# Appendix

**Table 1.** Top 100 most cited articles on university rankings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order | Cites | Authors | Title | Year | Source |
| 1 | 173 | HF Moed | A comparative study of five world university rankings | 2017 | *Scientometrics* |
| 2 | 142 | GA Olcay, M Bulu | Is measuring the knowledge creation of universities possible?: A review of university rankings | 2017 | *Technological Forecasting and Social Change* |
| 3 | 137 | MM Vernon, EA Balas, S Momani | Are university rankings useful to improve research? A systematic review | 2018 | *PloS one* |
| 4 | 121 | J Brankovic, L Ringel, T Werron | How rankings produce competition: The case of global university rankings | 2018 | *Zeitschrift für Soziologie* |
| 5 | 105 | J Johnes | University rankings: What do they really show? | 2018 | *Scientometrics* |
| 6 | 92 | RA Shahjahan, G Blanco Ramirez, ... | Attempting to imagine the unimaginable: A decolonial reading of global university rankings | 2017 | *Comparative Education Review* |
| 7 | 80 | VP Rindova, LL Martins, SB Srinivas, ... | The good, the bad, and the ugly of organizational rankings: A multidisciplinary review of the literature and directions for future research | 2018 | *Journal of Management* |
| 8 | 64 | N Pollock, L D'Adderio, R Williams, ... | Conforming or transforming? How organizations respond to multiple rankings | 2018 | *Accounting, Organizations and Society* |
| 9 | 61 | E Hazelkorn | Reshaping the world order of higher education: the role and impact of rankings on national and global systems | 2018 | *Policy Reviews in Higher Education* |
| 10 | 60 | C Daraio, A Bonaccorsi | Beyond university rankings? Generating new indicators on universities by linking data in open platforms | 2017 | *Journal of the Association for Information Science and Technology* |
| 11 | 60 | J Pietrucha | Country-specific determinants of world university rankings | 2018 | *Scientometrics* |
| 12 | 50 | B Hammarfelt, S De Rijcke, P Wouters | From eminent men to excellent universities: University rankings as calculative devices | 2017 | *Minerva* |
| 13 | 44 | F Christie | The reporting of university league table employability rankings: a critical review | 2017 | *Journal of Education and Work* |
| 14 | 43 | NH Tien, LP Dana, RJS Jose, NT Vu, ... | Human resource development strategy of Ton Duc Thang University to improve its position on the international rankings | 2019 | *International Journal of Advanced Education and Research* |
| 15 | 41 | M Decuypere, P Landri | Governing by visual shapes: University rankings, digital education platforms and cosmologies of higher education | 2021 | *Critical Studies in Education* |
| 16 | 41 | YW Hou, WJ Jacob | What contributes more to the ranking of higher education institutions? A comparison of three world university rankings | 2017 | *International Education Journal: Comparative Perspectives* |
| 17 | 40 | MA Peters | Global university rankings: Metrics, performance, governance | 2019 | *Educational Philosophy and Theory* |
| 18 | 37 | C Urdari, TV Farcas, A Tiron-Tudor | Assessing the legitimacy of HEIs' contributions to society: the perspective of international rankings | 2017 | *Sustainability Accounting, Management and Policy Journal* |
| 19 | 36 | M Mussard, AP James | Engineering the global university rankings: Gold standards, limitations and implications | 2018 | *IEEE Access* |
| 20 | 34 | S Marginson | Do rankings drive better performance? | 2017 | *International Higher Education* |
| 21 | 34 | PG Altbach, E Hazelkorn | Pursuing rankings in the age of massification: For most—forget about it | 2017 | *International Higher Education* |
| 22 | 33 | CK Huang, C Neylon, C Brookes-Kenworthy, ... | Comparison of bibliographic data sources: Implications for the robustness of university rankings | 2020 | *Quantitative Science Studies* |
| 23 | 33 | I Brusca, S Cohen, F Manes-Rossi, ... | Intellectual capital disclosure and academic rankings in European universities: Do they go hand in hand? | 2019 | *Meditari Accountancy Research* |
| 24 | 33 | JA Dearden, R Grewal, ... | Strategic manipulation of university rankings, the prestige effect, and student university choice | 2019 | *Journal of Marketing Research* |
| 25 | 33 | RM Allen | A comparison of China's ‘Ivy League’ to other peer groupings through global university rankings | 2017 | *Journal of Studies in International Education* |
| 26 | 33 | M Souto-Otero, J Enders | International students' and employers' use of rankings: a cross-national analysis | 2017 | *Studies in Higher Education* |
