends on the indicators of the rate of the scientific and research publications compared with the size of the university getting Prize or Fields Medals, Nobel education quality, and the quality of academic staff [4]. Based on this ranking, the universities' leaders can understand and realize the level of scientific performance through a number of years.

Universities require these rankings to maximize the research outcomes by taking part in global research works, attracting undergraduates, postgraduates, and researchers. The research would provide valued knowledge to increase the quality of websites of universities as contents and structures. Various studies covered this subject, such as [8] that stated a comparison between the webometrics based on rankings of global universities with the classifications, using the traditional parameters (non-webometrics) such as educational quality, requirements, resources quality, staff experience, and research outcomes.

Dill and Soo, reported, "There are roughly more than 50 major ranking methods in use around the world, which use hundreds of different indicators. These indicators broadly fall into eight categories" [9]. Many universities and organizations maintain lists of university ranking according to an academic value, which is different from website visibility ranking [10]. The international academic ranking, which is comparing world universities has proliferated recently, in accordance with letter conceptual and methodological advances in academic ranking approaches [11].

Some university ranking methods established for the national and global level. Although these methods have attracted attention, they criticized due to a number of issues such as the unworthiness of indicators chosen, the scoring procedure implemented and weighing [12]. The ranking of an international university leads to forwarding push in the direction of excellent level for universities globally. There is therefore growing recognition, in both developing and industrial countries, of the need to establish one or more world-class universities that can compete effectively with the best globally [13].

Currently, the Internet services include a complex system of hybrid websites with huge amounts of data and information. The website is a massive data repository that represents a huge data warehouse or a Big Dataset employed for information retrieval and knowledge extraction over the past years from this treasure of data and information. Many educational applications of Big Data can be achieved based on accumulated data [14], created for learning, teaching, and administrative in the education sector [15].

Many analysis tools developed and used for website analysis. An algorithm applied for link analysis purpose by [16], while other research focuses on the development of an algorithm and S/W tools for link analysis to collect an

oriented dataset then to extract some invisible features from these data. The aim was to measure the websites development cost[17].

A semantic and neural based E-commerce algorithm of page ranking developed, this algorithm implemented in the form of website ranking tool that utilized for ranking of E-commerce websites. The objective was to assist the customers in finding related homepages on the top when they search to find a specific product. The owner or user may specify the criteria to compare the competitive E-commerce website and to get their rank as per requirements easily [18].

Another study accomplished to evaluate web metrics for 10 Saudi universities as examples, to analyze their web pages, they used the Woo-Rank analytics tool that was considered as a professional Search Engine and Optimization Techniques (SEOT) tool to analyze different website features include; domain strength, link architecture, backlink, social media reputation, and Keywords Analysis [19]. The website analysis is concentrating mainly on web structure, which is a quantitative study of hyperlinks that connect all web pages together [20], link analysis represents the website structure and contents, it is a type of information retrieval [21]. The number of links embedded in an academic website might be proportional to the research outcomes at the university level [22], or colleges, and department levels [23], with a limited productivity of individual researchers [24]. Various search engines are applied for website analysis include; Majestic Google, SEOT, Bing, and Yahoo get necessary information through this analysis, which applied for many attributes; document types, number of web pages, and external links to the medical universities websites in Iran. Findings have shown an important relationship between the university rank placed under analysis and the webometric value by [25]. Until right now, there are few studies concentrates on the website's components such as document files, website contents, website structure, and page links. One of the few studies that used rich files to examine universities websites accomplished in 2011. The objective was to analyze and study the webometric for various aspects of the website including its contents, structure, topology, organization, interconnections, characteristics, design, and development [16].

Universities' websites have significant features can be employed for continuing academic evaluation, also, for visibility and usability of a website, which are types of the most important measures of the website quality. This field is a popular subject in various websites apart from their usage and application [26] and [27]. Other similar studies achieved with a main intention of the investigation to learn the impact of 19 universities in Sri Lanka country for webometric analysis based on the hyperlinks [28]. Especially, the analysis of websites can be connected with the global ranking process of universities based on website data analysis, the creation of new indicators, and developing of evaluation procedures. For example, a study of carrying out to analyze the contents of the websites and to suggest a combined indicator for global universities ranking[29].

In addition, in this respect, a number of studies investigated a number of academic websites. These studies directed to encourage access to academic data, knowledge, improve the learning activities, and educational abilities of a university. Also, they are a valuable means for users' websites, according to many Datasets were established [29], [30]. Improving the academic websites of universities, according to the indicators of a webometric leads to attention and supports to get higher level on the ranking list [25], for instance, the Website Impact Factor (WIF) of a 99 Arab University website investigated from 20 countries, the AltaVista search engine was employed for the calculation. Results presented that about 56% of these universities had a high websites absence. A number of Saudi Arabian Universities got the top rank of all Arab universities list in terms of the presence of their websites and followed by four Jordanian universities [31]. During the period (2006 - 2012), a few studies have carried out on the websites indicators. A webometric analysis of South Asian Association for Regional Cooperation (SAARC) countries achieved. In part of this study, the Aguillo website indicators used for Science, Technology, and Innovation Research (WISER) formula for the ranking process. WISER ranking formula = log (Visibility 50%) + log (Size 20%) + log (rich files 15%) + log (Google Scholar 15%) [28]. The previous formula focuses on partial contents of a website, likewise, [32] measured the university's website presence and its Impact Factor using different search engines and used the same formula applied by [28].

