Research and Higher Education

Building Philippine Knowledge and Human Capital

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Vice-Chancellor for Research and Innovation
De La Salle University, Manila, Philippines

About the Speaker

Career highlights

- Professor of Chemical Engineering and University Fellow
- DLSU Vice-Chancellor for Research and Innovation
- 300+ publications, 5000+ citations and *h*-index = 41 (Scopus)
- Member, Philippine National Academy of Science & Technology (NAST)
- BSc and MSc ChemE, PhD MechE (DLSU)
- Multiple scientific awards from the DOST, CHED, NAST, NRCP and PAASE
- Co-editor-in-chief of *Process Integration & Optimization for Sustainability* (Springer Nature) and subject editor of *Sustainable Production & Consumption* (IChemE/Elsevier)
- Member of the editorial boards of the journals *Clean Technologies & Environmental Policy* (Springer Nature) and *Int. J. of Supply Chain and Operations Resilience* (Inderscience)
- Co-author of *Input-Output Models for Sustainable Industrial Systems* (Springer Nature)
- Co-editor of *Recent Advances in Sustainable Process Design and Optimization* (World Scientific) and *Process Design Strategies for Biomass Conversion Systems* (Wiley)

Areas of interest

- Process systems engineering (PSE), process integration (PI), life cycle assessment (LCA), input-output (I-O) modelling, process graph (P-graph)

De La Salle University
Manila, Philippines

"A leading learner-centered and research University bridging faith and scholarship, attuned to a sustainable Earth, and in the service of Church and society, especially the poor and marginalized."

- A private, comprehensive, non-stock/non-profit Catholic university founded in 1911
- Ranked **1st among PH HEIs** in number of Scopus-indexed publications 2014-2018.
- **400%** research output growth in 2010-2018
- THE World Ranking **801+**
- THE Emerging Economies Ranking **251+**
- THE Asia-Pacific Ranking **201+**
- THE Asian Ranking **251+**
- THE Impact Ranking **301+**
- THE Subject Ranking (Eng. & Tech.) **501+**
- QS World Ranking **801+**
- QS Asian Ranking **155**
- Scimago Institution Ranking **714**

Outline

- Research and innovation in academia
- Regional landscape and implications for education
- University competitiveness
- Concluding thoughts

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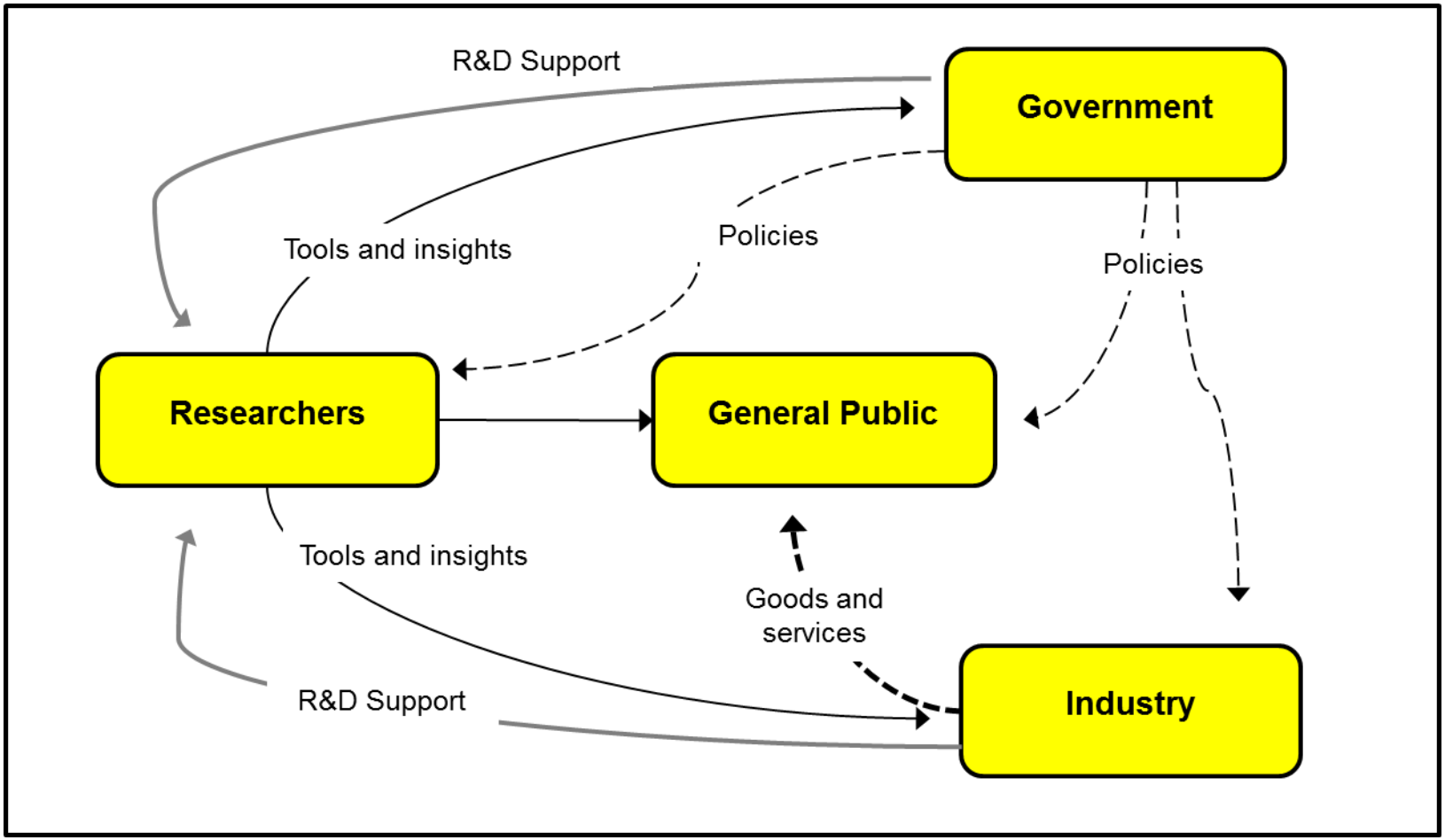
Interdependencies: Researchers and Society