| 27 | 31 | MA Lim, J Williams Øerberg | Active instruments: on the use of university rankings in developing national systems of higher education | 2017 | *Policy Reviews in Higher Education* |
| 28 | 31 | V Safón | Inter-ranking reputational effects: an analysis of the Academic Ranking of World Universities (ARWU) and the Times Higher Education World University Rankings (THE) reputational relationship | 2019 | *Scientometrics* |
| 29 | 31 | J Kim | The functions and dysfunctions of college rankings: An analysis of institutional expenditure | 2018 | *Research in Higher Education* |
| 30 | 30 | MA Fauzi, CNL Tan, M Daud, ... | University rankings: A review of methodological flaws | 2020 | *Issues in Educational Research* |
| 31 | 30 | M Hauptman Komotar | Global university rankings and their impact on the internationalisation of higher education | 2019 | *European Journal of Education* |
| 32 | 30 | A Estera, RA Shahjahan | Globalizing whiteness? Visually re/presenting students in global university rankings websites | 2019 | *Discourse: Studies in the Cultural Politics of Education*  |
| 33 | 30 | R Pizarro Milian, J Rizk | Do university rankings matter? A qualitative exploration of institutional selection at three southern Ontario universities | 2018 | *Journal of further and higher education* |
| 34 | 28 | E De la Poza, P Merello, A Barberá, A Celani | Universities' reporting on SDGs: Using the impact rankings to model and measure their contribution to sustainability | 2021 | *Sustainability* |
| 35 | 28 | E Hazelkorn, A Gibson | Global science, national research, and the question of university rankings | 2017 | *Palgrave Communications* |
| 36 | 28 | M Benito, P Gil, R Romera | Funding, is it key for standing out in the university rankings? | 2019 | *Scientometrics* |
| 37 | 28 | SMI Valmorbida, SR Ensslin | Performance evaluation of university rankings: literature review and guidelines for future research | 2017 | *International Journal of Business Innovation and Research* |
| 38 | 27 | C Pérez-Esparrells, E Orduna-Malea | Do the technical universities exhibit distinct behaviour in global university rankings? A Times Higher Education (THE) case study | 2018 | *Journal of Engineering and Technology Management* |
| 39 | 26 | F Selten, C Neylon, CK Huang, P Groth | A longitudinal analysis of university rankings | 2020 | *Quantitative Science Studies* |
| 40 | 26 | MH Komotar | Discourses on quality and quality assurance in higher education from the perspective of global university rankings | 2020 | *Quality Assurance in Education* |
| 41 | 25 | N Kurniasih, C Hasyim, A Wulandari, ... | Comparative case studies on Indonesian higher education rankings | 2018 | *Journal of Physics: Conference Series* |
| 42 | 25 | B Uslu | A path for ranking success: what does the expanded indicator-set of international university rankings suggest? | 2020 | *Higher Education* |
| 43 | 25 | L Dowsett | Global university rankings and strategic planning: a case study of Australian institutional performance | 2020 | *Journal of Higher Education Policy and Management* |
| 44 | 23 | G Doğan, U Al | Is it possible to rank universities using fewer indicators? A study on five international university rankings | 2018 | *Aslib journal of information management* |
| 45 | 23 | O Kivinen, J Hedman, K Artukka | Scientific publishing and global university rankings. How well are top publishing universities recognized? | 2017 | *Scientometrics* |
| 46 | 22 | M Marques, JJW Powell | Ratings, rankings, research evaluation: how do Schools of Education behave strategically within stratified UK higher education? | 2020 | *Higher Education* |
| 47 | 22 | S Anafinova | The role of rankings in higher education policy: Coercive and normative isomorphism in Kazakhstani higher education | 2020 | *International journal of educational development* |
| 48 | 21 | P Boyadjieva | Invisible higher education: Higher education institutions from Central and Eastern Europe in global rankings | 2017 | *European Educational Research Journal* |
| 49 | 21 | Z Liu, GJ Moshi, CM Awuor | Sustainability and Indicators of Newly Formed World-Class Universities (NFWCUs) between 2010 and 2018: Empirical analysis from the rankings of ARWU, QSWUR … | 2019 | *Sustainability* |
| 50 | 21 | KB Atici, G Yasayacak, Y Yildiz, A Ulucan | Green University and academic performance: An empirical study on UI GreenMetric and World University Rankings | 2021 | *Journal of Cleaner Production* |
| 51 | 19 | N Robinson-Garcia, D Torres-Salinas, ... | Mining university rankings: Publication output and citation impact as their basis | 2019 | *Research Evolution* |