In addition, [33] analyzed the presence of more than 170 Indian university websites. It found that a number of critical factors, which are relevant to some educational outcomes and research activities. Lee and Park proposed that "indicators of website visibility can function as a proxy measure of classic university rankings" [34].

As explained above, it can say that university website contents and structure can be analyzed then employ the analysis result as an important factor contributes to the global ranking model enhancement for this university. In this research, a modified version of the ranking criteria will be updated by including new criterion which is "University website" as a weighted criterion will be added to the ARWU model as a modified ranking model of world universities.

3. World Universities' Ranking Model

A number of criteria/indicators employed in the ARWU as universities ranking model, such as research performance,

staff winning famous prizes, medals related to the fields creatively, highly cited researchers, papers published, cited, and indexed in leading journals. Each indicator in Table 1 has a value or score, the top scoring university allocates a score = 100, and other universities are calculated as a percentage of the top score. The distribution of values for each indicator is examined for any significant distribution effect. Each indicator has a score with a specific weighting value, to reach at overall the final score for a university [35].

4. Research Methodology

This section discusses the research methodology. It includes a sequence of tasks. First, data extraction using the S/W tool developed by[17]. Second, gathering two data samples, third, data analysis. Fourth, study the relationship between university website components besides its ranking level. Finally, model modification. The outlines of the research methodology presented in Fig. 1.

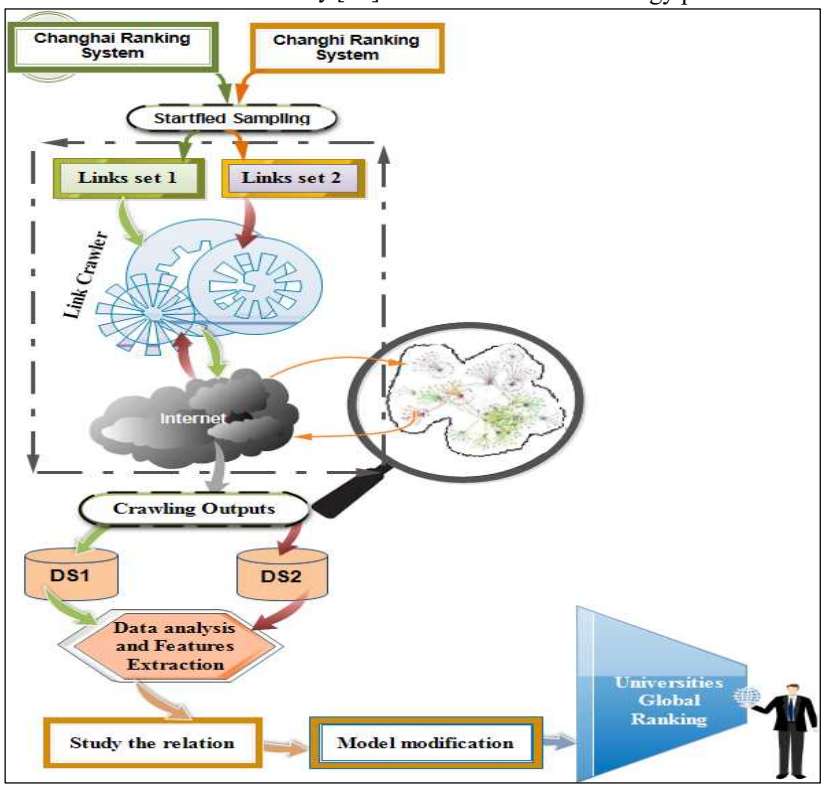

Fig. 1. Methodology layouts

The details of the research methodology presented in the following points:

1. Gathering a Sample of 62 universities selected from the top 200 ranked universities classified in Chinghai ranking list 2016.
3. Use the Stratified Sampling method to gather a sample of 62 universities from various continents around the world that did not rank or classify at any previous time.
4. Preparation of two lists of website addresses, as in the second column of Appendix A and B.
5. Apply the selected S/W tool, to run 124 experiments to analyze all hyperlinks of these addresses for each sample, save the collected data.
6. Extract the required data from that collected set as records organized in two tables, each table contains 10 attributes for each sample (as shown in column 3 to 12 in Appendix A and B.).
7. Analysis the datasets and compare the initial results according to the visualization process, then, study the relationship between the two classes of results.
8. Modify the ARWU model in case there is a big difference in the initial results between the two classes of (ranked and unranked universities), as follows:
   - Assigning a new criterion and its weighting value.
   - Modify the weights of the other criteria.
   - Design of the ARWU Modified Model components.
9. Calculate the WSC Value and apply some examples.

5. Research Datasets

The datasets used in this research collected from a number of universities. It includes two parts; the first is a sample includes data from universities involved in the global

ranking list 2016 denoted by (DS1) contains 62 universities selected from top 200 Ranked Universities list. The second is a sample of universities have not involved at any time in the global ranking. It denoted by (DS2), contains 62 websites selected randomly based on the Stratified Sampling method from all world countries. The contents of DS1 and DS2 are a statistical summary of the extracted data, which comprise hundreds of thousands of links, tracks, and millions of components.