Philippines 2018 GII Rank

(Source: www.globalinnovationindex.org)

Cornell SC Johnson College of Business · INSEAD The Business School for the World · WIPO World Intellectual Property Organization

GLOBAL INNOVATION INDEX 2018

Energizing the World with Innovation

Philippines

Key indicators

Population (millions)	102.3
GDP (US$ billions)	311.7
GDP per capita, PPP$	7,254.2
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

		Score (0–100 or value (hard data))	Rank
	Global Innovation Index (out of 127)	**32.5**	**73**
	Innovation Output Sub-Index	25.6	65
	Innovation Input Sub-Index	39.4	83
	Innovation Efficiency Ratio	0.6	55
	Global Innovation Index 2016 (out of 128)	31.8	74
1	**Institutions**	**52.0**	**89**
1.1	Political environment	44.2	84
1.1.1	Political stability & safety*	43.5	98
1.1.2	Government effectiveness*	44.9	65
1.2	Regulatory environment	48.4	105
1.2.1	Regulatory quality*	41.2	72
1.2.2	Rule of law*	29.3	81
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	111 ○
1.3	Business environment	63.3	81
1.3.1	Ease of starting a business*	68.9	120 ○
1.3.2	Ease of resolving insolvency*	55.2	53
1.3.3	Ease of paying taxes*	65.7	84
2	**Human capital & research**	**22.3**	**95**
2.1	Education	26.9	113 ○
2.1.1	Expenditure on education, % GDP[a]	2.7	106 ○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap[a]	9.1	99 ○
2.1.3	School life expectancy, years[a]	12.7	81
2.1.4	PISA scales in reading, maths, & science	n/a	n/a
4.2	Investment	30.2	111
4.2.1	Ease of protecting minority investors*	41.7	105
4.2.2	Market capitalization, % GDP	81.7	17 ●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	74
4.3	Trade, competition, & market scale	72.9	27 ●
4.3.1	Applied tariff rate, weighted mean, %[a]	2.2	56
4.3.2	Intensity of local competition†	70.2	59
4.3.3	Domestic market scale, bn PPP$	801.9	28 ●
5	**Business sophistication**	**36.9**	**45**
5.1	Knowledge workers	45.5	45
5.1.1	Knowledge-intensive employment, %	24.0	58
5.1.2	Firms offering formal training, % firms	59.8	9 ●
5.1.3	GERD performed by business, % of GDP[a]	0.0	69
5.1.4	GERD financed by business, %[a]	36.9	41
5.1.5	Females employed w/advanced degrees, % total	13.0	47
5.2	Innovation linkages	21.2	95
5.2.1	University/industry research collaboration†	41.4	59
5.2.2	State of cluster development†	45.7	62
5.2.3	GERD financed by abroad, %[a]	1.8	77
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	50
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	79
5.3	Knowledge absorption	43.8	25 ●
5.3.1	Intellectual property payments, % total trade	0.8	45
5.3.2	High-tech imports less re-imports, % total trade	n/a	n/a
5.3.3	ICT services imports, % total trade	1.0	68
5.3.4	FDI net inflows, % GDP	1.8	86
5.3.5	Research talent, % in business enterprise[a]	63.2	8 ●
6	**Knowledge & technology outputs**	**28.3**	**42**
6.1	Knowledge creation	10.6	65
6.1.1	Patents by origin/bn PPP$ GDP	0.5	75
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	89
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	33

