Science Communication in Practice:
A Malaysian Perspective with Global Relevance
A Training-of-Trainers Module

Science Communication in Practice: A Malaysian Perspective with Global Relevance

A Training-of-Trainers Module

YOUNG SCIENTISTS NETWORK MALAYSIA

AKADEMI SAINS MALAYSIA

2022

Science Communication in Practice:
A Malaysian Perspective with Global Relevance
A Training-of-Trainers Module

Academy of Sciences Malaysia
Level 20, West Wing, MATRADE Tower
Jalan Sultan Haji Ahmad Shah off Jalan Tuanku Abdul Halim
50480 Kuala Lumpur, Malaysia

Perpustakaan Negara Malaysia Cataloguing-In-Publication Data

Science Communication in Practice:
A Malaysian Perspective with Global Relevance
A Training-of-Trainers Module

Preview this book at www.akademisains.gov.my/science-communication

ISBN 978-983-2915-64-5

CONTENTS

FOREWORD

The COVID-19 pandemic has taught us many lessons on the importance of science communication. Continuous public engagement is vital to ensure the development of informed and responsible society. The message conveyed to people must be clear and accurate. A well curated science information presented through effective science communication will go a long way to inform and forge behavioural change in society. This will bridge the gap between scientists and public.

YSN-ASM has grown and developed as a platform for prominent young scientists from various backgrounds. For the past 10 years, these young scientists of YSN-ASM have always strived to implement, advance, and create awareness of science in the community. Throughout their programmes, YSN-ASM have brought together institutions, industries, and organisations to implement impactful programmes and varieties of engagements. These young scientists are expected to be the changemaker to transform the landscape of STIE for a better future of Malaysia.

As YSN-ASM will continuously educate society on STIE, it is about time for this module to be published. I have no doubt that with the experiences obtained from various public engagements over the years, the contents available in this science communication module will be a good reference for scientists, researchers, members of the media and teachers out there.

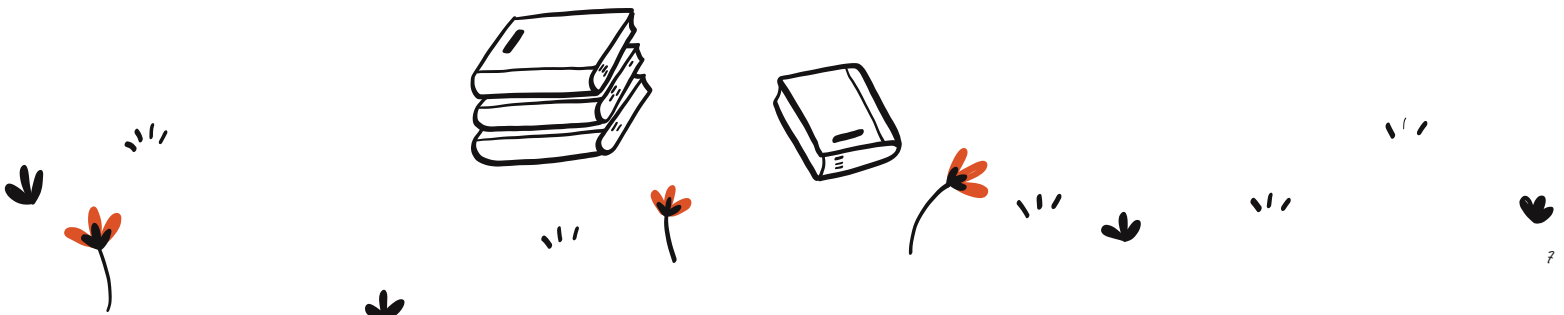
As the nation's Thought Leader in STI, ASM champions science communication as an important approach to transmit scientific ideas, methods, knowledge, and research to the community in an accessible, understandable, or useful way.

Research and innovation are not meant to serve scientist but humanity. Scientific knowledge and discoveries should be carefully translated into relevant applications to benefit society. Such inventions and innovativesolutions should be communicated to the public through effective science communication.

I wish to congratulate the team of authors from the Young Scientists Network of ASM for their hard work in developing this Science Communication Module. I believe this module would serve as a great tool to enable researchers, teachers, and media practitioners to better communicate and engage the public. I hope this module would inspire many to learn the art and demonstrate the heart of effective science communication.

– Professor Emerita Datuk Dr Asma Ismail FASc

President, Academy of Sciences Malaysia



FOREWORD

We often hear people claim "I don't understand what the scientists are trying to say", "All these seems so academic and not relevant to our lives", and "Why can't scientists just give a direct answer – Yes or No!". These disgruntled views reflect the science communication gap that exist between scientists and the relevant stakeholders such as policymakers, public, media, and industry. The inability to communicate their science effectively also hampers the ability of researchers from different areas of expertise to collaborate in interdisciplinary teams to solve the highly-complex grand challenges that humanity is currently facing.

Despite its importance, science communication training is not part of the formal training of most scientists. Recognising this needs gap,the Young Scientists Network-Academy of Sciences Malaysia (YSN-ASM) established Science Communication and Science @Media working groups in 2014/2015. Through these working groups, various initiatives such as the Science Café, *Borak Sains*, Meet the Scientist session (in collaboration with Petrosains), and the most recent e-estidotmy (an ASM programme) have been carried out. YSN-ASM also organises effective science communication training and through its social media platforms, provides an opportunity for our emerging scientists to practise science communication and hence popularise science.

As such, YSN-ASM Science Communication is one of the most popular working groups among YSN-ASM members and affiliates. It is through this working group that a group of highly talented and motivated young scientists got together and decided to create the first-of-its-kind training-of-trainers module on science communication, from a Malaysian viewpoint but with global relevance.

