

Article

Saudi Universities Rapid Escalation in Academic Ranking Systems: Implications and Challenges

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Abstract: High scientific output has made two Saudi universities perform well in academic ranking systems. The improvement in university ranking is generally observed in other indicators such as the innovation index, the abundance of cutting-edge research, and the number and success of patents and startups. In this paper, the impact of research output of highly cited researchers at two Saudi public universities is investigated from different standpoints and compared with international examples. Many citation databases, ranking systems and international indicators have been used in this paper to thoroughly discuss the research and development landscape in Saudi Arabia. Saudi public universities have the greatest number of highly cited researchers who mostly have another international affiliation. The Saudi academic patent number has increased dramatically since 2014, with minimum improvement in the country's innovation and startups performance. Many of the Saudi highly cited papers are scattered in the literature with neither a specific targeted field nor follow-up studies. The role of the Saudi universities in industrial collaboration, technology advancement and economic prosperity is less than expected considering the Saudi position on the international stage. Entrepreneurship, innovation and research commercialisation ought to be supported by more private and public initiatives. Transparency, critical thinking, and accountability are needed the most in Saudi academic institutes. Recommendations are given for improving the research culture and following the best practice.

Keywords: Saudi Arabia; Saudi universities; Vision 2030; Saudi higher education; Saudi research and development; university ranking; highly cited researcher

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Introduction

It has been almost 70 years since the first university was established in Saudi Arabia (SA), with tens of others after that. In 1979, it was reported that the Saudi educational machinery could not develop sophisticated science and technology plans, although foreign consultants could provide the necessary expertise, which arguably has not changed much up until today.¹ The two oldest universities in SA are King Saud University (KSU) in Riyadh and King Abdulaziz University (KAU) in Jeddah; they both offer a wide range of degrees and have the best national reputation in education.² These institutes have been primarily teaching undergraduate students to meet local employment demands in various fields. Currently, there is only one postgraduate research university in SA, King Abdullah University of Science and Technology (KAUST) which was established in 2009. However, KAUST is not under the Ministry of Education management, unlike the other two universities.

In the late 1970s, the number of scientific authors in SA was only eight while there were 293 in Egypt, which had the only sizeable number in the Arab world.³ The remarkable increase in research publication in SA started in 2008 when the two main Saudi universities, KSU and KAU, started considering global university rankings such as the Quacquarelli Symonds (QS) and other ranking metrics.⁴ This pivotal point in publication was three years after the launch of the King Abdullah Scholarship Program, which enabled many Saudis to study abroad, mainly in Europe and the US.⁵ SA was ranked fourth in the countries sending the largest numbers of students to the United States in 2015.⁶ Surprisingly, many sponsored students are sent to study at universities that have ended up falling behind many Saudi universities in the world ranking in recent years.⁷ It was reported that Saudi students find their way to be enrolled in research programs that lack a worldwide reputation and are more teaching-focused.⁸ Although some students study in prestigious universities, they do not usually stay to gain experience in research and experimental development after completing the degree. This is primarily due to

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- ¹ Mitchell, B., and Alfuraih, A., 2018. The Kingdom of Saudi Arabia: Achieving the aspirations of the National Transformation Program 2020 and Saudi Vision 2030 through education. *Journal of Education and Development* 2: 36; Moshashai, D., Leber, A.M., and Savage, J.D., 2020. Saudi Arabia plans for its economic future: Vision 2030, the National Transformation Plan and Saudi fiscal reform. *British Journal of Middle Eastern Studies* 47: 381–401; Szyliowicz, J.S., 1979. The Prospects for Scientific and Technological Development in Saudi Arabia. *International Journal of Middle East Studies* 10: 355–72.
 - ² Al Kuwaiti, A., Downing, K., and Subbarayalu, A.V., 2019. Performance of Saudi Universities in Global Rankings and appropriate strategies for its improvement. *Library Philosophy and Practice* 1N21; Khan, I.H., 2019. A Unified Framework for Systematic Evaluation of ABET Student Outcomes and Program Educational Objectives. *International Journal of Modern Education & Computer Science* 11.
 - ³ Szyliowicz, The Prospects for Scientific and Technological Development in Saudi Arabia.
 - ⁴ Kehm, B.M., and Erkkilä, T., 2014. The ranking game, *European Journal of Education* 49(1); Tayeb, O., Zahed, A., and Ritzen, J., 2016. *Becoming a World-Class University: The Case of King Abdulaziz University*. Springer Nature.
 - ⁵ Taylor, C., and Albasri, W., 2014. The impact of Saudi Arabia King Abdullah's scholarship program in the US. *Open Journal of Social Sciences* 2: 109.
 - ⁶ Unruh, S., and Obeidat, B.F., 2015. Adjusting to learning in the US: Saudi students speak out. *Journal of Higher Education Theory and Practice* 15: 45.
 - ⁷ Ibraheem, A.I., and Devine, C., 2016. Saudi students, American Academic Library: A survey. *Library Review* 65(4/5): 267–280.
 - ⁸ Yakaboski, T., Perez-Velez, K., and Almutairi, Y., 2016. Collectivists' decision-making: Saudi Arabian graduate students' study abroad choices. *Journal of International Students* 7: 94–112.

restrictions placed upon them by their sponsors, demanding their immediate return, as well as other employment opportunities at home.

Saudi public universities have been generously run by oil-dependent revenue since they were founded.⁹ However, this golden era was destined to change. In 2016, Saudi Vision 2030 was introduced with the launch of the Saudi National Transformation Program to reform many governmental entities and diversify the economy.¹⁰ Achieving and maintaining this important national update for 2030 and beyond requires the engagement and thorough feedback of the local and international academic community.¹¹ In the last two decades, many Saudi universities have made dramatic advances in their world rankings which has made them the focus of many research and scientific articles.¹² Two of the most influential and widely observed university ranking systems are the Academic Ranking of World Universities (ARWU) and the QS World University Rankings.¹³ The ARWU is known as the Shanghai Ranking and is the oldest ranking system.¹⁴ The history and screening methods of these ranking systems have been highlighted and criticised in the literature.¹⁵ In general, a combination of indicators is considered, such as the employment rate of the graduates, the number of international academics and students, research paper output, and impact.¹⁶ The criteria used in each system vary, for example, currently the ARWU considers faculty members' publications and citations, whereas the QS systems take expert-based reputation indicators into account.¹⁷ It is worth mentioning that ranking systems can undergo regular updates when an issue is raised. This was the case when, in 2012, ARWU noticed the affiliation of highly cited researchers (HCR)

⁹ Khorsheed, M.S., 2015. Saudi Arabia: From oil kingdom to knowledge-based economy. *Middle East Policy* 22: 147–57.

¹⁰ Mitchell and Alfuraih, The Kingdom of Saudi Arabia; Moshashai et al., Saudi Arabia plans for its economic future.