Criterion	2018 Rank
Overall	**73***
R&D expenditure	97
PCT patents	97
Scientific articles	120
***From 83rd in 2015**	

Gold Standard: Discovery-Driven Innovation

Electric Field Effect in Atomically Thin Carbon Films

K. S. Novoselov,[1] A. K. Geim,[1]* S. V. Morozov,[2] D. Jiang,[1] Y. Zhang,[1] S. V. Dubonos,[2] I. V. Grigorieva,[1] A. A. Firsov[2]

We describe monocrystalline graphitic films, which are a few atoms thick but are nonetheless stable under ambient conditions, metallic, and of remarkably high quality. The films are found to be a two-dimensional semimetal with a tiny overlap between valence and conductance bands, and they exhibit a strong ambipolar electric field effect such that electrons and holes in concentrations up to 10^{13} per square centimeter and with room-temperature mobilities of ~10,000 square centimeters per volt-second can be induced by applying gate voltage.

The ability to control electronic properties of a material by externally applied voltage is at the heart of modern electronics. In many cases, it is the electric field effect that allows one to vary the carrier concentration in a semiconductor device and, consequently, change an electric current through it. As the semiconductor industry is nearing the limits of performance improvements for the current technologies dominated by silicon, there is a

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than traditional semiconducting devices (3)]. However, this would require atomically thin metal films, because the electric field is screened at extremely short distances (<1 nm) and bulk carrier concentrations in metals are large compared to the surface charge that can be induced by the field effect. Films so thin tend to be thermodynamically unstable, becoming discontinuous at thicknesses of several nanometers; so far, this has proved to be an insurmountable obstacle to metallic electronics, and no metal or semimetal has been shown to exhibit any notable (>1%) field effect (4).

We report the observation of the electric field effect in a naturally occurring two-dimensional (2D) material referred to as few-layer graphene (FLG). Graphene is the name given to a single layer of carbon atoms densely packed into a benzene-ring struc-

- Discovery of graphene in 2004 by **Geim** and **Novoselov**
- **2010 Nobel Prize** in Physics
- Establishment of the **National Graphene Institute** at the University of Manchester in 2015
- **25k+ patents** and **1M+ publications**
- Market value projected to grow to **US$400M in 2024**