I would like to congratulate all the co-authors on the successful development and publication of this outstanding module. I also want to express my heartfelt gratitude to Dr. Khayriyyah Mohd Hanafiah (or Dr Kye as she is fondly known), the module's lead author, whose vision and tremendous effort in the conceptualization, writing, evaluation, revising, designing, and finally publishing this module cannot be understated. In 2018 at the Cheltenham Science Festival in the UK, Dr Kye became the first Asian woman to win the International FameLab Competition, the largest science communication competition in the world. Her success and subsequent inclusive leadership and tenacity to promote effective science communication is epitomised by this fantastically curated module. Congratulations, Dr Kye and team!

I would also like to express my heartfelt appreciation to Professor Emerita Datuk Dr Asma Ismail FASc, President of the Academy of Sciences Malaysia (ASM), and Puan Hazami Habib, CEO of ASM, for their visionary leadership and strong support for the development of this module. They not only provided timely advice and constructive feedback to improve the module but they have also played such an important and active role in promoting effective science communication in Malaysia. Most significantly, their steadfast commitment towards empowering the holistic development of young scientists truly fuels our confidence and determination to pursue scientific excellence!

Last but not least, I am confident that the readers will find this module valuable in strengthening and refining their science communication skills. I am convinced that this science communication training-of-trainers module will boost effective science communication efforts in Malaysia, Southeast Asia, and beyond. Let us all work together towards promoting science excellence, relevance, and impact through effective science communication! Happy reading!

– Associate Professor Dr Chai Lay Ching
YSN-ASM Chairperson

PREFACE

As scientists, "So, tell me about your research!" are the six words at a party that often churns our stomachs. Invariably, we would find ourselves formulating an answer to this question as if the polite inquirer wanted an extended thesis abstract. It would not be long before both parties awkwardly stand in the quiet wake of the death of a conversation.

But now, rather than reactively rattling off keywords more useful for journal indexing than for casual discourse, we must take a pause. Rather than formulate answers that were reflective of what we wanted to hear, we must first appreciate that the value of an answer depends on the person who is asking. This empathy, along with various strategies for simplifying and clarifying complex ideas, is key in effective science communication, which we cover in various ways throughout this book.

Many of the ideas on communicating science among our group of co-authors developed thanks to our participation in FameLab, organised nationally by the British Council and the Malaysian Industry-Government Group for High Technology (MIGHT). Moreover, we can be proud that Malaysia's participation in the international edition of FameLab held at Cheltenham Festivals produced not one, but two champions, Prof Abhi Veerakumasivam and Dr Khayriyyah Mohd Hanafiah, who have driven this training-of-trainers agenda. As a group, we realized that not only is science communication a necessary skill, but it is too frequently absent from general scientific training. And, while daunting at first, it can be extremely rewarding when done well.

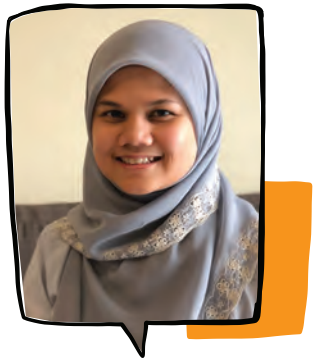
In this endeavour, we have found many friends who share the same passion. Our team of authors come from various scientific, communication, academic and educational backgrounds and together we have volunteered our time and expertise to bring to life a shared vision for capacity building in science communication. While the pandemic certainly took a toll on this project as it did on all aspects of modern human life, COVID-19 further emphasized the immense need for experts to be able to communicate as effectively as possible to as many people as possible. In trying to address this need, we have tried to balance theory and practice throughout the different aspects of science communication training described in this book. Our intention is to provide strategies rather than rigid rules, thereby providing sufficient space for creative ownership of this thing called 'science communication'. We hope that this module contributes towards strong culture of empathetic communication and knowledge sharing across Malaysia's diverse and dynamic society.

The development of this module began as a flagship initiative of the Young Scientists Network-Academy of Sciences Malaysia entrusted to our care in early 2019. Over the past 3 years, this project has evolved and expanded into a collaborative effort of co-authors cum co-trainers, other groups who shared interest and saw the potential of this effort, and the dedicated and talented team of officers at the Academy of Sciences Malaysia. We would like to thank the Academy of Sciences Malaysia, the Young Scientists Network-Academy of Sciences Malaysia, British Council Malaysia, MIGHT and everyone who has helped us discover our passion in science communication and supported our quest to produce this module.

After three years of constructing, deconstructing and reconstructing different aspects of the module, we are honoured and humbled to share the product of our hearts and hours, and the successful creation of this first Malaysian Science Communication Module. We hope you love and enjoy this module as much as we have loved and enjoyed bringing her to life.

– Dr Khayriyyah (Kye) Mohd Hanafiah
Lead Author & Editor

ABOUT THE AUTHORS



Khayriyyah (Kye) Mohd Hanafiah, PhD

MSPH, BBioMed (Hons) / Lead Author & Editor

Kye conducts research in infectious disease at the School of Biological Sciences, Universiti Sains Malaysia and adjunctly at Burnet Institute, Australia. She was awarded the prestigious Australian Endeavour Research Fellowship in 2017, became the first female Asian Champion of FameLab International in 2018, and received the Ministry of Youth and Sports Malaysia "Youth Award" in 2019. She conducts regular science communication training for students and researchers at various stages of their career, and adjudicated science communication competitions nationally and internationally. She has given numerous public talks and interviews and produced a documentary on sustainable palm oil and short videos to raise awareness on various SDG-related issues. She regularly writes for The Star in her column "Science, She Wrote".

Wan Abdul Matiin Wan Abdul Rahim Kamil

MSc, BSc / Author, Co-Editor

Matiin has science, society, and sustainability close to his heart. As a professional in learning and development, he is obsessed with understanding how humans communicate, learn, and grow in a world full of dynamic interactions. In his role as EdTech Lead at an international education and advisory firm, he leverages his science and engineering background towards designing high-impact and robust learning experiences for diverse audience profiles. He delights in helping stakeholders demystify the intricate dynamics of human learning and embrace a scientific mindset towards growth. Prior to this, he was actively involved in sustainability research at the Masdar Institute, UAE with a focus on the land-water-energy nexus. His investigations into microbe-mineral interactions and sustainable agriculture have led to scientific publications, conference presentations, op-eds, and even the final stage of FameLab Malaysia 2019. He also helped develop Malaysia's flagship futures study with the Academy of Sciences Malaysia, looking 35 years into the nation's future.