¹¹ Meshari, A.Z., Othayman, M.B., Boy, F., and Doneddu, D., 2021. The impact of learning organizations dimensions on the organisational performance: An exploring study of Saudi Universities. *International Business Research* 14: 1–54; Mitchell and Alfuraih, The Kingdom of Saudi Arabia; Schmoch, U., Fardoun, H.M., and Mashat, A.S., 2016. Establishing a World-Class University in Saudi Arabia: Intended and unintended effects. *Scientometrics* 109: 1191–207.

¹² Ahmad, S., Ur Rehman, S., and Ashiq, M., 2020. A bibliometric review of Arab World Research from 1980–2020. *Science & Technology Libraries*, 1–21; Bhattacharjee, Y., 2011. Saudi universities offer cash in exchange for academic prestige. *American Association for the Advancement of Science* 334(6061): 1344–45; Kehm, B.M., 2020. Global university rankings: Impacts and applications. *Gaming the Metrics*, 93; Kehm and Erkkilä, The ranking game; Mazi, A., and Altbach, P.G., 2013. Dreams and realities: The world-class idea and Saudi Arabian higher education. In *Higher Education in Saudi Arabia*. Springer, 13–26; Meo, S.A., and Eldawlatly, A., 2018. Turning of the tides: Saudi Arabia sits a top in the academic impact factor race in the region. *Saudi Journal of Anaesthesia* 12, 512; Schmoch et al., Establishing a World-Class University in Saudi Arabia.

¹³ Huang, M.-H., 2011. A comparison of three major academic rankings for world universities: From a research evaluation perspective. *Journal of Library & Information Studies* 9.

¹⁴ Moed, H.F., 2017. A critical comparative analysis of five world university rankings. *Scientometrics* 110: 967–90.

¹⁵ Ibid.

¹⁶ Altbach, P., 2006. The dilemmas of ranking. *International Higher Education* 42; Taylor, P., and Braddock, R., 2007. International university ranking systems and the idea of university excellence. *Journal of Higher Education Policy and Management* 29: 245–60.

¹⁷ Hou, Y.-W., and Jacob, W.J., 2017. What contributes more to the ranking of higher education institutions? A comparison of three world university rankings. *International Education Journal: Comparative Perspectives* 16: 29–46.

had changed, and reassigned a weighted score related to the declared percentage of affiliation.¹⁸

The improvement of Saudi universities in the world university academic rankings, by affiliating with highly cited researchers (HCR) and editors of high impact journals, is controversial.¹⁹ For example, two years after starting a postgraduate program in a Saudi university, the mathematics department was ranked directly after Harvard in the US News and World Report in 2014. Similarly, the chemical engineering department of the same university, which has only a handful PhD students and postdocs, was ranked fourth in the US News that year. These issues have increased criticisms of the reliability of the university ranking systems, and their usefulness is debated within the research community.²⁰

Academics can be described as hyperprolific if they have a high rate of annual publications and as hyperprolific and distinguished (or HCR) simultaneously if they publish highly cited papers.²¹ The publication rate and the number of citations vary from one field to another. Research, that is up to date, deals with crucial issues, and paves the way for ground-breaking discovery would be expected to have a high number of citations. This can be seen, for instance, in the case of COVID-19 and some other medical research.²² The fast rise of the Saudi universities up the world ranking systems should be reflected in economic, social, and industrial landscapes. The Saudi leading public universities claim to be world-class institutes, hence can be compared to other leading academic institutes.²³

This paper focuses mainly on research-related issues in SA rather than teaching output, which is highlighted elsewhere.²⁴ KAU and KSU will be compared with a national benchmark, KAUST; a regional benchmark, The Weizmann Institute of Science (WIS); and two leading international institutions, the National University of Singapore (NUS) and Imperial College London (IC). These international benchmarks were chosen to represent a wider range of geographical, educational and historical spectra. These include the fact that they are STEM-based institutes, and they were founded closely to each other, except for IC. The main parameters in the comparison are the number of HCR in 2020 and their recent annual academic article output, the number of HCR in 2020 who did

¹⁸ Docampo, D., and Cram, L., 2019. Highly cited researchers: A moving target. *Scientometrics* 118: 1011–25.

¹⁹ Petersen, J., Hattke, F., and Vogel, R., 2017. Editorial governance and journal impact: A study of management and business journals. *Scientometrics* 112: 1593–614; Schmoch et al., Establishing a World-Class University in Saudi Arabia.

²⁰ Altbach, The dilemmas of ranking; Lim, M.A., 2018. The building of weak expertise: The work of global university rankers. *Higher Education* 75: 415–30; Peters, M.A., 2019. Global university rankings: Metrics, performance, governance. *Educational Philosophy and Theory* 51(1): 5–13; Rindova, V.P., Martins, L.L., Srinivas, S.B., and Chandler, D., 2018. The good, the bad, and the ugly of organizational rankings: A multidisciplinary review of the literature and directions for future research. *Journal of Management* 44: 2175–208; Vernon, M.M., Balas, E.A., and Momani, S., 2018. Are university rankings useful to improve research? A systematic review. *PLoS ONE* 13: e0193762.

²¹ Bornmann, L., and Tekles, A., 2019. Productivity does not equal usefulness. *Scientometrics* 118: 705–7; Yan, R., Tang, J., Liu, X., Shan, D., and Li, X., 2011. Citation Count Prediction: Learning to Estimate Future Citations for Literature, Proceedings of the 20th ACM International Conference on Information and Knowledge Management, pp. 1247–52.

²² Ho, Y.-S., Satoh, H., and Lin, S.-Y., 2010. Japanese lung cancer research trends and performance in Science Citation Index. *Internal Medicine* 49: 2219–28; Ram, S., 2020. Coronavirus research trends: A 50-year bibliometric assessment. *Science & Technology Libraries* 39: 210–26.

²³ Tayeb et al., *Becoming a World-Class University*.

²⁴ Allmnakrah, A., and Evers, C., 2020. The need for a fundamental shift in the Saudi education system: Implementing the Saudi Arabian economic Vision 2030. *Research in Education* 106: 22–40.

not appear in the 2019 list, and the HCR's gender and academic origin if they have a second international affiliation. In addition, citations per faculty, innovation, and human development indices in 2020, along with the number of startups and patents in the home country, will be considered. Some domestic aspects which affect Saudi academic performance will be presented. Finally, some popular papers will be highlighted and discussed. The result will be explained with a summary of the Saudi academic system in order to get to the root of the issue that is disturbing many academics.²⁵

Method

The Institute of Scientific Information (ISI) was used to determine the list of HCR. The institute name and the desired year were inserted to access their Web of Science Researchers ID. The full name, primary and secondary affiliations, and field of research could be found. Some of these researchers have retired or moved from one university to another, hence their Google Scholar, PubMed, and ResearchGate profiles were also checked.