The collected data consist of a list of 10 attributes such as Total Links (TL), External Links (El), Internal Links (IL), Total Number of Leaves (TNL), Analysis Time Rate (ATR), Total Number of Pages (TNP), Total Number of Images (TNI), Total Number of Docs(TND), Analysis Time/Seconds (AT), and Maximum Number of Levels (MNL). The real values of these attributes illustrated in Appendix A and B.

6. Data Analysis and Interpretation of the Initial Results

The data analysis is showing the initial results, it accomplished to find out the relationship between universities' global ranking and their website features. The initial results presented in the following figures, it shows a number of interrelationships in terms of the given attributes of the data. Fig. 2 illustrates the relationship between the total analysis time for the two samples (ranked and unranked universities). The minimum value of this attribute = 76.7 Milliseconds (MS). It ended with a maximum value = 283376.5 MS and the average value was = 10649.9 MS, whereas the values of the other sample started by = 21.45 MS, the maximum value = 5218 MS, and the average value = 557.3 MS. Note that the analysis process is going to 20 levels in depth for each website's in the most of the paths. The analysis time for the ranked universities has higher results in values, as displayed in Fig. 2 and in Appendix A and B.

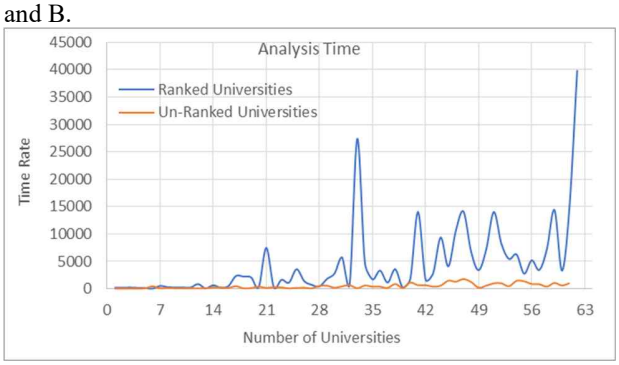

Fig. 2. Time Comparison

The attribute is shown in Fig. 3 shows the number of leaves (end pages when imagines a website as a spanning tree with various paths) for all websites. It found that the values of this attribute in the first sample (ranked universities) started by a minimum value = 1771 paths. It ended by a maximum value = 6682014 paths and its average value = 251083.7 paths, whereas the values of the second sample (unranked universities) started by a minimum value = 115 paths and ended by maximum value = 211735 paths, the average value = 21952 paths. It noticed that all ranked universities with this attribute have higher values except one or two cases.

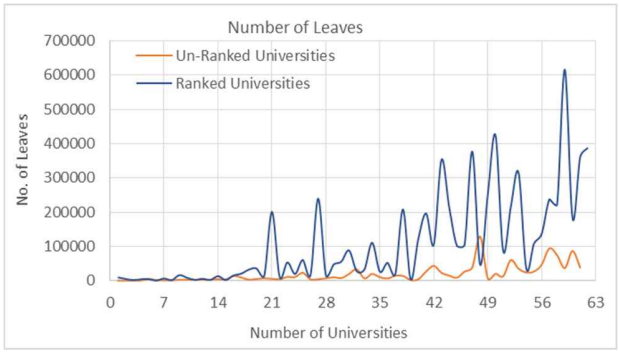

Fig. 3. Number of Leaves / Paths Comparison

Fig. 4 shows the number of pages of each website in each sample. From the results analysis, it found that the values of this attribute in the first sample started with a minimum value = 108 pages, ended with a maximum value = 305888 pages and the average value was 11496.8 pages, whereas the other sample values started by a value =29 pages and a maximum value = 6362 pages, where the average value = 933.4 pages. In addition, it noticed that the ranked universities according to this attribute have high values for 95% of the total pages.

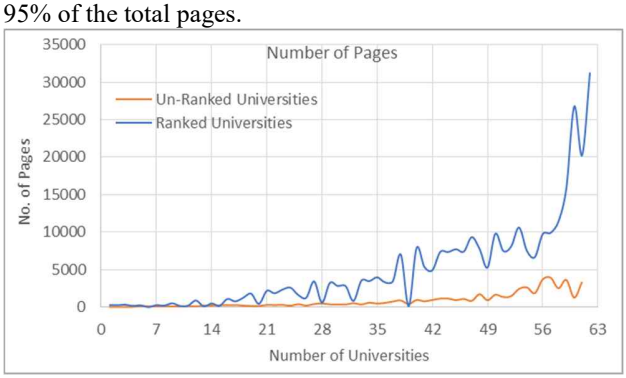

Fig. 4. Websites Pages

Fig. 5 displays the relation between the ranked and unranked universities regarding the total number of links that constitute the website structure. Based on the analysis of the results, it found that the values of this attribute for the first sample started with a minimum value = 1159 links. It ended by a maximum value = 506396 links and the average

value = 18982 links, whereas the values of the second sample started by 40 links and ended by a maximum value = 10510 links, its average value = 1394.8 links. It found that the ranked universities with this attribute have higher values for the most websites, likewise, when the university rank is high, the values of this attribute is also high.
As shown in the same figure, a few numbers of ranked universities have lower values (about 22%) and the rest is high, but about 70% of the unranked universities' values are low.

