

## Deducing dimensions of quality education among the world's top universities



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### ABSTRACT

Higher education institutions invasions to deliver quality education at all levels at all times. World ranking universities are good in research, publication, and international partnership. This study aims to deduced dimensions of quality education among the world's top-ranking universities. Findings revealed that top-ranking universities are good in research and provide quality teaching performance. Quality education is the pursuit of building an academic reputation, research influence, and industry reputation. Research-based teaching and learning increased academic performance. Thus, there are different dimensions of quality education in the universities.

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### 1. Introduction

In view of the long been debate about the real measure of quality education, several attempts at disclosing these have been initiated. One significant attempt taken is the world ranking of universities. This ranking game discloses information on the kind of quality education a university provides and directs universities in determining priority and relevance in their curricular implementation.

A university's scorecard is determined through various factors and measures set by a ranking institution and this dictates which specific university provides the best quality education. However, ranking institutions like those of Times Higher Education, Quacquarelli Symonds (QS), and Shanghai University differ in the number of indicators and dimensions to determine quality education.

Times Higher Education, for one, examines the number of citations-research influence, teaching-the learning environment, research-income, volume, and reputation as key factors in determining a university's scorecard in the ranking game while the QS ranking considers employer review, citations per faculty, faculty-student ratio, international students and international faculty as criteria for identifying best universities and there are ranking agencies who

have similar criteria. Shanghai university ranking has also set a different criterion.

Although differing in criteria set, one thing common about higher education ranking is that it dictates who has the best reputation in terms of research, salaries, and internationality as measures of quality education so if you are a student trying to find a good university you must how that university stands in ranking or if you are a funding institution, you pour your money out in a university that has the best reputation. Approximately four or five university ranking systems take a global approach. QS "World University Ranking"; Times Higher Education World University Ranking; Academic Ranking of World Universities (ARWU)-often referred to as the "Shanghai Jiao Tong" ranking because it is produced by a unit at Shanghai Jiao Tong University); the CWTS Leiden Ranking and the Webometrics Ranking comprise the four university ranking system. However, in terms of environmental sustainability, the UI Green Metric World University Ranking by the University of Indonesia is the most distinct among other ranking systems.

According to Var (1988) "multivariate data analysis techniques can be used to model factors and responses and find the relationship that exists between all factors and responses and can extract useful information from multivariate data". A multivariate analysis of a set of indicators for 178 world universities shows that 70% of the data variance can be explained by three main components: The academic performance (Principal Component 1 explains 48% of the variance); the degree of internationalization (Principal Component 2 explains 14% of the variance) and the faculty-to-

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student ratio (Principal Component 3 explains 8% of the variance). As it is usual in the assessment of institutions, academic performance is strongly correlated with publications, citations, awards, and reviews—canonical indicators of excellence.

In order to establish which “parameters and corresponding weights for the academic excellence and assessment in the context of university rankings” (Steiner, 2006) made for 178 institutions, multivariate data analysis on a set of 13 parameters are more appropriate and the relevant components are academic (teaching) excellence internationalization and faculty/student ratio.

However, some important factors are not measured or are not measurable like living conditions, campus diversity, food in the university, etc. These are difficult for a ranking to capture and all these imply that rankings are not perfect and standards in determining the top universities vary greatly yet there is a need to identify what components greatly contribute to the top rank status of universities by reducing the dimension in determining quality education using Times Higher Education criterion to provide directions to universities on what activities to prioritize in order to ensure the quality of education they provide.

**Objectives of the Study:** The study explored and deduced the principal component analysis of the top-ranking universities in the world.

## 2. Materials and methods

### 2.1. Quality education framework

This study utilized Principal Component Analysis a form of multivariate analysis (Murtagh and Heck, 1987), Principal Component Analysis (PCA) is a dimension-reduction tool used to reduce large sets of variables to small sets containing most of the information in the large set. There are five (5) indicators in university ranking, namely: Teaching, research, citation, industry income, and international outlook. According to Murtagh and Heck (1987), “Object correlation (universities) establishes a scale of performance (ranking) of the universities”. Interpreting the data in a more meaningful form means the number of variables has to be reduced to a few, linear combinations of the interpretative data. Each linear combination comprises the principal component.

The World University Ranking 2018 is the basic source of data presented in this study which were validated by the Times Higher Education, 2018. The identification of the top-ranking universities in the world is consistent with the results based on the following components: teaching, research, citations, knowledge transfer, and international outlook.