Abhimanyu Veerakumarasivam, PhD

Author

Abhi is a Professor of Genetics and the Provost of Sunway University, Sunway University. He has special interest in cancer and birth defects genetics. He is the immediate Past Chair of the Young Scientists Network - Academy of Sciences Malaysia, the Chair of the International Network for Government Science Advice - Asia and the Co-Chair of the ASEAN Young Scientists Network. He was the first Asian champion of FameLab International in 2016. He has adjudicated several science and science communication competitions including FameLab Malaysia and conducted science communication workshops in more than 20 countries. He has given several interviews on print, radio and live television and believes that science communication is a necessity for all scientists.

Danial Abdul Rahman

Mphil in Law / Author

Danial is a Director at the Sunway Education Group. Having started his career as a human rights and constitutional lawyer, Danial's professional journey has traversed policy, education, media and technology. He has worked at three federal government ministries (Education, Higher Education and Finance) and most recently served as Press Secretary to the Finance Minister, providing strategic policy and communications advise, as well as managing local and international press. In 2019, Danial was part of a successful IPO with an Australian education technology and often gave talks and trainings on AI and Sustainability. In the media space, Danial is a columnist with TheStar newspaper, Malaysia's no.1 daily, since 2014 and hosted his own TV show on Malaysia's National News Agency, BERNAMA, where he's interviewed CEOs, influencers and award-winning corporate figures. Danial holds a master's in law from the University of Oxford.

Fatimah Salim, PhD

BSc (Hons) Applied Chemistry / Author

Fatimah is a senior lecturer of chemistry and research fellow at Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns), UiTM. She is the secretary of Organic and Biomolecular Chemistry Division, and examiner for Organic Chemistry LMIC paper at Malaysian Institute of Chemistry (IKM). She is the international liaison head of IKM Malaysian Young Chemists Network, affiliate of ASM Young Scientists Network, and committee member of Malaysian Natural Product Society (MNPS). She actively communicates science on her Facebook account under the pseudonym 'Ahli Kimia' and she is a founding member of the Facebook Group 'Makmal Makanan (MaMa)'. Her visibility has improved her credibility as a chemist allowing her to reach mass social media users. Upon googling 'Ahli Kimia Fatimah Salim' many news and webpages quoted her responses to issues that have captured public attention, which not only elevates conversations that intersect science and society, but also helps expand the impact of chemistry beyond the limits of the laboratory.

Magaret Sivapragasam, PhD

BSc (Hons) Biotechnology / Author

Magaret is an affiliate of the Young Scientists Network (YSN)-Academy of Sciences Malaysia (ASM). She currently serves in the YSN-ASM science communication working group as well as a sub-editor in the estidotmy e-magazine committee. She was awarded the Science Finder CAS Future Leader by American Chemical Society in 2017 and was placed on the Periodic Table of Younger Chemist by IUPAC, representing the element (Ytterbium) in 2019. She is honoured with the title Super Female by FEMALE Magazine where she was selected as the top 45 women in Malaysia and also bagged herself the KOTEX She Can! award in 2020. She is a founding member of the Facebook group "Sembang Science" where she aims to make science conversational. Magaret is a professional technologist and currently serves as a senior lecturer and head of school at QUEST International University.

Murni Wan Mohd Nor, PhD

Author

Murni is a senior lecturer at the Faculty of Human Ecology, UPM. She has researched the issue of hate speech for over 7 years, and her current research interests extend to media representation on racial and religious issues, as well as problems of media literacy and fake news. Murni has held several consultancies on human rights, hate speech and communication-related projects, most recently for The Centre's research on Developing a Framework for Hate Speech Categorisation and Response, UNDP on the impact of hate speech and misrepresentation in relation to Covid-19 on social cohesion, and CENTHRA's stakeholder report for the Universal Periodic Review on Human Rights. Murni believes that the way in which language is used in communication, particularly when it employs hateful rhetoric and negative narratives, can influence the minds of the public. It is her hope that communication practices and media literacy can be improved to strengthen relations and increase understanding within the community.

Mohd Bakri Bakar, PhD

Author

Bakri is an associate of the Academy of Sciences Malaysia (ASM) and affiliate of the Young Scientists Network (YSN)-Academy of Sciences Malaysia (ASM). He is also a founding member of the American Chemical Society Malaysia Chapter and an Exco of the Institut Kimia Malaysia Southern Branch. His broad-based science contributions are well-established in science education, outreach, communication, policy and leadership. Bakri was previously assigned to the National Policy on Science, Technology, and Innovation Working Group, with a focus on science enculturation. He also served on the ASM working group that published a series of COVID-19 Factsheets. Bakri has a solid background in programming science strategic initiatives and leading national and international level programs that reach diverse audiences. He has contributed to the communication and popularization of science via both oral and writing platforms. Bakri is currently a professional chemist at the Faculty of Science, Universiti Teknologi Malaysia.

Rosdiadee Nordin, PhD

Author

Rosdiadee is a professional engineer and researcher in the area of wireless communications at Universiti Kebangsaan Malaysia. He is an immediate past Vice-Chair of Young Scientists Network (YSN)-Academy of Sciences Malaysia (ASM), and a former exco in the Science Communication Working Group in YSN-ASM. He has served as an advisor and editor to Majalah Sains, an independent online science magazine for 12 years. Currently, he is a member of the Engineering and Technology Committee, under the World Federation of Science Journalists (WFSJ). He has written more than 40 popular science articles in various magazines and newspapers, and has vast experience in conducting training and talks related to popular article writing. In 2020, he was named among the Top Research Scientists Malaysia (TRSM), a prestigious award under the ASM.