| 52 | 18 | M McAleer, T Nakamura, C Watkins | Size, internationalization, and university rankings: Evaluating and predicting Times Higher Education (THE) data for Japan | 2019 | *Sustainability* |
| 53 | 18 | M Muñoz-Suárez, N Guadalajara, JM Osca | A comparative analysis between global university rankings and environmental sustainability of universities | 2020 | *Sustainability* |
| 54 | 18 | J Lee, K Liu, Y Wu | Does the Asian catch-up model of world-class universities work? Revisiting the zero-sum game of global university rankings and government policies | 2020 | *Educational Research for Policy and Practice* |
| 55 | 18 | M Stack | Academic stars and university rankings in higher education: impacts on policy and practice | 2020 | *Policy Reviews in Higher Education* |
| 56 | 18 | J Torabian | Revisiting global university rankings and their indicators in the age of sustainable development | 2019 | *Sustainability: The Journal of Record* |
| 57 | 17 | RM Allen | Commensuration of the globalised higher education sector: how university rankings act as a credential for world-class status in China | 2021 | *Compare: A Journal of Comparative and International Education*  |
| 58 | 17 | L Csató, C Tóth | University rankings from the revealed preferences of the applicants | 2020 | *European Journal of Operational Research* |
| 59 | 17 | P Perez Mejias, R Chiappa, C Guzmán-Valenzuela | Privileging the privileged: The effects of international university rankings on a Chilean fellowship program for graduate studies abroad | 2018 | *Social Sciences* |
| 60 | 17 | M Pinar, J Milla, T Stengos | Sensitivity of university rankings: implications of stochastic dominance efficiency analysis | 2019 | *Education Economics* |
| 61 | 17 | M Dobrota, V Jeremic | Shedding the Light on the Stability of University Rankings in the ICT Field | 2017 | *IETE Technical Review* |
| 62 | 16 | A Khaki Sedigh | Ethics: An indispensable dimension in the university rankings | 2017 | *Science and engineering ethics* |
| 63 | 15 | I Chirikov | Does Conflict of Interest Distort Global University Rankings? | 2021 | *Open Access Publications from the University of California* |
| 64 | 15 | J Welsh | Ranking academics: Toward a critical politics of academic rankings | 2019 | *Critical Policy Studies* |
| 65 | 15 | R Yeung, P Gigliotti, P Nguyen-Hoang | The impact of US news college rankings on the compensation of college and university presidents | 2019 | *Research in Higher Education* |
| 66 | 15 | AG Meyer, AR Hanson, DC Hickman | Perceptions of institutional quality: Evidence of limited attention to higher education rankings | 2017 | *Journal of Economic Behavior & Organization* |
| 67 | 14 | T Erkkilä, O Piironen | Trapped in university rankings: bridging global competitiveness and local innovation | 2020 | *International Studies in Sociology of Education* |
| 68 | 14 | SM Poole, MA Levin, K Elam | Getting out of the rankings game: A better way to evaluate higher education institutions for best fit | 2018 | *Journal of Marketing for Higher Education* |
| 69 | 14 | D Pride, P Knoth | Peer review and citation data in predicting university rankings, a large-scale analysis | 2018 | *International Conference on Theory and Practice of Digital Libraries* |
| 70 | 14 | CG McCoy, ML Nelson, MC Weigle | Mining the Web to approximate university rankings | 2018 | *Information Discovery and Delivery* |
| 71 | 13 | JJ Lee, H Vance, B Stensaker, S Ghosh | Global rankings at a local cost? The strategic pursuit of status and the third mission | 2020 | *Comparative education* |
| 72 | 13 | E Adam | 'Governments base performance-based funding on global rankings indicators': A global trend in higher education finance or a global rankings literature fiction? A … | 2020 | *International Journal of Educational Development* |
| 73 | 13 | Z Dembereldorj | Review on the Impact of World Higher Education Rankings: Institutional Competitive Competence and Institutional Competence. | 2018 | *International Journal of Higher Education* |
| 74 | 13 | JG Kelley, BA Simmons | Governance by other means: Rankings as regulatory systems | 2021 | *International Theory* |
| 75 | 13 | M Hosier, BKA Hoolash | The effect of methodological variations on university rankings and associated decision-making and policy | 2019 | *Studies in Higher Education* |
| 76 | 12 | L Angelis, N Bassiliades, ... | On the necessity of multiple university rankings | 2019 | *COLLNET Journal of Scientometrics and Information Management* |
