

Progress in Clinical Neurosciences, Cognitive Neurosciences, Clinical Psychology, Neurotechnology and Brain Mapping in Malaysia

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Abstract

Last year, there was an increase in the amount of manpower in Malaysia, especially in terms of the numbers of neurosurgeons, cognitive neuroscientists and clinical psychologists. One way to increase the number of cognitive neurotechnologists in the country in 2021 is to allow neuroscientists to register as neurotechnologists with the Malaysian Board of Technologists (MBOT). The Malaysian Brain Mapping project has risen from its humble beginnings as an initiative of the Universiti Sains Malaysia Brain Mapping Group in 2017. There is currently a proposal for its entry into the national arena via the Precision Medicine Initiative with the Academy Science Malaysia, the Ministry of Science, Technology and Innovation, Ministry of Higher Education and Ministry of Health. The current Malaysian Government's Science, Technology, Innovation and Economy (STIE) plan was launched in 2020, leading to the establishment of neurotechnology as one of 10 STIE drivers.

Keywords: neurotechnology, brain mapping, manpower, clinical psychologist, cognitive neuroscientist, neurosciences, precision medicine, Malaysia

Introduction

On 14 July 2020, the Prime Minister of Malaysia, Tan Sri Muhyiddin Yassin, chaired the National Science Council with the Ministry of Science, Technology and Innovation's Minister Khairy Jamaluddin, Deputy Minister Ahmad Amzad Hasim and Secretary-General Datuk Ir Dr Siti Hamisah Tapsir and launched 10 Science, Technology, Innovation and Economy (STIE) drivers in accordance with the Malaysian National Policy on Science, Technology and Innovation (DSTIN) 2021-2030. One of the STIE drivers was neurotechnology (1).

Neurotechnology took many years to be recognised in Malaysia. In 2017, the Academy of Science Malaysia prepared a report entitled *Science & Technology Foresight Malaysia 2050: Emerging Science, Engineering & Technology (ESET) Study*. Then, in December 2020, the 10-10 MySTIE framework, which trailblazed a path for prosperity, societal well-being and global competitiveness, was published and officiated by Minister Jamaluddin with the New Science Policy: DSTIN 2030 (2, 3).

On 15 December 2020, Bank Negara Malaysia established a RM1 billion High Tech Facility-National Investment Aspiration (HTF-NIA) as part of its efforts to provide additional assistance for small medium enterprises (SMEs) affected by COVID-19. SME project participants

in key government programmes involved in research, development and innovation for critical technologies identified under national blueprints from IR 4.0-related technologies, green technology and biotechnology to ensure continuity and the completion of existing projects. These technologies included blockchain, artificial intelligence, big data analytics, internet of things, additive manufacturing (3D/4D/5D/6D printing), cybersecurity, system integrators, augmented reality, advanced materials, drones and manufacturing systems as well as bioscience technology and neurotechnology (4).

Moving a New Generation Forward During the COVID-19 Pandemic in Malaysia

Figures 1-5 show the current batches of manpower being trained after our last report a year ago (5, 6). The percentages of our neuroscience and psychology graduates being hired up to 2021 from the end of 2019 were: 100% for Masters of Surgery (Neurosurgery) and Advanced Masters of Medicine (Neurology), 50% for PhDs/Doctorate, 55%-75% for the Masters of Cognitive Neurosciences and the Integrated Programme, and 44% for the Clinical Psychology graduates (7).



DR ABDUL
HALEEM BIN
NOORSHAM



DR AIMAN ASYRAF
BIN AHMAD SUKARI



DR
JAGATHESAN
SATHIVEELO



DR JONATHAN
JOSEPH J
NAESARAJOO



DR LEONARD
LEONG SANG
XIAN

Figure 1. (continued on next page)



DR MOHAMAD
MUHAIMIN BIN
ABDULLAH



DR MUHAMMAD
HAFIZ BIN HAJI
MOHAMAD BOHARI



DR NG PEI
MENG



DR NOR BAIZURA
BINTI ISMAIL



DR NUR
NAZLEEN BINTI
SAID MOGUTHAM



DR OOI LIN-WEI



DR SARWINDER
SINGH BHARMJIT
SINGH



DR YONG DE
JUN



DR ZAITUN
ZAKARIA



DR ALVERNIA
NEYSA BINTI
UJAT



DR ANIS
NABILLAH MOHD
AZLI



DR KHAIRUL AIZAD
BIN ADZMAN



DR KHOO YEE
HWA



DR KUGAN VIJIAN



DR LEE KING
PENG



DR MOHAMMAD
IMRAN BIN
AHMAD



DR MOHAMMAD
ISKANDAR BIN
SA'UAD



DR MOHD
ARMAN BIN
MUHAMAD
NOR



DR MUHAMMAD
ADAM BIN
ZAINUDDIN



DR NAAVIN
KUMAR
BALAKRISHNAAN

Figure 1. (continued on next page)