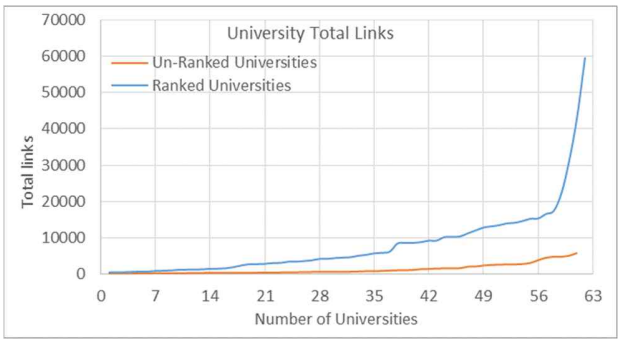

Fig. 5. Number of Total Links

Fig. 6 illustrates the total number of internal links for each website in both samples. The values of internal links for the first sample started by a minimum value = 6 links, ended by a maximum value = 397999 links and its average value = 12832.6 links, while the second sample values started by a value= 40 links, ended by a maximum value = 8234 links, and its average value = 1356 links. Based on the average value, it found that the ranked universities with this attribute also has higher values. A few number of websites have lower values within the ranked universities. It noticed that whenever the university rank is high, the value of this attribute is also high; just three to four cases have low values, as shown in Fig. 6.

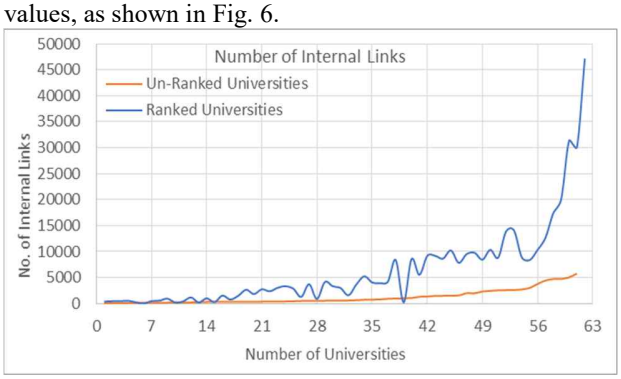

Fig. 6. Websites Internal Links

Fig. 7 presents the relation between the ranked and unranked universities regarding the total number of external links, which links any website with other similar websites relevant to the same class. The values of external links for the first sample started by a minimum value = zero links, ended by a maximum value = 108397 links, and it has an average value = 3497 links, whereas the second sample has a minimum value = zero, maximum value = 2276 links, and it has an average value = 39 links. Based on the average values of these samples, it found that the ranked universities, according to this attribute has the highest values with few numbers of websites that have very low values, while the unranked universities have very low values in the whole sample.

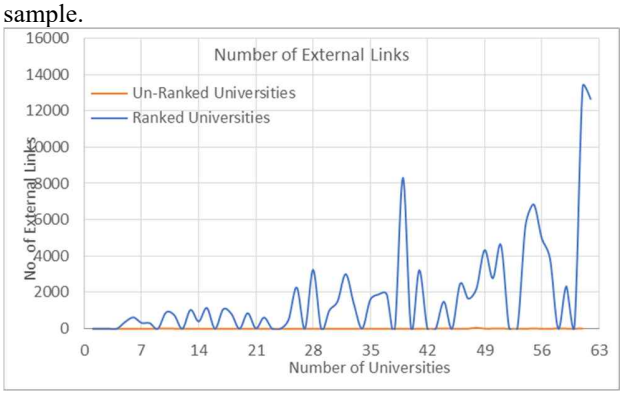

Fig. 7. Websites External Links

Fig. 8 illustrates a type of websites contents (documents), it presents the relation between the ranked and unranked universities regarding the total number of documents in each website in the sample. The total number of documents for the ranked universities started by a minimum value = zero documents and ended with a maximum value = 29797 documents. The average value = 961 documents, while the unranked universities' values have a minimum value = zero documents and a maximum value = 1951 documents with an average value equal = 190.6 documents. The document type can be MS-Office, pdf, zip files, etc. Based on the average value of documents, it found that the ranked and unranked universities with this attribute have similar values to some extent, a few values for the ranked universities still high as in Fig. 8.

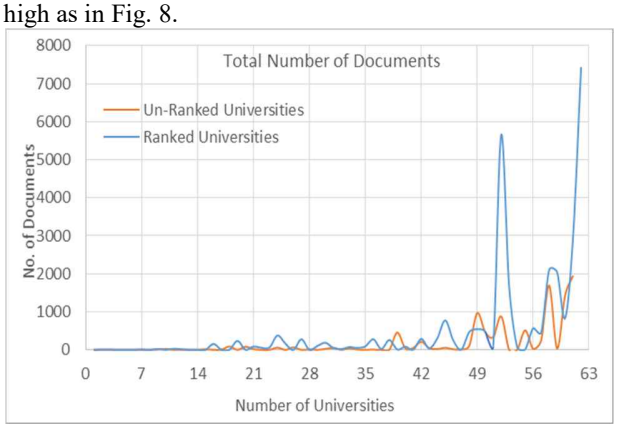

Fig. 8. Websites Documents Statistics

7. Model Modification

The presentation of the initial results above is showing a strong relationship between the websites components and the state of a university (ranked or unranked), this, in turn, leading and supporting the Modification and addition of new criterion "university website" to the ranking criteria's list of Table 1, to contribute to modify the Chinghai Ranking model for world universities.