All affiliated papers were checked, as the same name as the sought author's can appear elsewhere in another field. Moreover, the affiliated-university website and the research papers were checked to ensure the author's identity with the expected affiliation. The QS world ranking website²⁶ and ARWU website²⁷ were used to determine universities' ranking position. The innovation index was found online and published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO).²⁸ The Human Development Index (HDI) was found in the United Nations Human Development Report 2020. The number of startups was obtained online.²⁹ Finally, the total number of patents per country since 1976 was found at the United States Patent and Trademark Office (USPTO).³⁰ The EU- and UK-based patents were omitted as they are far fewer than those for the US for these considered countries. The number of patents was divided by the number of populations rounded to one decimal digit which was taken from Worldometer for 2021.³¹ The rate of increase in population since 1976 is similar for the considered countries in this study, apart from the UK which shows the smallest percentage increase.

Results and Discussion

The improvement of the considered universities' position in the ARWU and QS systems are shown in Table 1. Sometimes the overall rank is not available, and the rank of a

²⁵ Ahmad et al., A bibliometric review of Arab World Research from 1980–2020; Bhattacharjee, Saudi universities offer cash in exchange for academic prestige; Kehm, Global university rankings; Kehm and Erkkilä, The ranking game; Mazi and Altbach, Dreams and realities; Meo and Eldawlatly, Turning of the tides; Schmoch et al., Establishing a World-Class University in Saudi Arabia.

²⁶ <https://www.topuniversities.com>.

²⁷ <https://www.shanghairanking.com>.

²⁸ Cornell University, I., and WIPO., 2020. The Global Innovation Index 2020: Who Will Finance Innovation? Ithaca, Fontainebleau, and Geneva.

²⁹ At www.startupranking.com.

³⁰ <https://www.uspto.gov>; Graham, S.J., Marco, A.C., and Miller, R., 2018. The USPTO patent examination research dataset: A window on patent processing. *Journal of Economics & Management Strategy* 27: 554–78.

³¹ <https://www.worldometers.info/population>, accessed 23 June 2021.

specific subject is suggested instead. However, the overall rank was only considered here, and the suggested subject rank was neglected and shown as N/A or removed completely, as in the case of KAUST and WIS. Likewise, the year 2014 column was removed because both KAU and KSU did not appear in the QS.

Table 1: Universities' rank based on the different ranking systems.

University/Year	ARWU					QS				
	2012	2016	2018	2020	2022	2012	2016	2018	2020	2022
KAU	301:400		101:150			334	303	267	186	109
KSU	201:300	101:150		151:200	101:150	197	237	221	281	277
KAUST	N/A		201:300					N/A		
WIS	93	101:150		93	92			N/A		
NUS	101:150	83	85	80	75	25	12	15	11	11
IC	24	22	24	25	25	6	8	8	9	7

ARWU: Academic Ranking of the World Universities; IC: Imperial College London; KAU: King Abdulaziz University; KAUST: King Abdullah University for Science and Technology; KSU: King Saud University; N/A: Not Available; NUS: National University of Singapore; QS: Quacquarelli Symonds; WIS: Weizmann Institute of Science.

KAU position improved from 2012 to 2016, and was then maintained in the 101:150 range according to ARWU. However, KAU made its most noticeable improvement in the QS, and KSU showed some fluctuations in both the ARWU and QS ranking systems. This could have been due to changes in research strategies, funding availability, and leadership positions in KAU and KSU.

The WIS, NUS and IC improved their positions slightly in the last decade or maintained them within a very small range. Top universities are less volatile in the university ranking than the universities beyond the top 100. For example, KAU climbed almost 100 positions in the QS between 2018 and 2020. This dramatic improvement is less pronounced in the top 100 universities. The utilisation of multiple indicators and ranking systems can help to get a better insight into the institute's academic performance, and to determine unusual progress.³²

The Abundance and Characteristics of the HCR

Most international universities hire early career researchers and allow them to grow and prosper to become academically influential in their field of study. However, some universities tend to hire full-time professors or HCR with a specific contract to accelerate the building of their reputation worldwide. As shown in Figure 1, in 2020 KAU had the highest number of HCR (52), while WIS had the lowest number of HCR (18). KAUST had 19. It seems clear that KAUST attracts HCR with a high publication rate as seen in their mean value of 44 publications per year. In addition, the lowest publication rate of the HCR is almost the same overall, except at KAUST, which is slightly higher. The average number of publications of the HCR is lowest for WIS (12 papers per year). In 2019 and 2020, the HCR of WIS and IC had a maximum publication rate of around 35 and 85 per year, respectively. In contrast, the other universities have many hyperprolific academics.

The HCR of KAU in 2019 published a paper every two days in 2020. Such a rate of publications cannot be realistically linked with the research of an individual researcher.

³² Moed, A critical comparative analysis of five world university rankings.

Some of these KAU HCR write with co-authors from other much less known Asian-based universities, such as Aligarh Muslim University and Shahjalal University of Science and Technology. The first authors of these papers are mostly from abroad, further confirming that these studies are conducted outside SA, perhaps with Saudi funds.

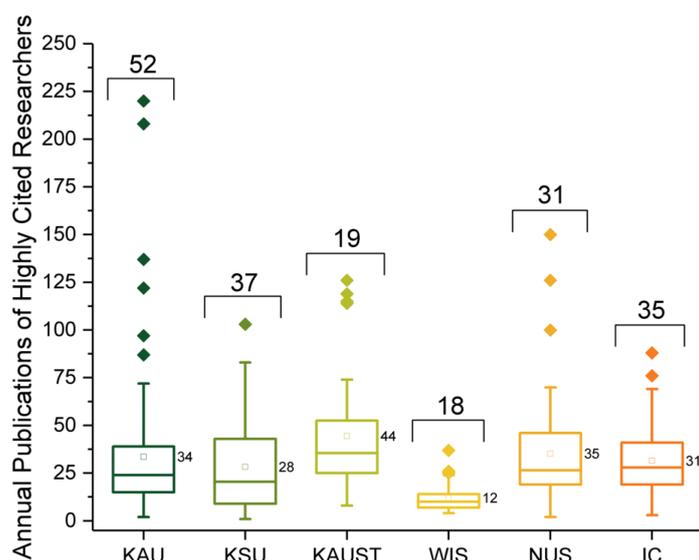


Figure 1: Annual publications for HCR at the six different universities of 2019 and 2020 based on ISI. The average is shown on the right-hand side of each column. The height of the column from the bottom to the top represents 25, 50 and 75 percent of the data. The whisker indicates the variability beyond the quartiles with a coefficient of 1.5. The number at the top of each data is the number of HCR in 2020.

The average number of publications of the HCR for the considered institutes is around 30 publications per year. The deviation between HCR publication output is the smallest for WIS and IC. This comparatively low research output could be justified by the fact that seeking research funds and working towards ground-breaking discoveries can take time to reach publication.³³ Hyperprolific HCR authors (100 publications per year) did not appear at WIS and IC.