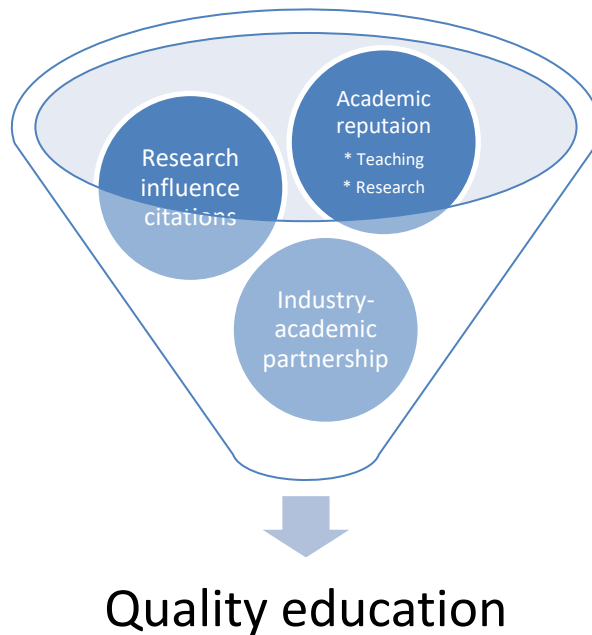
## 3. Results and discussion

In world university rankings, measurements and indicators play an essential role. A balanced way to

produce a proper ranking system is to employ bibliometrics and reputational survey. Then the criteria mechanisms and indicators of that of Times Higher Education World University Rankings will be introduced and examined. Fig. 1 represents the framework of quality education in top-ranking universities in the world.

The multivariate data analysis techniques are used to model the factors and responses and find the relationship that exists between all factors and responses to be able to extract useful information from the multivariate data. This set of indicators for 178 world universities revealed that 70% of the data variance can be explained by the three main components: the academic performance (Principal Component 1 which explains 48% of the variance); the degree of internationalization (Principal Component 2 explains 14% of the variance) and the faculty-to-student ratio (Principal Component 3 explains 8% of the variance). As usually observed in the institutional assessments, academic performance is strongly correlated with publications, citations, awards, and reviews—canonical indicators of excellence while the degree of internationalization does not correlate with academic performance. Distinct countries and regions have differing performances with respect to internationalism such as size, integration with other countries, political and or geographical isolation. The increase of the faculty/student ratio can be correlated with academic performance. This ratio has also distinct values in different countries such as France and Australia, the two being both extremes. The correlations of these parameters with the three main principal components are provided together with the list of universities ordered according to Principal Component 1 but this should not be regarded as a new ranking. Internationalism criteria as well as the faculty/student ratio most likely is advantageous to private universities than public universities whose faculty-student ratio goes beyond the ideal. The present study holds relevance in institutional strategic planning or in the formulation of public policies. Further, identifying and implementing policies supporting world-class universities become associated with risks; some of them are identified in this study.

The increased global demand for information on academic quality led to the development in terms of the worldwide university ranking system. During the UNESCO/CEPES conference on higher education, cross-national research was recommended to identify the ranking system indicators which could improve the international market for higher education because it could help answer a number of important questions on policies such as the emerging consensus in measuring academic quality; its impact on the academic behavior and that of the university itself; and public interests and policy in the development and distribution of ranking systems in universities not reflected in the current ranking system.



**Fig. 1:** Quality education framework

Merisotis and Sadlak (2005) mentioned that the outlined process of university rankings such as data collection, selection of the ranking types and variables, selection of indicators, and weighting before analysis greatly influenced the decision for indicators and weightings which were the most influential key factors Van Raan (2005) in the ranking system.

Bibliometrics refer to citation analysis, peer reviews, web visibility, and web flows which were the frequently used indicators, and any indicator adopted greatly influenced ranking results (Geuna and Martin, 2003). This emphasized the two predominant methods of academic evaluations which were the bibliometric (quantitative) and peer review (qualitative).

A comparative study of ranking institutions namely: Shanghai Jiao Tong University, Times Higher Education, Swiss Science Technology Council, and Asiaweek, Hong Kong was conducted several (Buela-Casal et al., 2007) that exposed ISI indicators of three of four ranking system employed and where two of four used peer reviews.

Measurements and indicators, previously mentioned, had a substantial influence on the rankings adopted in world universities, bibliometrics, and peer reviews were constantly the topics of discussions (Van Raan, 2005; Buela-Casal et al., 2007; Aguillo et al., 2010). The major argument centered on data appropriateness. The bibliometric approach which made use of citation analysis as a bibliometric method used data that existed and was found to be more objective than peer reviews.

Many scholars had opposing views on citation analysis (Virgo, 1977; Nederhof and Van Raan, 1993) and pointed particularly on the question on self-citation, citation errors, national bias, language bias, citation, the behavior of different discipline, and type

of documents (Kokko and Sutherland, 1999; Leimu and Koricheva, 2005; Wong and Kokko, 2005).

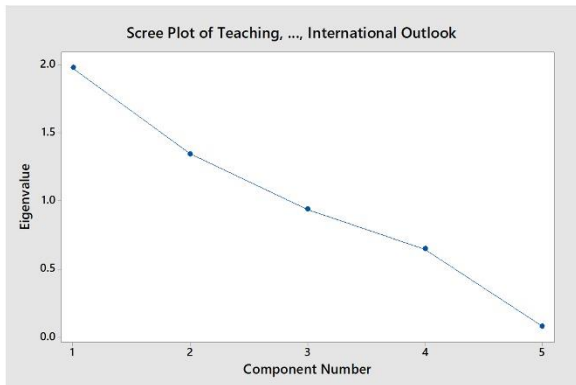
Van Raan (2005) pointed out that it was necessary to consider the expert's opinions for evaluating research performance and confirmation of the importance of peer reviews insisting that peer reviews were the foundation of academic evaluation and that bibliometric indicators were used as a supplement after adjustment although it is acknowledged that university ranking and performance could be affected by subjective to reputational reviews which may have their own advantages and disadvantages. Thus, was suggested not to rely solely upon one approach (Van Raan, 2005; Nederhof and Van Raan, 1993).