ACKNOWLEDGEMENT

Content Reviewers

The authors sincerely appreciate the constructive input from the following reviewers, which elevated the value and quality of the module:

Lisa Bailey
President, Australian Science Communicators & Senior Exhibition Manager at the Museum of Discovery, The University of South Australia

Sabariah Mohamed Salleh
Head, Media Literacy Empowerment and Digital Content Research Cluster, Centre for Media and Communication Research, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia &
Special Officer (Media) for the Executive Director, Economic Action Council

Saqib Sheikh
Founder & Marketing, Urban Hijau

Shawn Keng Teck Ee
Marketing Manager, QIAGEN Science Café KL

Tan Su Lin
Science Media Centre Malaysia

Special thanks to Mr Zeffri Yusoff and Google Malaysia for generously hosting a memorable author brainstorming workshop; to Ajarmalaysia.com, British Council Malaysia, Petrosains and Pusat Sains Negara for their continuous partnerships in championing science communication in Malaysia; to Dr Chai Lay Ching, Dr Manraj Singh and all Young-Scientists Network-Academy of Sciences Malaysia affiliates and members for their continuous engagement in supporting and piloting various materials designed throughout the development of this module, and last but not least, to everyone at Academy of Sciences Malaysia, especially Mdm Hazami Habib and Professor Emerita Datuk Dr Asma Ismail, for financial, technical and moral support of our endeavours to raise science communication capacity in Malaysia.

Additionally, we would like to thank the following individuals and parties for their contribution towards the development of this module:

2019 In-Person Stakeholder Engagement Workshop

Yasmin Noorul Amin, Lilia Halim, Yen Sim Kuek, Rowena Lim, Clare Walker, Ashraff Tahrim, Ameen Kamal, Ramesh Pillai, Razinah Sharif, Muhammad Haziq bin Abd Rahim, Elena Mazlinda Mazlan, Mohd Nurman Yaman, Aditya Hutama Iswardi, Umaiyal Munusamy, Noor Fazreen Dzulkafli, Syahirah Adnan, Ahmad Syihan Fadzli Khairi, Noor Asmaliza Romlee, Muhammad Zaid Zainuddin, Muhammad Khairul Syafiq Sharifuddin, Izyan Hazwani Baharuddin Mukesh Singh Sikarwar, Nazmi Lao, Low Yoon Keong, Mohd Khaidir bin Abd Hamid, Nurul Haryadie Mazuki, Mohd Haziq Rosli, Husni Mohd Amir & Nor Azhar Ishak.

2021 Virtual Pilot Workshop

Aida Rasyidah Azman, Celine Ng, Ng Nyuk Ting, Nadiah Ghazalli, Teo Hwee Li, Poorani Kannan, Teow Yeit Haan, Raznim Arni Abd. Razak, Nina Naquiah Ahmad Nizar, Wan Mohd. Arif Aziz Japar, Kalidasan Vasodavan, Haida Umiera Hashim, Julenah Ag Nuddin, Khoo Tze Sean Nurhidayu Al-Saari, Nik Aina, Norlida Mat Daud, Ahmad Syihan Fadzli bin Khairi, Siti Khadijah Ali, Yuvarani Nair Sukumaran, Kumuthini Chandrasekaram, Nurfatin Najihah Hamzah, Saarani, Shawn Keng Teck Ee, Nur Aizati Athirah Daud, Mohamad Shazeli Che Zain, Mohd Azri Hizami Rasid, Nurnadiah, Hanis Maketab, Dayana Farzeeha Ali, Mohd Afzanizam Muda & Zaid Omar.

YSN-ASM

Tan Suat Cheng (Committee)
Bong Yii Bonn (Committee)
Chau De Ming
Jaysuman Puspanathan
Felicita Fedelis Jusof
Mohd Sukor Suait