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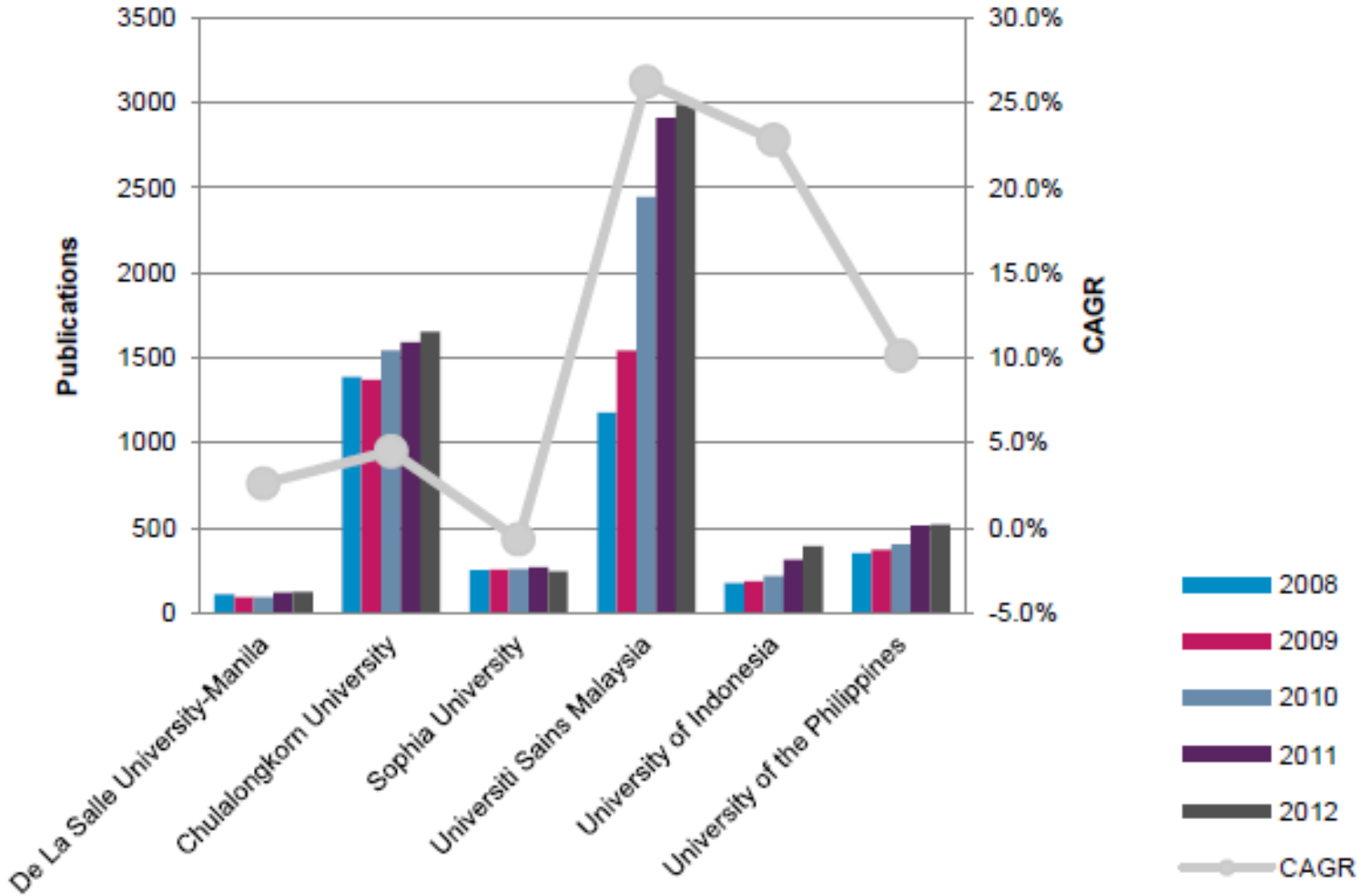
Research Growth in ASEAN and Beyond

(Source: Thomson Reuters)

Output Levels and Asian Benchmarks



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A Brief Rationale for Rankings