7.1 Assigning a New Criterion

The ARWU model criteria modified by adding a new important criterion to the current set, therefore the current criteria extended to five instead of four, see the modification in Fig. 9 and Table 2.

Table 2. A Modified Indicators and Weights for ARWU

Criteria / factor	Indicator	Code	Weight
Per Capita Performance	Per capita academic performance of an institution	PCP	8%
Research Output	Papers published in Nature and Science*	N&S	19%
	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	PUB	19%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	Award	18%
	Highly cited researchers in 21 broad subject categories	HiCi	19%
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	Alumni	8%
University Website	Website Structure and Contents	WSC	9%
Total			100%
* For institutions specialized in humanities and social sciences such as London School of Economics, N&S is not considered, and the weight of N&S is relocated to other indicators.			

The proposed criterion is called "University Website", it is an indicator represents the Website Structure and Contents (WSC) for each university. The new criterion is a positive reflection of the development and usage of the recent technology facilities and tools via the internet. The modification includes; add this criterion with an assigned weight value = 9%. In addition, the weight values of other criteria updated to adjust the total value of all criteria to be 100%, as shown in Fig. 9, which presents the components of the modified Model, where the proposed part of the modification presented on the right-hand side of the figure.

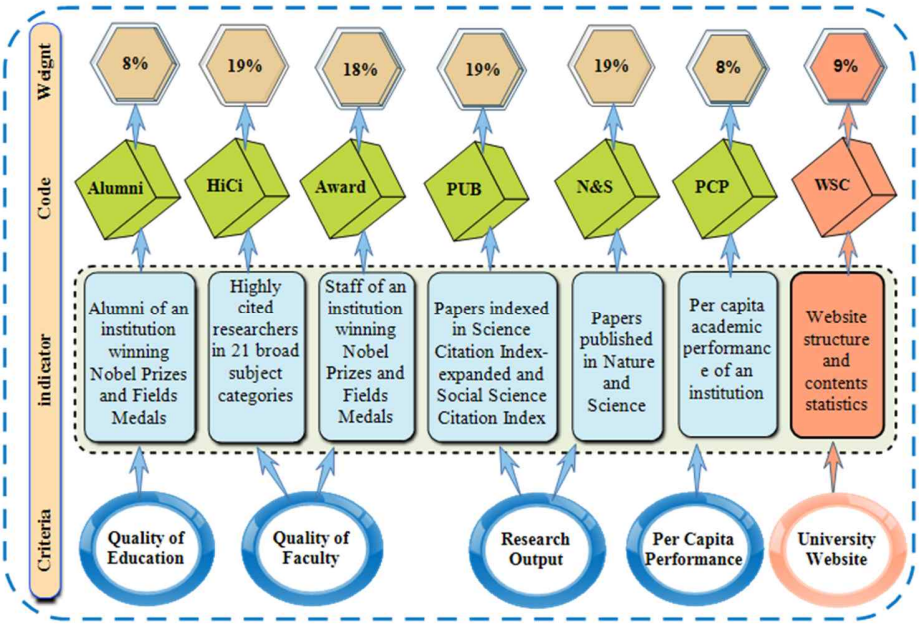

Fig. 9. Design of the ARWU Modified Model Components

7.2 WSC Value Calculation and Final Results Examples

The weight value of the proposed criterion "WSC", which added to Table 2, calculated as follows:

1) Use the Websites Structures Size Measure (WSSM) formula (1) proposed by [3], apply the same steps of analysis to calculate the website's size, which mainly based on the website structure attributes analyzed in this research.

$$WSSM = TL + (TEL \times \frac{1}{2} \times \sqrt[2]{TS}) - (NOF + \sqrt[2]{\frac{NOP + TNAL}{NAL}}) \quad (1)$$

Where, *TL*: Total Links, *NOF*: Number of other Attributes, *TEL*: Total External Links and *NOP*: Number of Pages, *TNAL*: Total Number of Analyzed Links, *TS*: Time in Seconds, *NAL*: No of Active Links (Internal Links).

2) Normalize the results of the *WSSM* model for each website to values, fall in the range from 0 to 9, where 0 is the lowest score and 9 is the upper score of this criterion, using the Min-max normalization formula (2), which applied to minimize data range [36],

$$R = (v - min_A)/(max_A - min_A) \times (new\_max_A - new\_min_A) + new\_min_A \quad (2)$$

Where, the min_A, max_A are the lower and upper limits of the dataset. The *new_min* and *new_max* are the lower and upper limits of the normalized range.

3) Example: Example: if WSSM results for all websites in all datasets, which selected for the ranking process and their sizes range starts from 98, ended by 820 pages/links, it normalized in the range [0, 9]. For instance, if (140, 328 and 665) are three WSSM results, it was mapped to the following weighted scores (0.5, 2.7, and 8.2) respectively. When the formula (2) applied to these values as in Table 3, we found that the values of v are the original values, which normalized from big values to smaller values in the range (zero to 9). R is the result of normalization. The required weighted score will be required value for the WSC.