Academy of Sciences Malaysia

PROJECT MANAGEMENT TEAM

Hazami Habib
Chief Executive Officer

Nitia Samuel
Chief Strategy Officer

Dr Sheril Rizal Vincent
Senior Analyst

Hendy Putra Herman
Analyst

Hayatun Syamilah Mohammad Jasni
Analyst

COMMUNICATION & CREATIVE PRODUCTION

Dharshene Rajayah
Designer & Head, Creative Production & Design

Mohd Najmie Mohd Yusoff
Multimedia & Web Designer, Creative Production & Design

Hazrul Liki
Head, ASM Press

Ain Athirah Rozali
Editor & Journal Manager, ASM Press

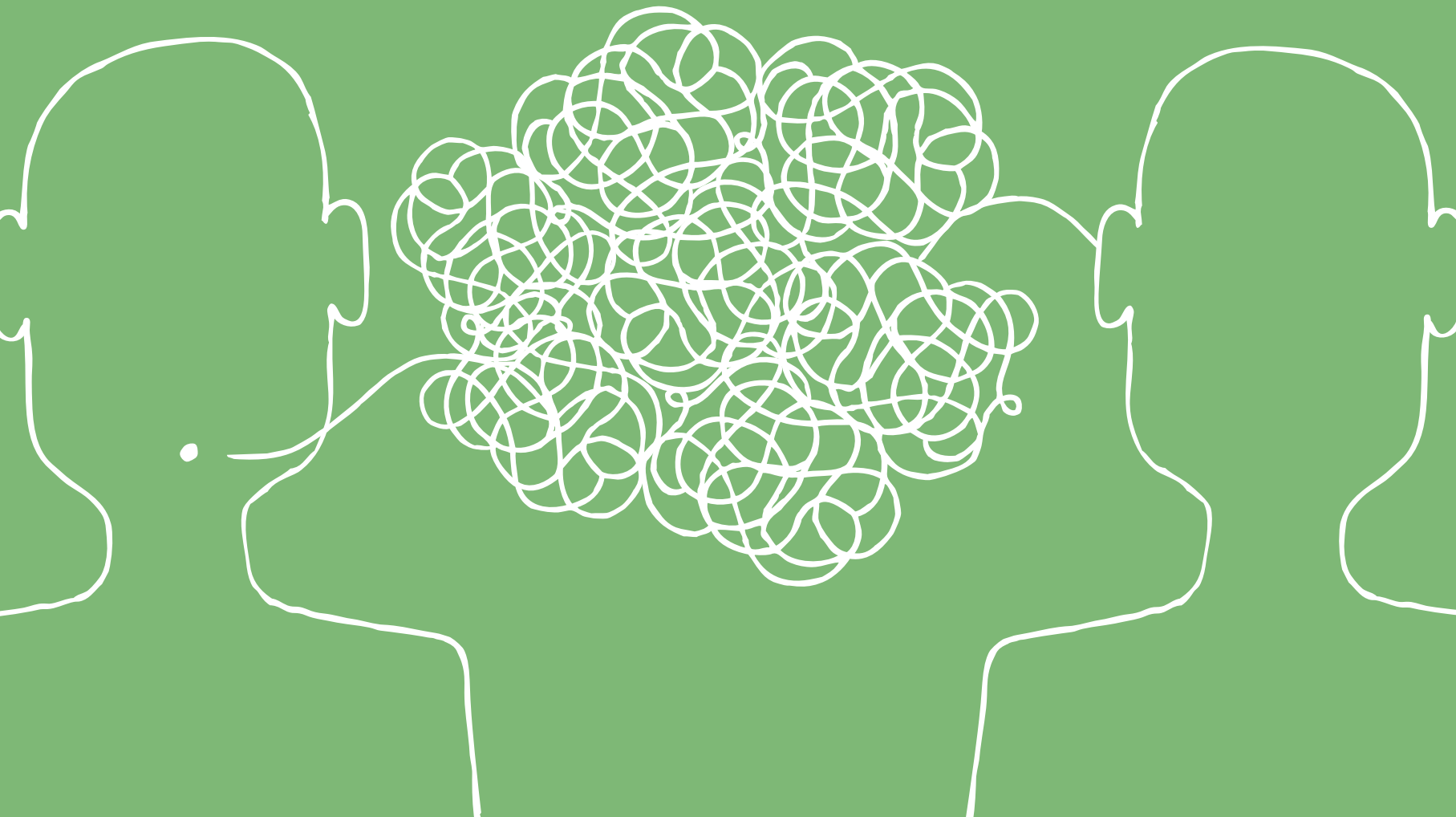
Najib Mohd Idris
Head, Marketing Communication

Syafiq Shafiee
Assistant Executive, Marketing Communication

Laviinia Dhanagunan
Head, Marketing Communication (2020-2021)

I THINK I KNOW WHAT COMMUNICATION IS. BUT WHAT IS 'SCIENCE' COMMUNICATION?

By Khayriyyah Mohd Hanafiah, Danial Rahman, Abhimanyu Veerakumarasivam, and Wan Abdul Matiin



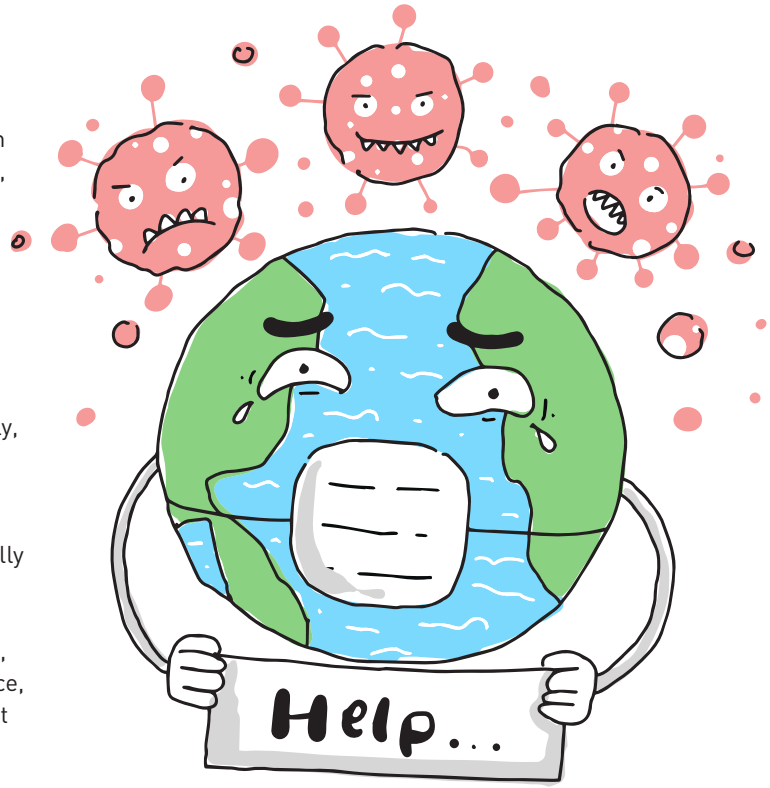
Science communication is broadly defined as "the practice of informing, educating, sharing wonderment, and raising awareness of science-related topics, covering science outreach (typically conducted by professional scientists to non-expert audiences) and science "in-reach" (expert to expert communication from similar or different scientific backgrounds)".

GREAT DEFINITION!

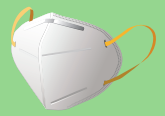
But what does this mean in practical terms?

Let us think about the current coronavirus pandemic situation that has arrested public attention thanks to its impact on modern life as we know it. Early in 2020 when the term 'Wuhan virus' was floating around like it came from the plot of a Michael Crichton novel, there was very little public interest or concern about infectious diseases. Sure, some Malaysians may have remembered the H1N1 flu outbreak of 2009, but flu (which still constantly gets confused with colds) have come and gone, and there was no real news here until Malaysia effectively entered its first wave of COVID-19 (as the World Health Organization later coined the disease) on the 18th of March 2020, thanks to a spike in numbers of people who were infected, and the movement control order that was put in place. This shake-up in life now also stirred curiosity and hunger for information at an unprecedented level. This was where we saw the value, and conversely, the pitfalls, in this act of 'science communication'.