DR NISHANTHI
APPAROW



DR SAKTI VINAYAGA
TAMIL SALVAN



DR SHARIFAH
NAWAL BINTI
SYED JAAFAR



DR
SUZUANHAFIZAN
BIN OMAR



DR UTHAYA
KUMAR
NALLAYAN



DR YAP TECK
CHENG



DR AHMAD ZULFADLI
BIN MOHAMED RADZI



DR ALARMELU
NITHYA A/P
RAMANATHAN



DR DEBBIE KONG
CHING CHING



DR DIANA NOMA
BINTI FITZROL



DR HARVINTH
NAGALINGAM
MUNIANDY



DR HEZRY ABU HASAN



DR IDRIS
SHAHROM



DR JESSE ZEN
NGUI



DR JULIAN TAN LI
KWANG



DR KUHA RAJ A/L
ARUMUGAM



DR KUMARAPPAN A/L
CHOCKALINGAM



DR LOOI MUN
CHOON



DR MAS
SYAZANEEZA
BINTI SHAB



DR MOHD
FARHAN BIN
MOHD FAIZ
WILSON YEO

Figure 1. (continued on next page)



DR MOHD
GHADAFI BIN
WAHAB



DR MOHD IRYAN BIN
CHE OTHMAN



DR MOHD
KHAIRUN
MOHD MISPAÑ



DR
MOVENTHIRAN
A/L
RAMAKRISHNAN



DR MUHAMAD
RIDZUAN BIN
ALIAS



DR NADIAH BINTI
AHMAD FUAD



DR NISHAN RAO A/L
SUBRAMANIAM



DR
NURSHAHEDA
BINTI MOHD
SALLEH



DR RAZMEENDER
SINGH KELLY



DR ROHAN
JEEVARAJ



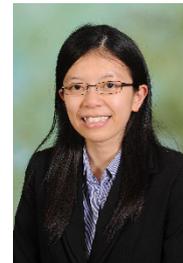
DR SAM JO EE



DR SARAH 'ATIQA
H BINTI MOHD
ZAMRI



DR SARAVANAN
A/L SRIDHARAN



DR TAN SHZE EE



DR TAN ZI HAN



DR THAVANESAN
A/L
S.PUVANEVARAN



DR V JEYASEELAN G
VASANTHAKUMARAN



DR VICNESH
THILLYNATHAN



DR ZAHARUL
AZRAN BIN
ZAHARI



DR ANG SONG
YEE

Figure 1. (continued on next page)



DR MUHAMMAD
NAJMI ABDUL
HALIM

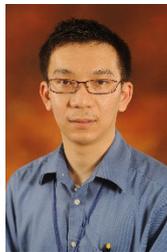
Figure 1. Masters of Surgery (Neurosurgery) residents from May 2019 till December 2020



DR DAVENDRAN
A/L KANESAN



DR RAKESH
RETHINASAMY



DR KHO GIAT
SENG



DR NELSON YAP
KOK BING



DR RAJENDRA
RAO RAMALU



DR RAMISSH
PARAMASIVAM



DR VINODH
VAYARA
PERUMALL



DR YEE SZE-VOON



DR ASMA'
MUHAMAD AFIFI



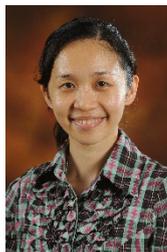
DR ASRARUL
FIKRI ABU
HASSAN



DR LAU BIK LIANG



DR LEE CHUN LIN



DR LEE SHWU YI



DR RAMANI
THIAGARAJAH



DR SHUKRIYAH
SULONG

Figure 2. (continued on next page)



Figure 2. Neurosurgeons who have graduated from postgraduate neurosurgical programme from 2019



Figure 3. (continued on next page)



PhD - HAZIM OMAR



INP - NUR
SYAZRENA
ASHYQEEEN
MUSTAFFA
KAMAL

Figure 3. Masters by Pure Research/Mixed Mode and PhD by Pure Research from May 2019



CHANG KAI RU



AW JIAN XIN



DALILI ZAHIAH ZABRI



MUHAMMAD AIMAN
ISMAIL



SYARAFANA
HAZIRAH ZULKIFLI



LIYANA BINTI MOHD
TARMIZI



NUR SYAHRAN
KAMARULZAMAN



AFFAF NOOR SAIDI



NUR SYAFIQAH
SYAHRAN MOHD
SHAFWI



GABRIEL THAI SHANG
HUA



PUNITHAMALAR A/P
RAJAGOPAL



FATIN NURAFIQAH

Figure 4. (continued on next page)