Gender of HCR and Cultural Tightness

Gender equality is a feature that many universities want to tackle.³⁴ As shown in Figure 2, WIS and IC have the highest number of female HCR. Although the number of female HCR might not accurately represent the gender equality situation in these institutions, it nevertheless gives an impression of the favouritism towards the male gender in Asian institutions.³⁵ KAU, which has gender-segregated campuses, has 8 percent female HCR. Gender academic segregation can hinder academic collaboration and efficient

³³ Sapir, A., and Oliver, A.L., 2017. From academic laboratory to the market: Disclosed and undisclosed narratives of commercialization. *Social Studies of Science* 47: 33–52; Thacker, P.D., 2003. Surprising discovery with Alzheimer's medication. *Drug Discovery Today* 8: 379–80.

³⁴ Mamlok-Naaman, R., 2021. Socio-cultural developments of women in Science. *Pure and Applied Chemistry* 93: 907–12.

³⁵ Tang, H.-h.H., 2019. World-class universities and female leadership in the academic profession: Case studies of East Asian higher education. In Neubauer, D., and Kaur, S. (eds), *Gender and the Changing Face of Higher Education in Asia Pacific*. Springer, pp. 41–56.

communication.³⁶ Even though SA has shown some improvements toward gender equality in the last a few years, the process needs more effort to shrink this gap.³⁷

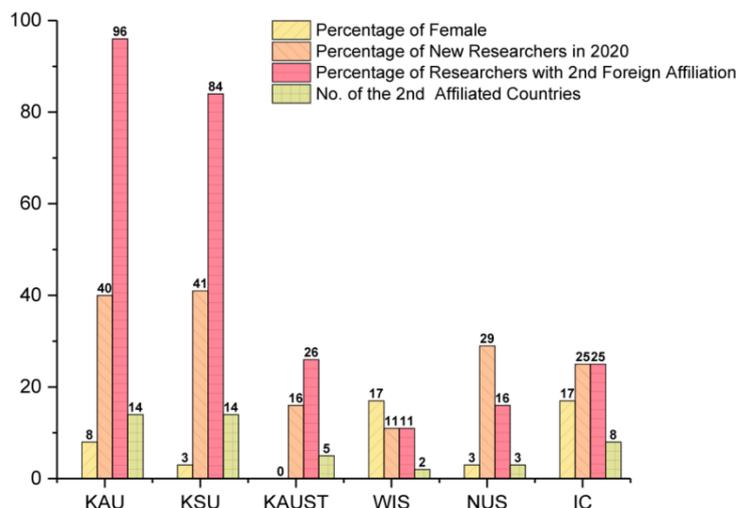


Figure 2: Some HCR criteria HCR in 2019–2020.

It is worth mentioning that most Saudi female academics are not obliged to show their faces on their online academic pages, even though they mostly did their PhDs abroad and many revealed their faces as students outside SA. This is not the case for other Islamic countries such as Malaysia and Egypt. Interestingly, KAUST, which is considered international and has the first mixed-gender campus in SA, has no female HCR, despite having female researchers in leadership positions.³⁸ Although SA has becoming more open and welcoming to tourists regardless of their ethnicity and religion, this might not be applicable to the academic culture. In fact, the existence of many talented scientists who are atheist or from the LGBTQ community, such as Ben Barres and Richard Summerbell, in SA is unlikely considering the conservative, rigid practices in the Saudi society.³⁹ These restrictions affect Saudi male academics as well; for example, having long hair, wearing shorts, piercing and tattoos are not allowed according to Saudi civil service laws. The focus should be on the mind and the skills of the academics, and these divisive attitudes are not welcome in the modern academic world.

HCR Turnover Rate, Origin and Domestic Funding Shortage

Looking at the turnover rate of HCR is crucial because it indicates whether a university targets HCR to share their fame annually. Forty percent of the HCR at KAU and KSU

³⁶ Matthews, K.R., Yang, E., Lewis, S.W., Vaidyanathan, B.R., and Gorman, M., 2020. International scientific collaborative activities and barriers to them in eight societies. *Accountability in Research* 27: 477–95; Onsmann, A., 2011. It is better to light a candle than to ban the darkness: Government led academic development in Saudi Arabian universities. *Higher Education* 62: 519–32; Unruh and Obeidat, Adjusting to learning in the US.

³⁷ Nelson, E., 2019. Women in Saudi Arabia: And the Source of Rights and Restrictions. *Political Science Class Publications* 3. <https://scholarlycommons.obu.edu/polisci/3>.

³⁸ Clary, C., and Karlin, M.E., 2011. Saudi Arabia's reform gamble. *Survival* 53: 15–20; Sarant, L., 2017. The gender divide: Agents of change. *Nature* 549: S70–4.

³⁹ Colella, T., 2020. Inclusion of LGBTQ+ People in University Bioscience, Dissertation, The University of Arizona; Ecklund, E.H., 2008. Religion and spirituality among scientists. *Contexts* 7: 12–15.

in 2020 did not appear in the previous year's list, which is the highest number in all considered universities. More importantly, 96 percent of the HCR at KAU and 84 percent for KSU show a second international affiliation alongside their main universities, mostly in the US, China and Europe. This is much lower percentage in all other institutes, including KAUST, where almost all HCR are full-time academics without a second affiliation. Clearly, KAU and KSU have failed to convince these HCR to move to SA and grow academically, and have focused entirely on their affiliation without any substantial long-term benefit to the institutes.⁴⁰

The high number of HCR in Saudi has a detrimental impact on the local early-career academics at KAU and KSU. This is because these HCR secure funds from local authorities, leaving many other academics with a much lower chance of funding their research at KAU and KSU. Scientific research should be weighed on its merit and on its potential for the advancement of our understanding, which would lead to problem-solving and scientific discovery. However, there seems to be an issue of trust between the funding agencies/university in SA and their local academics that further hinders accessibility to funding. For example, funding opportunities with announced budgets are advertised and made available to all. However, upon acceptance of a proposal, the funding agencies bargain with the principal investigators over the funding amount that will be available to them. Furthermore, these universities require the results to be published in Q1 and Q2 journals, and the first-named author to have the funding university as their first—and sometimes sole—affiliation.

Moreover, the financial rewards and consumables fees are only provided after the academic publication appears on the Web of Science website. This means that academics might have to pay from their own pocket to fund their research or even fake purchasing receipts to get funding on time. These practices became normal because of the inefficient funding system. Consequently, these domestic issues have made some Saudi academics become just a research paper acquisition machine for the sake of career promotion and university ranking improvement. Moreover, ordering biological kits from abroad (e.g., *RNA isolation kits*) might take up to two months to arrive at a Saudi public university because of the bureaucratic and slow clearance systems of Saudi customs and the Saudi Food and Drug Administration. Ordering some of these kits locally is possible, but at up to three times the cost of the main distributor website. Some of the kits require storage at a temperature of $-20\text{ }^{\circ}\text{C}$ and slow clearance means that the ordered kit is no longer useable. It is worth mentioning that this is not the case for KAUST, which has its own chemical and biological warehouse with very efficient ordering and clearance systems.