Suddenly anyone with a science or medical degree became a focal point for every aunt, neighbour, and friend who would have a burning question related to COVID-19 specifically and the pandemic generally. Infographics, videos, manuals and booklets from various sources, and link after link to news articles, blogs or journal articles came in through various channels of social media. Now, although the information came in various forms, and travelled widely, such information was not equally accessible to all. Take for instance, the following examples outlining the ability of different types of masks to protect against catching and spreading the COVID-19 virus.



TYPES OF FACE MASKS

	MATERIAL	FITTING	LEAKAGE	USAGE LIMIT
Surgical or disposable face masks 	Usually made from non-woven fabric	Loose-fitting	Leakage can occur on the edges of the mask when wearer inhales	One-time use, must be changed whenever it becomes damp
N95 respirators 	Non-woven polypropylene fibre	> Tight-fitting > Respirators are properly-fitted to a wearer to achieve a fit	When properly fitted and worn, minimal leakage occurs around the edges	One-time use
Cloth face masks 	Made of cloth (such as cotton) and can be made at home	Loose-fitting	Leakage can occur	Can be washed and reused

Adapted from
The STAR graphics

Simple Respiratory Protection-Evaluation of The Filtration Performance of Cloth Masks and Common Fabric Materials Against 20-1000 nm Size Particles

Samy Rengasamy ✉, Benjamin Eimer, Ronald E. Shaffer

The Annals of Occupational Hygiene, Volume 54, Issue 7, October 2010
Pages 789-798, https://doi.org/10.1093/annhyg/meq044
Published: 28 June 2010 **Article history**

Abstract

A shortage of disposable filtering facepiece respirators can be expected during a pandemic respiratory infection such as influenza A. Some individuals may want to use common fabric materials for respiratory protection because of shortage or affordability reasons. To address the filtration performance of common fabric materials against nano-size particles including

This is the crux of science communication in application. While the snapshots are talking about mask materials and how effective they are at reducing the spread of COVID-19, they are clearly written with a specific audience in mind. The journal article, whose title may already be nonsensical to many people, is written by researchers thinking that the people who will read the article are other researchers who have a similar level of background knowledge that they have. The infographic from the news article recognises a readership with diverse levels of education and presents content that can be understood by an 'average educated adult'. But both news and journal articles are still communicating at an 'educated' level, i.e. they assume the reader to at least meet a certain educational baseline. In contrast, social media posts are often written for social media followers, and with the penetration and affordability of the internet across societies, these have become an even more diverse group. So rather than thinking about or aiming to be understood by a certain group with a certain level of education or knowledge, good social media posters target demographics and preferences of the audience— i.e. what they think the audience like or are like not what they think the audience knows.

Source
Rengasamy et al., 2010

In short,
science communication is communicating science—supplemented with an explicit understanding of who the communication is for. In this case, science communication in-reach is what most subject matter experts are familiar with and trained to do: to present papers at conferences, to submit manuscripts to peer-reviewed journals, to write pages and pages of thesis, write up experimental methods and results in reports – all for the purpose of sharing and evaluating information to spur further research and scientific progress in their field of expertise. Unfortunately for many subject matter experts, when it comes to their subject matter of expertise, this is the only type of communication they think exists and are able to deliver.

However, as COVID-19 has shown, while communicating science among subject matter experts is important, successful science communication outreach to the public and non-subject matters experts (which for simplicity, is now what we mean when we say science communication) is what may make or break the pandemic. Communicating the importance of mask-wearing, how to wear it properly, what kind of material to use, and embedding it into social norms is not achieved by scientists sharing journal articles. Rather, it is through continuous public engagement, simplifying and humanizing messages, and enabling as well as empowering these behaviours—which all fall in the realm of science communication, to be co-created, deployed, and consumed by stewards and various stakeholders.

Both (science in-reach and science communication) are important forms of communication because they serve two distinct and equally important purposes. The former serves to spur scientific research and development, bringing to mind the proverbial image of scientists standing on shoulders of other scientists, while the latter allows for translation of research into societal impact by allowing everyone to reap the advancement of knowledge and innovation.

But communicating science among peers is already a lot of work.
Why should scientists communicate their science beyond their own research community?

We already discussed earlier how important science communication is when dealing with an emergency situation that requires all of society to play its role, as seen throughout the unfolding COVID-19 pandemic. But even beyond emergency situations, there are many reasons to communicate science to audiences other than like-minded scientists and researchers.

Think of great scientists like Nobel Laureate Richard Feynman, Neil de Grasse Tyson, Michio Kaku, and Jane Goodall and how much they impact public opinion. They do not do this by being amazing scientists alone; rather, these scientists generate impact socially by forging a strong sense of connection between their audiences and the subject areas they represent.

We see the impact of science communication already with the rise of the celebrity scientist and the growing success of science festivals—there is a public desire to consume science if it were presented to them more palatably. But beyond consumption, effective science communication can spark inspiration, capture the imagination, and ensure a new generation of science lovers, enthusiasts, practitioners, and at the very least, science believers. Indeed, the future of science relies on how relevant it remains in the eyes of society at large.

This brings to an urgent importance of communicating science. Science is only as useful as it can be communicated, and now more than ever, ensuring that science reaches a wider audience has many practical implications. Scientists have the knowledge and credibility to counter misinformation and misconceptions (for e.g. "fake news"), which clutter public debate. It is critical for scientists to inform the public about important issues, complex problems, and new discoveries. And in light of growing discontentment with science and modern medicine and so-called return to 'all natural' lifestyles, scientists need to continue reminding the public about the importance of advancements often taken for granted, such as lifesaving modern medicine, vaccines, and other public health measures. Indeed, we have reached an age where some people have forgotten and rejected basic scientific knowledge such as the fact that planet Earth is a sphere. Moreover, the growing number of 'pseudo-scientist' peddling science falsehoods and using platforms like WhatsApp, Telegram and Signal and is thereafter forwarded amongst family members and communities is truly a concern.