NURAIN MD YUSRI



OON YEN MIN



TAN JING HON



LIM CHEAN WEI



HAZIRAH ZULKIFLI



NUR HANI LIYANA
KAMARUL AZHAR



EVELYN NGUI AILING



AMIRAH MUDRIKAH
AMIRRUDDIN



ALI SAMAT



ALICIA NG CHER CHING



AMIRAH ZULAIKHA
ZAFRUL AZLAN



ARMAN IMRAN ASHOK



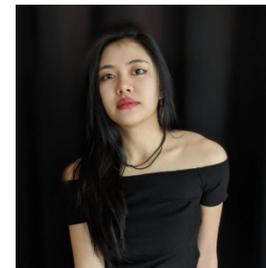
AUNEI ANUAR



BANU JOTHIMALARR



CHAN KAH MUN



CHIN YENG ZIEN



CHONG SHAO YIN



DITHIAMALAR
LENGATHARAN



FAKHARUDIN AIMAN
JAMAL



KHAIR BENJAMIN
LOKMAN

Figure 4. (continued on next page)



MEGAT SYAIFUL
IZZUDDIN MEGAT
MOKHTAR



WAN FARAH ADILAH
WAN AZLAN



MUMTAZAH AFIFAH
ABDUL HALIM



NUR HAFIZAH ZAINOL



PHOON JU YEE



RUBIN KHOO BU BOEN



SHAMNI MARKUNDU



SYAMIMI AMIRUDDIN

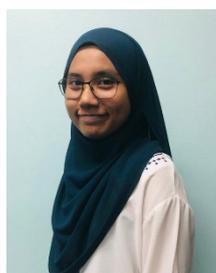


TAN JIUN TING



WAN ADIBAH NADIAH
ABD RAZAK

Figure 4. Second and third batch of Clinical Psychology students USM-UPSI



AMIRA MAISARAH
MOHD DAUD



CHANG SHU
CHUAN



HUSNA MD ISA



INTHU JAA A/P
GOVINDAN

Figure 5. (continued on next page)



KONG YEE MUN



KOW WEN XUAN



LEE HUEY YI



LEE JA NICE



MARYAM ADAM



MUHAMMAD
NASIRRUDDIN
TAJADIN



NADHIRAH KHAIDZIR



NEESHALLINI
KALEAPPAN



NUR FAHIMAH
AHMAD SANDARA
LELA PUTERA



NURSABRINA
MOHD FIRDAUS
ALOYSIOUS



SHAMSUL OMAR
TAJIDIN



SITI HAJAR ZABRI



SONIA DHIYA A/P
RADHAKRISHNAN



SYAZWANI MD
SALLEHAN



TAN WEI TING



UNAISA SAUD

Figure 5. (continued on next page)



WAN SARAH WAN
AHMAD KAMIL



ANNIS SHAFIKA
AMRAN



CHANG XIN NI



CHIANG YING JEE



CHIN CHUN MING



GOH YIN HOONG



IFFAH ADLINA
IBRAHIM



IZMIR ARMANI
ISTAL ZANI



NORHAYATI ISMAIL



NURUL AIMAN
MOHAMED



NURUL ASYIKIN
ZAINAL ABIDIN



DHIVIYA GOPAL
BALAKRISHNAN



ELIF MALMQVIST



FONG SZE WEI



HANISAH MUHAMMAD
FAIZ



KAVISHASHREE
VIJAYAKUMAR

Figure 5. (continued on next page)



LIM ROONZOE



MELISSA LIM ZI QI



MOHAMAD FIRDAUS
CHE FAUZI



MUHAMMAD
SYAMIL
KAMARUDIN



NOR SYALIZA AHMAD



NUR AKHTAR AB
RASAB



NUR AYUNIE AYOB



NUR MADIHAH
AZMAN



ONG BONG HEE



SALINI
MANIMARAN



MOHD AZMARUL A
AZIZ



SITI SYAHMINA
SHUHAINOR



SUBASHINY
KALIAPERUMAL

Figure 5. Third, fourth and fifth batch of Masters of Cognitive Neurosciences USM offered at Postgraduate Institute @Kuala Lumpur

The Malaysian Brain Mapping project that uses various neurotechnologies (electroencephalography, functional magnetic resonance imaging, event related potential, eye tracking, magnetoencephalography, deep brain microrecording, near infrared spectroscopy) has risen from its humble beginnings as an initiative of the Universiti Sains Malaysia Brain Mapping Group in 2017. There is currently a proposal for its entry into the national arena via the Precision Medicine Initiative with the Academy Science Malaysia, the Ministry of Science, Technology and Innovation, and the Ministry of Health in a recent meeting with the Academy of Science Malaysia in early 2021. This is a Malaysia's parallel initiative of the successful Cuban Brain Mapping Project which was published recently (8).

Thus, Malaysia must have a Centre of Excellence for Clinical Neuroscience, Psychiatry and Psychology services that, at least, represents the cluster of hospitals and teaching institutions with clinical neurosciences as well as psychiatry and clinical psychological services situated in the east coast of West Malaysia in the 12th Malaysia Plan that emphasises the use of neurotechnology in healthcare. It is also important to consistently build the younger generation of neuroscientists, neurologists, neurosurgeons, neurorehabilitation specialists, clinical psychologists and clinical neuropsychologists since it takes nearly 11 to 16 years to train them to address the needs of the country using neurotechnology to diagnose and cure diseases.

Correspondence

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