Table 3. WSC weights calculation examples

Value (V)	min_A	max_A	new_ min	new_ max	R= WSC Weight
140	98	820	0	9	0.5
328	98	820	0	9	2.7
754	98	820	0	9	8.2

4) Put the result of this formula (weighted value) as a score to the WSC criterion in Table 2, and then calculate the total rank of the university based on the modified model out of 100%.

8. Results Discussion

As shown in the analysis of the data above (in Fig. 2 to 8), more than 90% of the websites of the ranked universities have higher values of all attributes used for the comparisons. This means that these websites have huge components, big sizes, and complicated structure. This gives a proof that there is a strong relation between university website and its international ranking sequence amongst the sample of ranked universities. As well as, the relationship between unranked universities and its website also found, but it is weak. This, in turn, represents a significant difference. Therefore, the website of any university represents a strong criterion can be employed to contribute to the ARWU model modification.

The leading universities have websites that are reflecting the ability to manage and improve its website, which acts as an important interface with the local and global society. On the other hand, it found that the low-level universities / unranked universities have weak interfaces to communicate with others in its environment through its websites. This kind of communication via the websites on the internet is useful for marketing the educational services and attracting students, researchers, and academics. The most content should be available on the websites to become an important criterion contributes to representing the university in the ranking process. It must include; procedures, policies, necessary data about administrative staff, academic staff, students, admission, courses, tasks, activities, publications and other learning outcomes, continuously updated.

Based on the data analysis and the initial results shown above and according to the emergent relationship between the university website and its ranking level, the ranking model modified to incorporate the current technology of the Internet to enable the official websites of universities to be an effective factor contributes positively in the universities global ranking.

9. Conclusion

The research achieved its objectives and provides strong indications based on the initial results presented and the modifications accomplished on the ranking model. The initial results can be generalized to all websites of world universities, with a low percentage of error. Moreover, the modified model can be a promising to enhance the ranking results based on the proposed technology criterion.

The research findings are serving universities, students and academics, researchers, countries, and global and local communities; moreover, leads to employing the websites as an efficient contributor to the global ranking model. This, in turn, motivates universities to improve and maintain their own websites continuously.

This improvement provides many benefits, including the ability of decision makers in world universities, and those are working with the continuous development to lead their universities a step forward to satisfy higher quality, perfect outcomes, and accurate performance and suitable level amongst world universities.

The research results reinforce a set of important principles for universities, as follows:

- Increase the degree of interest of colleges and its academic departments in the universities to have official and perfect websites.
- Establishment of a clear view of the contents and structure of the websites of departments, colleges, service, and facilities.
- Increase the ability of the university to employ the current technology in the communication, management, archiving, and marketing of educational services.
- Increase university's ability to keep up with the level enjoyed by other universities in different places of the world.
- Big size websites are giving positive indicators related to better documentation of activities, contents, academic processes, courses, administrative works, students, activities, other facilities, and tasks.

Finally, it is expected that the modified model will be more flexible and will improve the ranking results of world universities and gives a good chance to enter a competition in the global ranking process, especially the universities that have perfect websites.

The limitation of this research is related to the data collection. This task is time-consuming, to overcome this challenge, the dataset can be collected by a team in a bound period of time (for example, three to five days or maximum one week) to avoid the periodic modification of websites' contents that may be made a significant difference in the results.

10 .Future Works

This research can be expanded and improved accordingly, many views; such as add more attributes to the current set of data, this, in turn, leads to modifying and improving the current analysis tool. In addition, the idea of this research can be applied using the data mining techniques and tools using advanced knowledge discovery methods. Moreover, apply the modified model on future samples of data for the years after 2016, the compare the results with the years before the modification. Also, restudy the previous criteria and readjustment its weights based on the importance of each one separately.

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Appendices

There are two appendices; the first includes the summary of data from ranked universities denoted by DS1, included in Appendix A, the second is a summary data of unranked universities denoted by DS2, included in Appendix B.