How an individual in the public sphere thinks can influence how their peers vote in future elections. What is discussed in town hall meetings or community groups, what causes they choose to support and where they volunteer are all interrelated. Thus, scientists who are able to wield science communication can also influence public and government decisions related to regulation, science policy and funding, which can in turn have an important impact on scientific progress. Similarly, even amongst scientists, there are various types of science and various fields of expertise. The ability and motivation to communicate with a public audience also means scientists will be able to improve their in-reach with the larger scientific community, and work across disciplines to solve different problems that exceedingly cannot be solved through specific narrow fields of expertise. It is a vicious communication cycle and feedback loop in which the entire fate of humanity could rest on scientists successfully communicating with others and collaborating to help solve the problems that are facing mankind today.

There are lots of books on science communication.
Why did we write this one?

If you picked up this book out of curiosity, then that is one reason why it was written in the first place! Perhaps you have heard about science communication but never really knew what this amorphous thing meant.

Perhaps you have always been interested in 'doing' science communication, and you never knew where to start. Perhaps you have already been using science communication in your work or daily life, but you want to get ideas on how to improve or teach others what you seem to be able to do intuitively. Perhaps you have read many other brilliant books on science communication, but you realized a lot of the examples and context are not relevant to Malaysians and the Malaysian context.

There are many reasons why we decided to develop the Malaysian Science Communication module, but it was mainly motivated by realizing that there was a niche, need and potential impact of having a learning and training resource for science communication as a way to bridge the communication gap between subject matter experts and various types of audiences in Malaysia.

In trying to design a training module on science communication that is relevant, we spoke to various purveyors and champions of science communication in Malaysia. This included iterative processes to engage informally and formally communication experts from industry, experts in public outreach and science education (including science museum curators), undergraduate science students, school teachers, as well as science influencers and social media content creators, just to name a few! Many people we consulted generously spent time with us in workshops (live and virtual), providing feedback and brainstorming ideas on how we could approach and write this book.

What this book is, and what it is not?

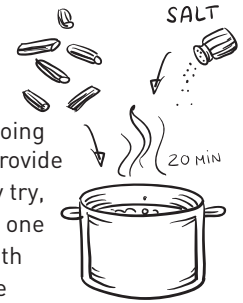
We wrote this book as a way to document our understanding and experience in applying science communication strategies and training others in using them. We believe that the world would be a better place if everyone could communicate better with each other, especially when we are talking about something as important as the survival of humankind (and this planet)! But most subject matter experts we met and trained all said the same thing: they never learned how to communicate science (besides for conferences and writing for academic journals) and wished they were trained and equipped with effective science communication skills sooner.

While we cannot change the past, we control our future. We realized we could improve this current situation by providing training to more and more people of different levels of interest and involvement in science, but there are only so many people who are able to train others. This is why this module was designed not only as a training module, but a training-of-trainers module. Because with more people trained to become proficient, confident, and experienced in science communication, there will be more people who can train others to become proficient, confident, and experienced in science communication!

The module is divided into basic chapters on understanding the audience and ensuring robust content followed by three main modes of communication that we expect a typical subject matter expert may be likely to use: oral communication (presentations, interviews, outreach), writing, and social media. Each chapter is written in an easy-reading style to give the reader an overview of theoretical perspectives regarding the topic followed by a list of training exercises.

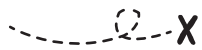
The module can be used as a learning companion for people who are interested in science communication and would like to use it for self-improvement. Through the rich training exercises and case studies provided, the module can also be used as a teaching and training reference for people who are teaching courses in science communication or conducting training workshops.

In saying that... this book is not a recipe book.



We are not prescribing one specific way of doing something to achieve a specific result. We provide a suite of ingredients and tools that you may try, but you may find a certain mixture gives you one result in some settings and not in others, with some content and not others, and with some audiences and not others.

This book is not a map.



We are not showing you a specific path to reach a specific destination. We provide a canvas and some colours that you may start planning and charting a course that you think is the best way to get to where you want to be.

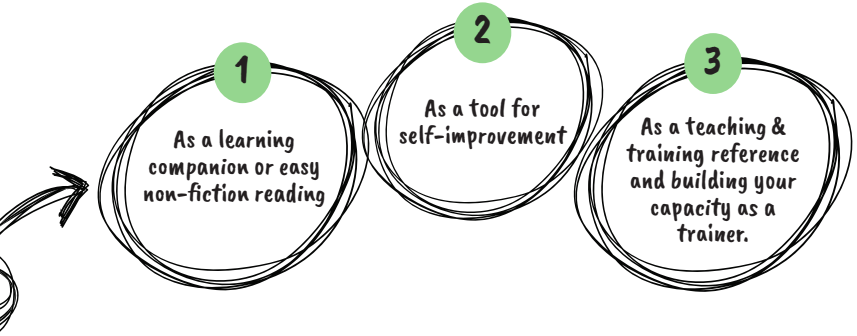
Use the book wisely and we believe it can take you to greater heights in your quest for self-improvement and endeavours in science communication.

Who is this book for?

This book is for anyone who wants to learn about and use science communication to better themselves and others around them. Because this book is written by a diverse group of authors who have experience in using different types of science communication as well as teaching science communication in its various forms and flavours in Malaysia, this module can be used by:

- **researchers or scientists** (primarily) who want to pitch ideas and reach funders/donors/ commercial partners, or to increase awareness, or stimulate public interest in their subject of expertise
- **budding science journalists and writers** of popular science content
- **science teachers/ lecturers, communicators, facilitators, volunteers** who want to equip themselves in strategies to stimulate interest in science
- **trainers** who want to teach/train others in strategies for science communication

How can you use this book?