International Students

One of the main reasons that universities want to improve their ranking is to attract more international students in order to maintain a competitive academic environment and gain more cash for development. However, this is not the case in SA as public universities do not ask for tuition fees, and most undergraduate students are Saudis. Another reason is to attract prominent academics, but in Saudi public universities there is an imposed cap on the percentage of foreign academics who, furthermore, cannot be in high leadership

⁴⁰ Al-Youbi, A., Zahed, A.H., and Tierney, W.G., 2020. *Successful Global Collaborations in Higher Education Institutions*. Springer Nature.

positions. If these two benefits of a better university rank are lacking in SA, many may question the reason behind the desperate Saudi move towards improving their ranking.

The only well-advertised, science-based Saudi international graduate programs are the ones that are offered by KAUST. It seems that the Saudi public universities tend to encourage accepting international postgraduate students to perform well in the other ranking criterion (i.e., international students' ratio). Almost all PhD students at KAU and KSU, if there is a programme, have Muslim backgrounds. This is due to the universities' proximity to the holiest cities in Islam, Makkah and Madinah.

It is no surprise that these public universities have almost no European and Latino students, as a PhD monthly stipend from a Saudi public university is \$500, along with benefits such as free tuition, accommodation and healthcare. This is less than for other benchmark universities including KAUST (\$1500–2000 for other considered universities here). This makes it a much less attractive place for talented students from outside the kingdom.

Academic Environment and Productivity of the Local Researchers

Another issue which makes Saudi universities less attractive to postgraduate international students could be that Saudi public universities have a mandatory teaching duty for all faculty members; however, research activities are not compulsory for Saudi academics, and they can spend years without publishing a single article, and without any consequences, such as being demoted. It is no surprise then to see a Saudi academic retiring, after decades of serving, without ever being promoted and with low research productivity.⁴¹ However, this is not the case for foreign academics who must publish to get their annual contract renewed.

Teaching-only-academics exist in many countries such as the UK, the US and Canada. Although an academic job in SA includes both teaching and research aspects, many academics resort to teaching exclusively. Furthermore, academics in leadership positions, such as heads of department and college deans, do administrative tasks that only require English language and some basic administrative skills, as the performance of the designated admin team is poor.⁴² According to Saudi academic regulations, such leadership positions exempt their holders from academic duties (teaching) and give more financial advantages, resulting in a significant waste of skills and knowledge.

The Recruitment Process for Saudi Academics and Expectations

In SA, scientists can be faculty members only if the obtained degrees are in the same field as the department which they applied for. This can hinder collaboration within the department as multidisciplinary research exists in every field. Saudi universities used to choose almost all Saudi academics after they had achieved their undergraduate degrees to be sponsored to study abroad, with a guaranteed faculty member job after their postgraduate studies. This means that the new academic becomes a colleague of those by whom they were previously taught; hence, they do not always feel comfortable

⁴¹ Meshari et al., The impact of learning organizations dimensions on the organisational performance.

⁴² Kaki, S.M., and Alaskar, S., 2017. Proposal for Administrative Staffing in Saudi Universities in the Light of Global Trends. *American Journal of Educational Research* 5: 493–515.

in openly challenging them for change.⁴³ Schimanski and Alperin shed some light on how academics should be evaluated considering their research output.⁴⁴

While nationalising manufacturing and businesses seems appealing for many countries, an excellent education system should recruit the best and the brightest regardless of their nationalities and backgrounds.⁴⁵ In return, the best minds will expect an efficient, modern and transparent academic system, which should be in demand at most Saudi public universities.⁴⁶ Unfortunately, it was reported that Saudi universities had neither achieved the objectives of Saudi higher education nor met the international standards, despite the rapid rise in the university rankings.⁴⁷

The working hours in these public universities follow the public sector requirement, which states that working hours are from 8 am to 3 pm. However, most academics do not adhere to such hours and come in a few times a week from 10 am to 2 pm, at best estimates. Many wonder how 4 hours for a few days a week is enough to realise the intellectual potential of these academics. Nevertheless, SA is one of the best countries in terms of academic salary scales.⁴⁸

The Rise in Academic Ranking of Saudi Universities: A Reflection of the Country's Development?

In the last two decades, the HDI has become the most successfully used multidimensional indicator to measure a country's development. It considers the health, education, and material wellbeing effect on life expectancy at birth, and a combination of literacy rate, gross enrolment rate and the GDP per capita.⁴⁹

Saudi universities have managed to perform well from the ranking point of view. In fact, as of 2022, 12 (out of 43) universities in SA (almost 28 percent) are in the top 1,000 universities according to the QS ranking system. In comparison, UK hosts 81 universities (29 percent of the total universities), Israel hosts 6 (67 percent) and Singapore hosts only 3 universities (9 percent) in the top 1000 universities. Despite the significant rise in the

⁴³ Robinson-Pant, A., 2009. Changing academies: Exploring international PhD students' perspectives on 'host' and 'home' universities. *Higher Education Research & Development* 28: 417–29; Unruh and Obeidat, Adjusting to learning in the US.

⁴⁴ Schimanski, L.A., and Alperin, J.P., 2018. The evaluation of scholarship in academic promotion and tenure processes: Past, Present, and Future. *F1000Research* 7.

⁴⁵ Henry, G.T., Bastian, K.C., and Smith, A.A., 2012. Scholarships to recruit the "best and brightest" into teaching: Who is recruited, where do they teach, how effective are they, and how long do they stay? *Educational Researcher* 41: 83–92.

⁴⁶ Alqarni, S.A.Y., 2016. Quality of work life as a predictor of work engagement among the teaching faculty at King Abdulaziz University. *International Journal of Humanities And Social Science* 6: 118–35; Darling-Hammond, L., Burns, D., Campbell, C., Goodwin, A.L., Hammerness, K., ... and Zeichner, K., 2017. *Empowered Educators: How High-Performing Systems Shape Teaching Quality Around the World*. John Wiley & Sons.

⁴⁷ AlMotairy, O.S., and Stainbank, L.J., 2014. Compliance with international education standards in Saudi Arabia: Policy and educational implications. *Journal of Business Studies Quarterly* 5: 5; Ghabban, F.M., Selamat, A., and Ibrahim, R., 2016. A performance measurement of research productivity in Saudi Universities. *Journal of Engineering and Applied Science* 100: 537–44; Khurshid, Z., 2014. Measuring the quality of contributions of Saudi authors to LIS journals using Journal Impact Factor (JIF), SCImago Journal Rank (SJR), and Google Scholar Netrics (GSM). *The Serials Librarian* 67: 81–98.

⁴⁸ Al-Ohali, M., and Al-Mehrej, H., 2012. *Faculty salary and remuneration in the Kingdom of Saudi Arabia. Paying the professoriate: A Global Comparison of Compensation and Contracts*. Routledge, pp. 278–87.

⁴⁹ Herreró, C., Martínez, R., and Villar, A., 2012. A newer human development index. *Journal of Human Development and Capabilities* 13: 247–68.

academic ranking of Saudi universities, the innovation and human development indices (Table 2) put SA well behind the other considered countries.⁵⁰

Table 2: The Innovation Index and Human Development Index in 2020.