Appendix A: first sample

i	Site Name	Total links	Num of Internal Links	No. of External Links	Num of Pages or Sites	Doc	Audio	Media	Max of Levels	Num of Leaves	Time Rate
1	ksu.edu.sa	378	378	0	284	0	0	94	20	9476	199.07
2	tamu.edu	444	444	0	254	7	0	183	20	5021	196.37
3	ustc.edu.cn	447	447	0	329	7	0	111	20	1617	222.38
11	ucsd.edu	540	538	2	171	1	0	366	15	3920	168.28
12	indiana.edu	615	245	370	243	2	0	0	12	4639	160.01
13	monash.edu.au	629	6	623	6	0	0	0	20	34	22.02
14	berkeley.edu	792	471	321	262	11	0	198	20	6281	534.86
15	umich.edu	852	544	308	217	0	0	327	20	1286	295
16	pitt.edu	940	940	0	516	19	0	405	15	16030	247.97
17	ucsb.edu	1105	212	893	161	2	0	49	20	8286	262.24
18	rice.edu	1159	407	752	189	27	0	191	20	2096	229.05
19	uq.edu.au	1172	1171	1	891	16	0	264	15	5325	857.39
20	utah.edu	1240	208	1032	108	0	0	100	20	1834	76.74
21	pku.edu.cn	1398	1000	398	495	2	0	503	20	13151	642.41
22	stanford.edu	1415	273	1142	176	0	0	97	20	1771	201.64
23	vanderbilt.edu	1524	1524	0	1093	155	0	276	15	14724	492.04
24	uwa.edu.au	1843	774	1069	773	1	0	0	12	20220	2342.92
25	gatech.edu	2309	1489	820	1252	3	0	234	20	32069	2231.83
4	virginia.edu	2660	2660	0	1800	236	0	624	20	35600	2087.97
26	ucla.edu	2686	1832	854	444	3	0	1385	20	14082	331.26
27	fudan.edu.cn	2756	2742	14	2180	87	2	473	20	200617	7466.67
28	nus.edu.sg	2973	2359	614	1859	56	0	444	20	11156	282.32
5	univie.ac.at	3023	3021	2	2355	60	0	606	20	53118	1649.84
29	mcmaster.ca	3336	3336	0	2597	375	1	363	15	19291	1131.56
30	brown.edu	3344	2856	488	1613	165	0	1078	20	60301	3566.95
31	uchicago.edu	3544	1272	2272	1253	0	0	19	20	16019	1404.9
32	lunduniversity.lu.se	3713	3713	0	3423	277	0	13	20	239093	719.74
33	newbrunswick.rutgers.edu	4118	879	3239	611	0	0	268	20	15971	431.04
6	swinburne.edu.au	4140	4139	1	3232	102	0	805	20	46862	1799.92
34	msu.ru	4351	3340	1011	2820	187	2	331	20	55469	2792.26
35	ox.ac.uk	4482	2974	1508	2808	49	0	117	20	88016	5725.01
36	harvard.edu	4596	1594	3002	830	21	60	683	20	27240	937.29
37	mayo.edu	5016	3664	1352	3537	72	0	55	20	32304	27375.37
38	snu.ac.kr	5253	5240	13	3468	50	0	1722	20	110498	4761.79
39	uq.edu.au	5660	4067	1593	3975	92	0	0	12	26275	1710.14
40	ucsf.edu	5815	3931	1884	3308	279	0	344	20	51997	3319.01
41	web.mit.edu	6125	4217	1908	3470	21	0	726	20	18483	1135.73
42	purdue.edu	8387	8380	7	7019	258	2	1101	20	207682	3571.24
43	wisc.edu	8531	231	8300	135	9	0	87	20	3729	227.48
7	cam.ac.uk	8550	8550	0	7892	82	0	576	20	122247	1882.97
44	u-psud.fr	8757	5537	3220	5355	6	0	176	20	195967	14005.91
45	qmul.ac.uk	9165	9165	0	4922	288	3	3952	20	105143	1704.21
46	manchester.ac.uk	9187	9187	0	7361	39	0	1787	15	352686	2835.26
47	northwestern.edu	10134	8654	1480	7348	301	0	1005	20	214024	9370.12
8	unibe.ch	10226	10225	1	7726	774	0	1725	20	101731	4088.06
48	kuleuven.be	10318	7842	2476	7411	250	0	181	20	104991	10635.99
49	illinois.edu	11179	9523	1656	9336	6	0	181	20	376579	14100.7
50	cmu.edu	11981	9775	2206	7738	467	0	1570	20	47306	6821.13
51	upmc.fr	12782	8454	4328	5280	540	1	2633	20	250397	3400.22
52	anu.edu.au	13111	10335	2776	9789	482	0	64	20	424408	7178.12
53	ucl.ac.uk	13420	8830	4590	7500	77	63	1190	20	87017	14005.91
9	uniroma1.it	13931	13894	37	8082	5646	0	166	20	215799	8223.55
54	icahn.mssm.edu	14099	14099	0	10617	1662	0	1820	20	314935	5448.83
55	columbia.edu	14582	8900	5682	7507	75	24	1294	20	35705	6269.03
56	cornell.edu	15213	8367	6846	6659	13	0	1695	20	107718	2754.48
57	rochester.edu	15289	10323	4966	9749	570	0	4	12	136745	5203.61
58	kcl.ac.uk	16518	12658	3860	9902	454	0	2302	20	237375	3431.73
59	case.edu	17415	17408	7	11417	2101	0	3890	20	222654	7242.03
60	kyoto-u.ac.jp	22414	20089	2325	15832	2039	1	2217	20	615592	14373.65
10	warwick.ac.uk	31532	31347	185	26757	834	8	3748	20	182444	3312.51
61	washington.edu	43488	30146	13342	20253	3002	6	6885	20	361209	15339.28
62	uni-heidelberg.de	59794	47173	12621	31298	7437	337	8101	20	387759	39939.53
Total		**506396**	**397999**	**108397**	**305888**	**29797**	**510**	**61804**	**1178**	**6682014**	**283376.54**
											78.7 hours