### 3.1. Determinants of quality education

Determinants of quality education among 100 top-ranking universities in the world are presented in tabulated form and scree plot. Fig. 2 shows the three (3) principal components which are: (1) academic reputation; (2) research influence, and (3) industry reputation.

The Scree plot in Fig. 2 shows the factors to retain in the principal component analysis. These factors are found to be the key indicators in determining the quality of education provided by universities being shortlisted in this study.

The top-ranking universities in the world include the University of Oxford, University of Cambridge, California Institute of Technology, Stanford University, Massachusetts Institute of Technology, Harvard University, Princeton University, Imperial College London, and the University of Chicago. Quality education and development are directly related according to Tokuhama-Espinosa et al. (2013).



**Fig. 2:** Scree plot of the principal components analysis of top world universities

The top-performing universities are found to be good in teaching and research. This means that teaching is based on research. If the universities

produce more quality research and published it in a reputable journal, then the citation will also increase. In assessing universities, the academic performance must be strongly correlated with research publications, citations, international outlook, and industry income to name a few, University of Oxford, University of Cambridge, and California Institute of Technology have produced more publications and citations attracting more foreign students to enroll because of the quality education offered. Thus, income will also increase. In the study of Steiner (2006), “the international faculty and student score as defined by the Times Higher Education considers that the more international members in the university, the better it should be ranked”. Table 1 shows the principal component analysis.

**Table 1:** Principal component analysis

Eigenanalysis of the Correlation Matrix					
Eigenvalue	1.9806	1.3462	0.9413	0.6490	0.0829
Proportion	0.396	0.269	0.188	0.130	0.017
Cumulative	0.396	0.665	0.854	0.983	1.000
Eigenvectors					
Variable	PC1	PC2	PC3	PC4	PC5
Teaching	0.673	-0.185	-0.099	-0.101	-0.702
Research	0.668	-0.205	0.098	-0.120	0.698
Citations	0.294	0.582	-0.042	0.757	0.026
Industry Income	-0.083	-0.580	0.619	0.516	-0.089
International Outlook	0.084	0.500	0.772	-0.370	-0.107

Table 1 shows the Eigenanalysis of the Correlation Matrix on indicators declared to be factors that determine the quality of education offered in top world universities. The variables: Teaching (0.673) and research (0.668) in PC1 are factors that are closely related which means that in the pursuit of quality education, teaching and research activities together build a university’s academic reputation. Research impacts instruction and improved instruction is an output of research, this is then what we called research-based teaching and learning. Thereby, PC1 shall be labeled ACADEMIC REPUTATION being one key indicator in achieving quality education for this study.

On the other hand, under PC 2, Table 1 reveals that citations computed to be 0.582 are one factor that may be considered to be closely related to PC1, the academic reputation factor.

Citations helped established the academic reputation of universities as this determines the degree of influence these universities have in the worldwide academic community. Citations served as material evidence in establishing a university’s extent of influence and spoke of the impact of its teaching and research activities in the global community. When a scholar’s work is cited, it would one’s intellectual property rights are acknowledged and respected by other scholars and the entire academic community. A citation gives credit for creative and intellectual works and it can also be used to locate particular sources and combat plagiarism. The number of times a scholarly work of a faculty is cited reveals how much influence he has

in the academic unit. Collectively in a university, the greater the number of citations the greater is its research influence and impact in the community. PC 2 shall be named in this study as RESEARCH INFLUENCE I becomes the second key factor in determining quality.

Further, under PC 3, the dimensions that are found to be closely related in the matrix are the industry income which speaks of income-generating from the output of researches and not purely tuition fees, and international outlook dimensions refer to the total number of international students as an outgrowth of the reputation the university has built which in turn speaks of the quality of education it offers, these have a great impact among top universities and are seen to be greatly attributed to their academic reputation and research influence. The study shall call this component INDUSTRY REPUTATION, Academic reputation ripples research influence which alongside builds a university’s industry reputation.

**3.2. Emergent theory**

The correlation between teaching and research has been established in the study implying that research and instruction are intertwined. Thus, this study poses a relevance in institutional planning or in the formulation of university policies on research and publication. The identification and implementation of policies supporting world-class research universities can be associated with academic reputation, research influence, and



industry reputation. Quality as observed by international scholars consists of more intangible outputs rather than the tangible ones

#### 4. Conclusion and recommendation

Quality education is the pursuit of building an academic reputation, research influence, and industry reputation. Academic reputation is achieved when research impacts instruction and vice versa which builds a university's integrity and influence and established its industry reputation. These three components together serve as the main ingredient in the quest for quality education.

Higher Education Institutions may enhance policy on research and instruction leading to the prioritization of research and instructional activities that may lead to the building of its influence in the academic community and the industry in general.

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#### Compliance with ethical standards

#### Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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