Country	Human Development Index	Innovation Index
Saudi Arabia	40	66
Israel	19	13
Singapore	11	8
United Kingdom	13	4

The purpose of registering a patent is to protect the intellectual property and to commercialise the invention. As shown in Figure 3, Israel has the highest number of patents per million current inhabitants, while SA is way behind the other considered countries. It was reported that the number of academic patents in SA with a university address was very small until 2009.⁵¹ Since 2014, Saudi universities have frequently appeared among the top 100 worldwide universities granted US utility patents.⁵² It was reported that between 2012 and 2016, King Fahad University for Petroleum and Minerals (KFUPM) produced a patent application for every five published STEM articles.⁵³

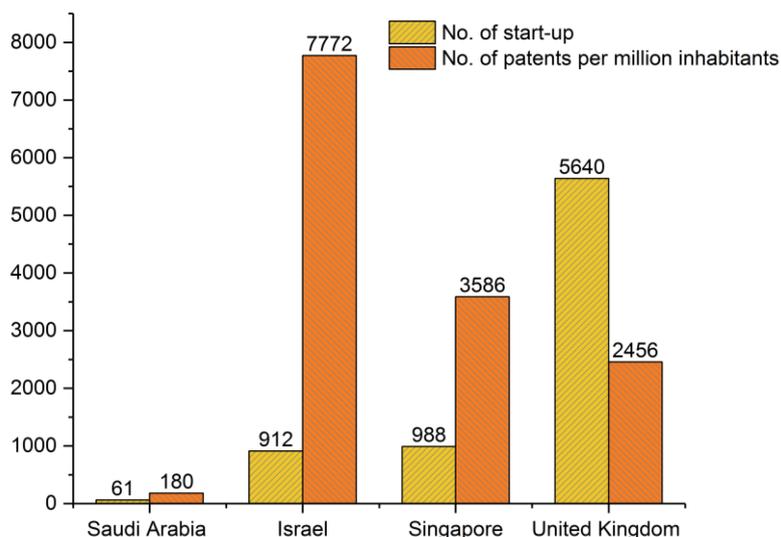


Figure 3: The number of startups (in 2020) and patents since 1976 per current million inhabitants of the four countries of the considered universities.

In 2020, three Saudi universities were among the top 50 universities to register patents in the world according to USPTO. This is because patent registry fees are paid by the Saudi affiliated university and the corresponding academics are financially rewarded. The local university patents interests has made local academics come up with ideas that are already commercialised, with little change to the available product, in order to gain domestic fame

⁵⁰ El-Awady, N., 2017. Call for an industrial-grade overhaul. *Nature* 549: S75–7; Khayati, A., and Selim, M., 2019. The status of innovation in Saudi Universities. *Cogent Education* 6: 1653635.

⁵¹ Leydesdorff, L., Etzkowitz, H., and Kushnir, D., 2016. Globalization and growth of US university patenting (2009–2014). *Industry and Higher Education* 30: 257–66.

⁵² Ibid.

⁵³ El-Awady, Call for an industrial-grade overhaul.

and reward, with almost no further product development. Government and corporate patents also need to increase as universities alone cannot improve the Saudi position when the entire population is considered.

Despite the significant rise in the number of the registered patents, the academic competition in patent registry has not led to any noticeable economic benefit to SA. Many academics are behind the increase of startups and spinouts in Israel, Singapore and the UK. These countries have a long history of encouraging entrepreneurship and attract many enterprises to move, with significant government support.⁵⁴ The entrepreneurship and innovation problems have been highlighted with clearly stated challenges in the literature for SA and Gulf Cooperation Council (GCC) countries.⁵⁵

The Innovation Index, patent per million inhabitants, HDI, and startup reputation cannot be suddenly improved based on university ranking or increasing scientific papers and patents. Universities need to play a bigger role in social, scientific and economic reforms. There is no surprise in the findings in Figure 3 regarding the Saudi approach to improve the ranking of its universities and patents rate from academia without taking its scientific ideas to the production phase.⁵⁶ A knowledge-based economy requires universities to foster industry's research and development activities and to be the driving force for real innovation and technology advancement. Therefore, these indices and indicators should be used simultaneously to get an insight in to the standing of a country on the scientific and technological scales.

Highly Cited Articles Led to Nowhere

Research conducted at universities aims to address unanswered scientific queries or solve urgent problems facing the society where these universities are based. A well-cited Chinese Hamster Ovary (CHO) genomic study (CHO cells are the workhorse for producing biopharmaceuticals) was affiliated with a Saudi university in 2013.⁵⁷ Unfortunately, it seems that the Saudi universities have not made enough national effort in advancing this industry and others apart from following a specific approach to improve their ranking and number of patents.

There are many well-cited papers, linked to KAU and KSU, in other fields such as the selective extraction of uranium,⁵⁸ seaweed production,⁵⁹ UV mutation of bacteria

⁵⁴ Mahmud, M., Akinwale, Y.O., Khan, R.A., and Alaraifi, A., 2019. Techno entrepreneurship adoption: An intention based assessment study of start-ups in the kingdom of Saudi Arabia. *Journal of Entrepreneurship Education* 22: 1–8. Sapir and Oliver, From academic laboratory to the market; Senor, D., and Singer, S., 2011. *Start-up Nation: The Story of Israel's Economic Miracle*. Random House Digital.

⁵⁵ Al-Khalifa, M., Al-Jayyousi, O., Mamlook, R., and Aldmour, F., 2021. *Assessing the Ecosystem of Innovation in GCC: Policy Implications and Strategic Directions, Research and Innovation Forum 2020: Disruptive Technologies in Times of Change*. Springer International Publishing, pp. 389–96; Almuzel, M., and Anderson, T., 2020. An Assessment of Entrepreneurial Ecosystem: The case of Saudi Arabia, 2020 IEEE Technology & Engineering Management Conference (TEMSCON). IEEE, pp. 1–6; El-Awady, Call for an industrial-grade overhaul.

⁵⁶ Kenny, J., 2017. Academic work and performativity. *Higher Education* 74: 897–913.

⁵⁷ Lewis, N.E., Liu, X., Li, Y., Nagarajan, H., Yerganian, G., ... and Bian, C., 2013. Genomic landscapes of Chinese hamster ovary cell lines as revealed by the *Cricetulus griseus* draft genome. *Nature Biotechnology* 31: 759–65.

⁵⁸ Shao, D., Hou, G., Li, J., Wen, T., Ren, X., and Wang, X., 2014. PANI/GO as a super adsorbent for the selective adsorption of uranium (VI). *Chemical Engineering Journal* 255: 604–12.