| 77 | 12 | M Torres-Samuel, CL Vásquez, ML Cardozo, ... | Clustering of top 50 Latin American universities in SIR, QS, ARWU, and webometrics rankings | 2019 | *Procedia Computer Science* |
| 78 | 12 | EF Tuesta, C Garcia-Zorita, RR Ayllon, ... | Does a country/region's economic status affect its universities' presence in international rankings? | 2019 | *Journal of Data and Information Science* |
| 79 | 12 | A Wolf, A Jenkins | What's in a name? The impact of reputation and rankings on the teaching income of English universities | 2018 | *Higher Education Quarterly* |
| 80 | 12 | J Vidal, C Ferreira | Universities under pressure: the impact of international university rankings | 2020 | *Journal of New Approaches in Educational Research* |
| 81 | 11 | PG Altbach, E Hazelkorn | Measuring education quality in global rankings: What's the likelihood? | 2018 | *International Higher Education* |
| 82 | 11 | L Leydesdorff, L Bornmann, ... | Statistical significance and effect sizes of differences among research universities at the level of nations and worldwide based on the Leiden rankings | 2019 | *Journal of the Association for Information Science and Technology* |
| 83 | 11 | V Safón, D Docampo | Analyzing the impact of reputational bias on global university rankings based on objective research performance data: the case of the Shanghai Ranking (ARWU) | 2020 | *Scientometrics* |
| 84 | 11 | ZW Taylor, J Childs, I Bicak, I Alsmadi | Is bigger, better? Exploring US News graduate education program rankings and internet characteristics | 2019 | *Interchange* |
| 85 | 10 | DAR Richards, JT Awokoya, BK Bridges, ... | One size does not fit all: A critical race theory perspective on college rankings | 2018 | *The Review of Higher Education* |
| 86 | 10 | A Gonçalves, AI Calderón | Academic rankings in higher education: trends of international scientific literature | 2017 | *Revista Diálogo Educacional* |
| 87 | 10 | E Siniksaran, MH Satman | WURS: a simulation software for university rankings—software review | 2020 | *Scientometrics* |
| 88 | 9 | W Guo, M Del Vecchio, ... | Global network centrality of university rankings | 2017 | *Royal Society Open Society* |
| 89 | 9 | S Mäkinen | Global university rankings and Russia's quest for national sovereignty | 2021 | *Comparative Education* |
| 90 | 9 | AS Mikhaylov, AA Mikhaylova | University rankings in the quality assessment of higher education institutions | 2018 | *Calitatea* |
| 91 | 9 | C Soudien | The influence of rankings and incentive systems on academic publishing in South African universities | 2021 | *Measuring Up in Higher Education* |
| 92 | 9 | V Bureva, A Michalíková, E Sotirova, S Popov, ... | Application of the InterCriteria Analysis to the universities rankings system in the Slovak Republic | 2017 | *Notes on Intuitionistic Fuzzy Sets* |
| 93 | 9 | L Bellantuono, A Monaco, S Tangaro, N Amoroso, ... | An equity-oriented rethink of global rankings with complex networks mapping development | 2020 | *Scientific Reports* |
| 94 | 9 | R Parvathi, V Atanassova, L Doukovska, C Yuvapriya, ... | InterCriteria Analysis of rankings of Indian universities | 2017 | *Notes on Intuitionistic Fuzzy Sets* |
| 95 | 8 | SS Donetskaia | The Berlin principles in Russian university rankings | 2017 | *Problems of Economic Transition* |
| 96 | 8 | ZT Kosztyán, Z Banász, VV Csányi, A Telcs | Rankings or leagues or rankings on leagues?-Ranking in fair reference groups | 2019 | *Tertiary Education and Management* |
| 97 | 8 | A Meseguer-Martinez, A Ros-Galvez, ... | Linking YouTube and university rankings: Research performance as predictor of online video impact | 2019 | *Telematics and Informatics* |
| 98 | 8 | M Benito, P Gil, R Romera | Evaluating the influence of country characteristics on the Higher Education System Rankings' progress | 2020 | *Journal of Informetrics* |
| 99 | 8 | K Rybinski | Are rankings and accreditation related? Examining the dynamics of higher education in Poland | 2020 | *Quality Assurance in Education* |
| 100 | 8 | RL Shreeve | Globalisation or westernisation? The influence of global university rankings in the context of the Republic of China (Taiwan) | 2020 | *Compare: A Journal of Comparative and International Education*  |

**Table 2.** Preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR) checklist

|  |  |  |  |
| --- | --- | --- | --- |
| Section  | Item  | PRISMA-ScR checklist Item  | Reported on page no.  |
| **TITLE**  |  |  |  |
| Title  | 1  | Identify the report as a scoping review.  | 1 |
| **ABSTRACT**  |  |  |  |
| Structured summary  | 2  | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.  | 1 |