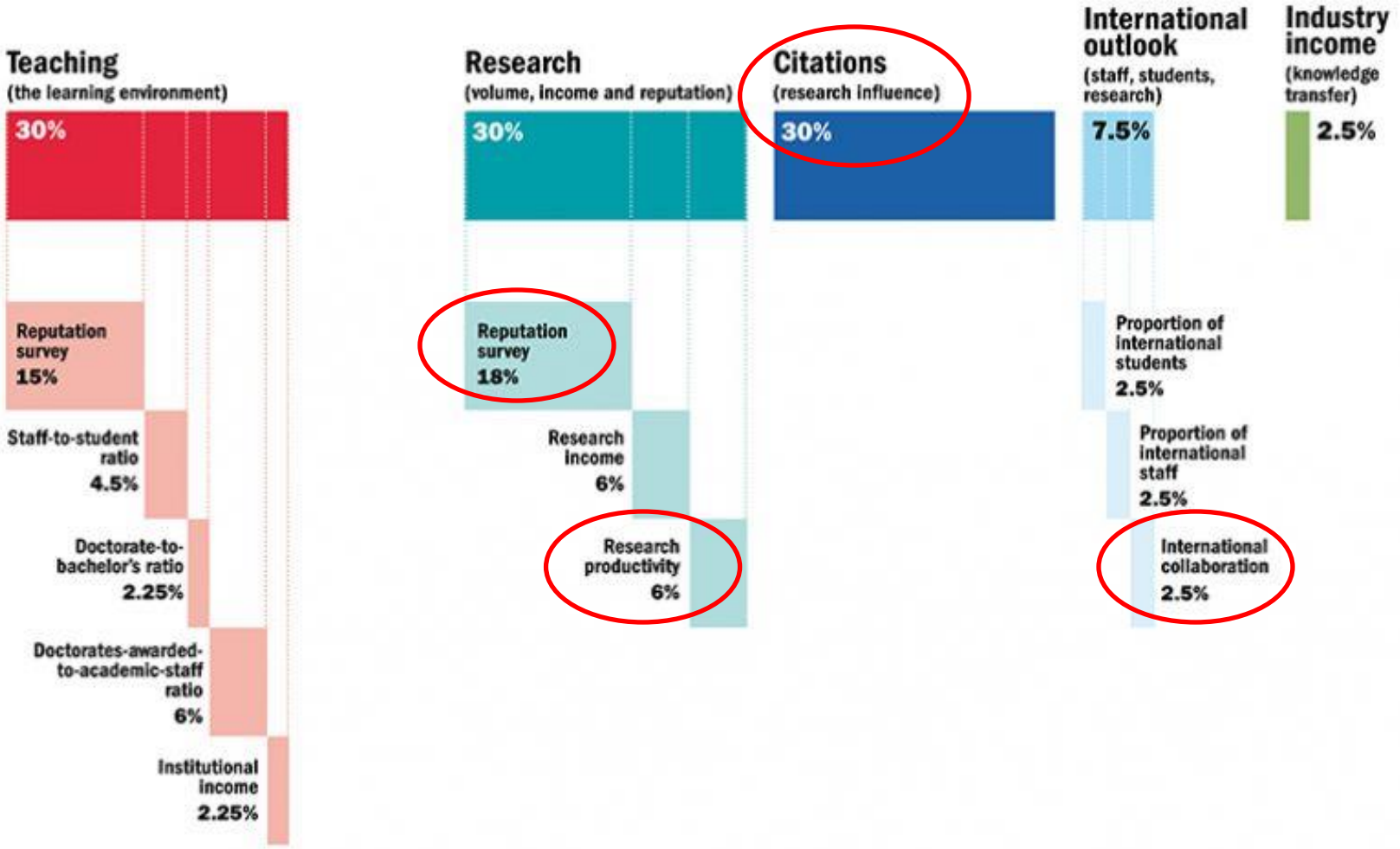
- Rankings provide a global scorecard for comparative assessment of institutions.
- Such information is crucial for decision-making involving international mobility, partnerships and linkages.
- Rankings are “low-resolution” and are not intended to replace in-depth assessments within countries (e.g., by CHED).

Ranks of Selected Philippine HEIs

Institution	2019 THE WUR/APUR	2019 QS WUR/	2018 QS AUR
UP	501+/101+	384	72
DLSU	801+/201+	801+	155
ADMU	n/a	651+	115
UST	n/a	801+	162
USC	n/a	n/a	301+
MU	n/a	n/a	401+
MSU-IIT	n/a	n/a	451+
SU	n/a	n/a	451+

Times Higher Ed. WUR Criteria and Weights

(www.timeshighereducation.com/world-university-rankings/methodology-world-university-rankings-2019)



Research and QS World Rankings

(www.topuniversities.com/qs-world-university-rankings/methodology)

Criterion	%
Academic peer survey	40
Employer survey	10
F:S ratio	20
Citations per faculty	20
International faculty	5
International students	5

Research Components:

"Academics may *not be well positioned to comment on teaching standards at other institutions*, but it is well within their remit to have a view *on where the most significant research* is currently taking place..."

"Citations… are the best understood and most widely accepted measure of *research strength*."

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Some DLSU Best Practices

- Research workload equivalency for faculty
- Research requirements for career progression
- Research requirements embedded in degree programs
- Research support offices and facilities (labs, subscriptions)
- Internal funding for small projects and grant matching
- Productivity-based financial incentives
- Institutional network (HEIs, industry, government, alumni)

Building Thematic Research Centers

- DLSU will launch the **Institute for Biomedical Engineering and Health Technologies** (IBEHT) in AY 2019-20.
- IBEHT will serve as the focal unit for R&D, training and knowledge transfer in health technologies.
- Many IBEHT projects will be supported by DOST via PCHRD.

DOST

Concluding Points

- Research is an integral component of quality tertiary education.
- Quality tertiary education is essential for building human and knowledge capital to drive Philippine development.
- **Programs must be put into place to enhance the regional competitiveness of Philippine higher education.**

Thanks for your attention

Comments and questions are welcome

Or contact me:

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