⁵⁹ Mazarrasa, I., Olsen, Y.S., Mayol, E., Marbà, N., and Duarte, C.M., 2014. Global unbalance in seaweed production, research effort and biotechnology markets. *Biotechnology Advances* 32: 1028–36.

to produce chemicals,⁶⁰ unique photothermal therapy for cancer treatment,⁶¹ triggered and targeted drug delivery for cancer treatments,⁶² *in silico* cancer growth simulation,⁶³ monoclonal antibodies production for Alzheimer and Ebola treatments⁶⁴ and recombinant spider silk proteins production for biomedical applications.⁶⁵

It is puzzling how such cutting-edge research and many more have not improved the Saudi position in innovation, industrial-academic collaboration, and startups. More importantly, these papers are scattered, with no follow-up studies or continuation of the research focus in the SA affiliated department. Sadly, it might be because none of their authors is a resident of SA (confirmed by the authors of this paper) and they might prefer to register the possible patent and startup in their country of permanent residence

Impactful Research or Publicity Stunts?

It is interesting to observe that Saudi universities also focus on attracting local media attention, regardless of the impact of their research. All Saudis remember that day in 2010 when KSU invited the late Saudi King Abdullah to launch the first-ever so-called Saudi-made car, Gazal 1. It was a national scientific propaganda event that was even shown at Geneva's International Motor Show.⁶⁶ That was a decade ago, and up to now SA still does not have a factory for cars, nor can it reliably make car parts to be exported to developed countries.⁶⁷ Likewise, the Fida Needle, which was described in the *Arab News* newspaper under the headline 'Saudi doctors train European doctors on Saudi invention in Germany'. However, the product can no longer be found online, despite the authors' best efforts.

⁶⁰ de Paula, F.C., de Paula, C.B., Gomez, J.G.C., Steinbüchel, A., and Contiero, J., 2017. Poly (3-hydroxybutyrate-co-3-hydroxyvalerate) production from biodiesel by-product and propionic acid by mutant strains of *Pandoraea* sp. *Biotechnology Progress* 33: 1077–84.

⁶¹ Tao, W., Ji, X., Xu, X., Islam, M.A., Li, Z., ... and Guo, Z., 2017. Antimonene quantum dots: Synthesis and application as near-infrared photothermal agents for effective cancer therapy. *Angewandte Chemie* 129: 12058–62.

⁶² Sriraman, S.K., Pan, J., Sarisozen, C., Luther, E., and Torchilin, V., 2016. Enhanced cytotoxicity of folic acid-targeted liposomes co-loaded with C6 ceramide and doxorubicin: In vitro evaluation on HeLa, A2780-ADR, and H69-AR cells. *Molecular Pharmaceutics* 13: 428–37; Xu, X., Saw, P.E., Tao, W., Li, Y., Ji, X., Bhasin, S., ... and Huo, M., 2017. ROS-responsive polyprodrug nanoparticles for triggered drug delivery and effective cancer therapy. *Advanced Materials* 29: 1700141.

⁶³ Wang, Z., Butner, J.D., Kerketta, R., Cristini, V., and Deisboeck, T.S., 2015. Simulating cancer growth with multiscale agent-based modeling. *Seminars in Cancer Biology* 30: 70–8.

⁶⁴ González-González, E., Alvarez, M.M., Márquez-Ipiña, A.R., Trujillo-de Santiago, G., Rodríguez-Martínez, L.M., Annabi, N., and Khademhosseini, A., 2017. Anti-Ebola therapies based on monoclonal antibodies: current state and challenges ahead. *Critical Reviews in Biotechnology* 37, 53–68; Hatami, A., Albay III, R., Monjazeb, S., Milton, S., and Glabe, C., 2014. Monoclonal antibodies against A β 42 fibrils distinguish multiple aggregation state polymorphisms in vitro and in Alzheimer disease brain. *Journal of Biological Chemistry* 289: 32131–43.

⁶⁵ Wohlrab, S., Müller, S., Schmidt, A., Neubauer, S., Kessler, H., Leal-Egaña, A., and Scheibel, T., 2012. Cell adhesion and proliferation on RGD-modified recombinant spider silk proteins. *Biomaterials* 33: 6650–59.

⁶⁶ Abidi, M.H., El-Tamimi, A., Al-Ahmari, A., Darwish, S., and Rasheed, M., 2013. Virtual ergonomic assessment of first Saudi Arabian designed car in a semi-immersive environment. *Procedia Engineering* 64: 622–31.

⁶⁷ Randheer, K., Trabulsi, H.U., Al Ajmi, H.A., and Al Jasser, H.K., 2017. Emerging Industry: A Case of Automobile Manufacturing in Saudi Arabia; Tausif, M.R., and Haque, M.I., 2018. Market dynamics and future prospects of the automobile industry in Saudi Arabia. *Problems and Perspectives in Management*, 246–58.

Another recent public scientific propaganda initiative is that led by KAU to work towards developing a COVID-19 vaccine in line with Islamic law (i.e., a Halal COVID-19 vaccine). The university website stated that ‘we are all responsible: the research center isolated the Corona virus in preparation for developing a vaccine’. If these promises took place in the UK or another developed country and were not delivered upon, a transparent national inquiry would be opened immediately as the research was conducted using public funds. What is shared between all these “inventions” is the uncertainty about their fate, and their failure to have an impactful and sustainable presence in the market, locally or internationally. Therefore, a national inquiry should be conducted urgently to determine the reasons behind the disappearance of these inventions. Immediate action plans should be issued to ensure the impactfulness and the sustainability of future research, rather than funding hollow yet publicly attractive promises.

Adjustment of Other Indicators and Rankings to Be Considered

University rank and patent numbers should not be the only indicators for the innovation position and knowledge-based economy performance. This was clearly seen in the case of the Belgium biotechnology boom, which revealed that patent statistics could be a misleading indicator of an individual university’s technological productivity.⁶⁸ The increase in SA scientific output has not been effectively transformed into new technologies for products and services. However, citation of patents can be used to illustrate the deep impact on subsequent technological change.⁶⁹ The number of startups and spinouts seems a more reliable way to discover the innovation and the knowledge-based economy than scientific papers and patents.

It is vital to have a vibrant and critically minded society to keep universities accountable for the funds they obtain and to minimise fraud in research and startups, such as the case of Theranos in the US’s Silicon Valley.⁷⁰ This will be crucial for the Saudis, particularly as questioning public figures openly can be problematic and people can feel uncomfortable about sharing an honest point of view.⁷¹

To make the ranking system less volatile, we suggest that universities should not be able to climb more than a certain range a year to allow regulatory bodies and academics to scrutinise any dramatic jump and analyse shortcuts to academic glory. Hou and Jacob suggest further steps, such as being aware of methodological issues used in university rankings, and the transparency of universities regarding financial and internationalisation data. They also warned about making public decisions based solely on ranking systems, which require regular examination.⁷²

⁶⁸ Saragossi, S., and de la Potterie, B.v.P., 2003. What patent data reveal about universities: The case of Belgium. *The Journal of Technology Transfer* 28: 47–51.

⁶⁹ Schmid, J., and Fajebe, A., 2019. Variation in patent impact by organization type: An investigation of government, university, and corporate patents. *Science and Public Policy* 46: 589–98.