| **INTRODUCTION**  |  |  |  |
| Rationale  | 3  | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.  | 1,2,3 |
| Objectives  | 4  | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.  | 3 |
| **METHODS**  |  |  |  |
| Protocol and registration  | 5  | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.  | 3 |
| Eligibility criteria  | 6  | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.  | 4 |
| Information sources\*  | 7  | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.  | 4 |
| Search  | 8  | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.  | 4 |
| Selection of sources of evidence†  | 9  | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.  | 4 |
| Data charting process‡  | 10  | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.  | 3,4 |
| Data items  | 11  | List and define all variables for which data were sought and any assumptions and simplifications made.  | 4,5 |
| Critical appraisal of individual sources of evidence§  | 12  | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).  | Critical appraisal of sources was not done as the sources refer to internationally known scientific databases consulted for number of citations. |
| Synthesis of results  | 13  | Describe the methods of handling and summarizing the data that were charted.  | 3,4 |

|  |  |  |  |
| --- | --- | --- | --- |
| **RESULTS**  |  |  |  |
| Selection of sources of evidence  | 14  | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.  |  5 |
| Characteristics of sources of evidence  | 15  | For each source of evidence, present characteristics for which data were charted and provide the citations.  |  5 to 11 |
| Critical appraisal within sources of evidence  | 16  | If done, present data on critical appraisal of included sources of evidence (see item 12).  |  Critical appraisal of sources was not done as the sources refer to internationally known scientific databases consulted for number of citations. |
| Results of individual sources of evidence  | 17  | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.  |  5 to 11 |
| Synthesis of results  | 18  | Summarize and/or present the charting results as they relate to the review questions and objectives.  |  5 to 11Presentation of findings follow the order of research questions. |
| **DISCUSSION**  |  |  |  |
| Summary of evidence  | 19  | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.  |  12 |
| Limitations  | 20  | Discuss the limitations of the scoping review process. |  13 |
| Conclusions  | 21  | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.  |  13, 14, 15 |
| **FUNDING**  |  |  |  |
| Funding  | 22  | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.  |  Funding was not used in this research. |

**Table 3.** Generation process of Figure 4

1. *Selecting a Central Topic*: The researcher selected ‘University Rankings’ as the central topic, which was placed at the centre of the mind map.
2. *Identifying Main Themes*: The researcher identified five main themes related to university rankings, which were Rankings, Methodology, Analysis, Approach, and Education. Each of these themes was connected to the central topic.
3. *Creating Branches*: Branches or lines extended from the central topic to each of the main themes, and the researcher labelled each branch with the name of the theme.
4. *Exploring Sub-themes*: For each main theme, the researcher identified sub-topics or concepts that were related to it. For example, under ‘Methodology,’ the researcher listed ‘Indicators’ and ‘Analyses of University Positions.’
5. *Connecting Sub-themes*: The researcher created branches extending from the main theme branches to the associated sub-themes and labelled each branch with the name of the sub-theme.
6. *Identifying Relationships*: The researcher noted the intersections and relationships between some of the themes and sub-themes, such as the relationship between ‘Rankings’ and ‘Education’. Lines were used to indicate these relationships.
7. *Adding Details*: If there were specific points, concepts, or details related to each theme or sub-theme, the researcher added them as text within the respective branches.
8. *Using Colour and Visuals*: Different colours, icons, or visual elements were used to make the mind map more visually appealing and to emphasize key points.
9. *Reviewing and Refining*: After creating the initial mind map, the researcher reviewed it to ensure it accurately represented the relationships and concepts. Any necessary refinements and expansions were made.
10. *Presenting*: The researcher used mind mapping software (nVivo).