Appendix B: second sample

i	Site Name	Total links	No. of Internal Links	Nn. of External Links	No. of Pages	No. of Documents	Audio	Media	Max of Levels	No. of Leaves	Time Rate
1	ugp.ac.id	40	40	0	29	3	0	11	10	124	21.45
2	shiep.edu.cn	57	57	0	40	1	0	17	8	115	46.55
3	kbca.ca	59	59	0	31	0	0	28	9	274	30.54
4	unimelb.edu.au	73	73	0	48	3	0	22	20	365	52.93
5	csuk.edu.kh	129	129	0	111	0	0	18	20	4028	69.81
6	urftd.org	135	135	0	125	0	0	10	20	1908	449.12
7	uoli.edu.pk	143	143	0	102	3	0	38	20	673	78.66
8	o6u.edu.eg	148	148	0	138	1	0	9	18	730	131.03
9	ubtec.org.in	174	173	1	96	11	0	66	20	2387	86.65
10	reynehpnu.ac.ir	175	171	4	90	24	0	57	20	2493	57.97
11	en.uofg.edu.sd	199	196	3	143	0	0	53	20	2581	71.97
12	uci.edu	221	221	0	109	3	0	109	20	2446	93.71
13	ous.edu.sd	250	250	0	213	0	0	37	20	2750	91.1
14	universitekongo.org	306	306	0	217	2	0	87	20	4388	249.58
15	unik.ac.ug	306	306	0	256	14	0	36	20	3420	220.94
16	du.edu.om	308	308	0	261	2	1	44	20	13626	154.08
17	ucasm.org	314	313	1	281	4	0	28	20	9129	476.8
18	unmasmataram.ac.id	315	315	0	203	88	0	24	20	2929	80.39
19	usu.edu.mn	318	317	1	159	0	0	158	20	4896	131.8
20	siirt.edu.tr	334	334	0	164	83	0	87	20	6568	381.99
21	vmsuniversity.in	357	357	0	296	20	0	41	20	5218	165.36
22	universityofbosaso.net	371	371	0	271	0	0	100	20	3858	287.98
23	hpust.com	395	395	0	311	0	0	84	20	10864	251.53
24	liuyemen.com	399	399	0	199	59	0	141	20	10582	72.08
25	suptech.fr	439	438	1	394	0	0	44	20	22695	165.83
26	eru.edu.eg	493	493	0	215	65	0	213	20	3620	185.96
27	rutgers.edu	518	518	0	418	1	0	99	20	4192	91.09
28	gagecollege.net	531	531	0	494	12	0	25	20	6555	518.42
29	asianu.ac.th	536	536	0	376	2	0	158	20	10032	565.39
30	gandhara.edu.pk	538	538	0	379	25	0	134	20	7465	184.11
31	dagonuniversity.edu.mm	576	576	0	355	52	0	169	20	19490	454.81
32	tu.edu.af	578	578	0	521	2	0	55	20	33049	644.42
33	hinducollege.ac.in	641	640	1	363	40	0	237	20	6511	112.58
34	asu.edu.et	721	721	0	593	7	0	121	20	19639	591.6
35	uatlantica.pt	740	740	0	479	3	0	258	20	10061	387.7
36	wwwe.sogang.ac.kr	796	795	1	575	6	0	214	20	6222	380.19
37	bsu-uni.edu.az	910	910	0	758	0	0	152	20	14558	163.77
38	qu.edu.sa	973	973	0	894	3	0	76	20	13809	868.51
39	unipune.ac.in	1003	1003	0	420	455	0	128	20	1615	168.98
40	wollouniversity.education	1072	1072	0	950	39	0	83	20	4019	1131.74
41	karatay.edu.tr	1296	1294	2	782	50	0	462	20	26624	649.45
42	univ-constantine3.dz	1356	1356	0	970	214	0	172	20	43023	659.86
43	pnu.edu.sa	1464	1462	2	1137	41	0	284	20	22794	406.39
44	kuniv.edu	1497	1489	8	1148	22	0	319	20	14780	582.58
45	uma.co.ao	1529	1528	1	944	54	0	530	20	8517	1484.94
46	universitassamawa.ac.id	1554	1554	0	1094	16	0	444	20	26678	1289.85
47	miuegypt.edu.eg	1989	1989	0	838	11	0	1140	20	38751	1771.11
48	uae.ma	2033	1978	55	1726	102	0	150	20	128874	1250.29
49	uobabylon.edu.iq	2309	2308	1	929	966	1	412	20	6604	191.21
50	aden-univ.net	2456	2452	4	1657	468	0	327	20	19980	572.85
51	damanhour.edu.eg	2548	2544	4	1353	335	0	856	20	12482	988.27
52	toros.edu.tr	2578	2578	0	1472	879	0	227	20	59914	1002.5
53	neelain.edu.sd	2599	2596	3	2434	0	0	162	20	34586	472.01
54	psu.edu	2707	2707	0	2636	0	0	71	20	23730	1461.45
55	univ-constantine2.dz	3013	3008	5	1866	511	0	631	20	26664	1356.3
56	wmu.se	3765	3765	0	3697	25	0	43	20	46768	877.47
57	uoh.edu.sa	4434	4434	0	3934	245	0	255	20	94079	829.25
58	philadelphia.edu.jo	4706	4702	4	2524	1690	0	488	20	73802	399.1
59	ju.edu.jo	4728	4727	1	3637	37	0	1053	20	36456	1070.01
60	uomosul.edu.iq	5043	5043	0	1276	1435	0	2332	20	86433	605.11
61	unibuc.ro	5773	5764	9	3376	1951	0	437	20	37873	1048.42
62	qu.edu.qa	10510	8234	2276	6362	1735	136	1	20	211735	5218.05
Total		**86438**	**15451**	**2388**	**57840**	**11817**	**138**	**14256**	**1195**	**1360907**	**34534.1**
											9.6 Hours