⁷⁰ Biagioli, M., Kenney, M., Martin, B., and Walsh, J.P., 2018. Academic misconduct, misrepresentation and gaming: A reassessment. *Research Policy*; Geiger, S., 2020. Silicon Valley, disruption, and the end of uncertainty. *Journal of Cultural Economy* 13: 169–84.

⁷¹ Alnajrani, H., Bajnaid, A., Elyas, T., and Masa'deh, R.E., 2018. Exploring the transitional era in Saudi Arabia journalism discourse and the path towards the right to freedom of expression. *Modern Applied Science* 12: 1–12; Pintak, L., and Ginges, J., 2020. *Arab Journalists, The Global Journalist in the 21st Century*. Routledge, pp. 429–42.

⁷² Hou and Jacob, What contributes more to the ranking of higher education institutions?

Moreover, top journals and academic institutes should monitor scholar's nomadic behaviour (i.e., sudden paper affiliation changes and collaboration based on cash exchange for academic studies). Engaging the public in these issues, which undermine the essence of good scholarship and undervalue the importance of teaching and learning, has also been suggested in the literature as a key step to holding universities accountable.⁷³

The Rise in University Rankings: A Problem on Its Own or a Manifestation of a Bigger Issue?

The persistent Saudi higher education, innovation and entrepreneurial stumbles might be worsened by other factors. For instance, the Saudi prime minister appoints all heads of universities in SA. Although this is not an issue on its own, the fact that such appointments are not based on competency is troublesome. The longest-serving Minister of Higher Education in Saudi was replaced in 2014, after almost a quarter of a century at the top of higher education in SA. Although some long-serving ministers might have gained popularity and seem knowledgeable, keeping an education minister for more than two decades can be disadvantageous in many ways.

Another potential issue that might hinder the actual progress at universities is that many governmental roles are held by the elite in the kingdom. Currently, the Minister of Education, Chairman of General Authority for Entertainment, Minister of Islamic Affairs, the Chairman of the Consultative Assembly, and the Grand Mufti of SA come from a single family. Many scientists wonder how families who dominate some of the Saudi senior political roles are magically the most competitive for any possible positions. This issue has filtered down from the top of the system, affecting some Saudi universities. It is no surprise to see an academic and his son appointed in the same department in a Saudi university. While they are educated and can do the job, transparency and criticism are still missing to a great extent.⁷⁴ These meritocratic political issues have been reviewed elsewhere and are beyond the scope of this paper but can indirectly preclude those with the best minds from leadership positions.⁷⁵

Possible Corrective Steps

Critical appraisal skills should be adopted in Saudi school curricula and public criticism should be better tolerated by the government. This issue was highlighted in 2009 by Robinson-Pant who explored differences in academic cultures between the UK and some other countries by interviewing international students.⁷⁶ A recent paper by Hertog showed that the rentier mentality is still prevalent in Saudi and GCC countries.⁷⁷

Saudis are proudly taught in primary school that the first Arab and Muslim astronaut is a Saudi prince who went to space in 1985. It is unbelievable that it took SA 33 years

⁷³ Adler, N.J., and Harzing, A.-W., 2009. When knowledge wins: Transcending the sense and nonsense of academic rankings. *Academy of Management Learning & Education* 8: 72–95.

⁷⁴ Freedom House 2017. Freedom of the Press 2017 – Saudi Arabia. <https://www.ecoi.net/en/document/1418687.html>.

⁷⁵ Sallam, A.A.E.A., 2013. Where Is Saudi Arabian Society Heading? *Contemporary Readings in Law and Social Justice* 5: 141.

⁷⁶ Robinson-Pant, Changing academies.

⁷⁷ Hertog, S., 2020. The 'rentier mentality', 30 years on: Evidence from survey data. *British Journal of Middle Eastern Studies* 47: 6–23.

after that to found the Saudi Space Commission.⁷⁸ The new Saudi generation needs to know where the country really is when it comes to technology and discovery, and to be encouraged to work hard, rather than simply importing new ideas and products from abroad. These deep-rooted problems cannot be solved overnight simply by a contract with an HCR or a royal decree to change the education minister. A thorough independent review and quality assurance steps are needed to improve Saudi university management, as well as a commitment to follow a solid framework to improve scientific research and practices.

Universities should receive only partial funding, with most of the money given to students to choose which Saudi university they wish to study at, in order to start competition among universities. The KAU and KSU are currently in a transition phase of becoming partially independent, although to a lesser extent than KAUST.

SA recently considered granting citizenship to foreigners with talented skills in medicine and technology, which is a step that should have been implemented decades ago. Interestingly, SA granted citizenship to Sophia, the humanoid robot, an official Saudi citizen in 2017.⁷⁹ Privatising education and other public sectors have also been considered for the near future. However, these actions alone will not improve the Saudi innovation and technological position unless most of the social and research problems are alleviated. The increase in Saudi universities' academic ranking should be reflected in the national economy and wellbeing, and in technological advancement. However, the current mission, i.e., increasing Saudi universities' global ranking, without any tangible economic and technical benefit to these universities, is detrimental and should be corrected.

Conclusion

The Saudi government wants to see three Saudi universities in the world's top 200 universities, before 2030, with priority given to KSU being in the top 50. Given the current ranking position and the approach taken, such an objective can be achieved, as some universities e.g., KAU and KSU, are already ranked in the top 200. However, an increase in the universities' ranking should not be an objective, but rather a reflection of the current state of these universities. The university ranking system and number of patents should not be the only metric for evaluating Saudi universities. Other given parameters should also be considered to ensure universities fulfil their economic and social duties.

The most necessary step is to reform the common Saudi academic mindset and to carry out research that benefits the Saudi economy as well as local and international communities. Such research should aim to overcome environmental, medical and technological challenges. This will lead to more non-petroleum-based industries, a better reputation in innovation and possibly an increase the number of useful patents and startups. The Saudi educational entities should be open to criticism, hiring the best scholar-researchers, facilitating the movement of talent to the kingdom and strengthening the management and administration roles of the public universities. Universities should endeavour to establish international collaborations, with mutual technical and economic benefits to both parties, rather than resorting to the current secondary affiliation

⁷⁸ Shirah, B.H., and Al Talhi, Y.M., 2020. Saudi Arabia and aerospace medicine in the era of the national vision of 2030. *International Journal of Health Sciences* 14: 1.

⁷⁹ Fernandes, J.V., 2019. Robot citizenship and women's rights: The case of Sophia the robot in Saudi Arabia. *Janus.net*.

academics. Such affiliations should be considered negatively if they do not reflect positively on Saudi innovation and economic advances.

At this critical time in the Saudi history, academics should be critical and direct while Saudis should remember what Aldous Huxley wrote in *Beyond the Mexique Bay*: 'Men have to work for every mental or material advance they make and, when they made it, can enjoy the fruits of their labours only on condition that they give up the privileges which were theirs before the advance was made.' Whether the people of SA are ready to undergo social, cultural and scientific transformations remains to be seen.

Conflicts of Interest: The authors declare that they have no conflicts of interest.