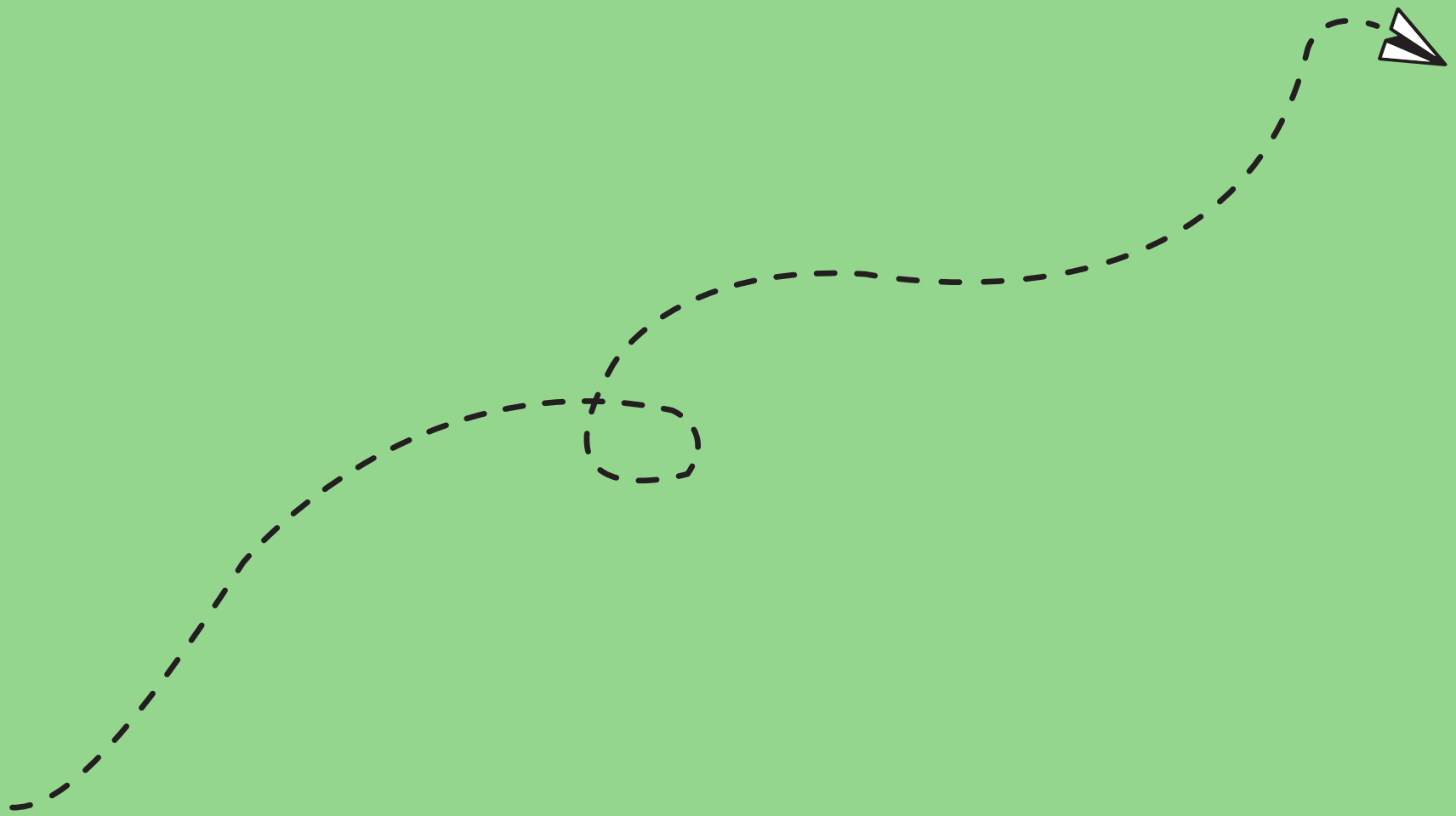
1. As a learning companion or easy non-fiction reading. Bring it around on your device or in hardcopy, read a few pages when you have the time and get a new idea or perspective. Use it to stoke your science communication interest further!

2. As a tool for self-improvement. Use the training exercises on yourself. What insights did you achieve while playing the role as a trainee? Try out some of the strategies in your next endeavour to engage a public audience and note what worked and what did not.

3. As a teaching and training reference and building your capacity as a trainer. Use the training exercises and resources in your course or workshops. Each chapter has a theory section with specific exercises suggested to provide opportunity for the reader/trainer-trainees to apply specific theories or strategies. The exercises are designed with expected duration, ideal number and ratio of participants, level of difficulty and other details for you to plan a lecture or tutorial session or workshop. Exercises can be arranged according to specific chapters, or they can be plucked out and combined with exercises from other chapters. Take note of your experience in delivering the training. Did the trainees respond in the way you expected or prompted by the module? How would you modify the structure or delivery of training exercises? Keep track of the results of the training. Can you see a shift or improvement in the people you trained?

In short, use this book to start or pivot your journey in science communication, a journey that we believe can be truly rewarding for those who sincerely want to use their powers for the greater good. Practice makes progress. Use this book to be your friend for solid theoretical grounding and dynamic practical training for yourself and for training others!

Ready to embark on your science communication journey? **Let's go.**



AUDIENCE PROFILING

By Khayriyyah Mohd Hanafiah and Wan Abdul Matiin

The most basic form of communication involves a sender, a message, and an intended receiver. This chapter covers audience profiling, a key part of preparation for a communication activity that focuses on the intended receiver of a message (s). Through this chapter, ideas behind how people think and process information, strategies to understand types and inclinations of different audiences, and ways to incorporate this understanding into communication materials will be explored.

LEARNING OUTCOMES

At the end of this chapter, trainees will be able to:

- Articulate what is meant by audience profiling and identify important factors that may influence how different audiences process and respond to information
- Utilise insights from profiling to tailor content and messages suitable for different audiences
- Assess whether a particular communication has achieved relevance to its target audience

> You don't lead with the facts in order to convince.
> You lead with the values—so as to give the facts a fighting chance.

Chris Mooney
The Science of Why We Deny Science

Heuristics and emotions:
How do people think and make decisions ?

As human beings, we often must make swift decisions based on the limited information and time we have at hand. Heuristics in essence are default thought processes or 'mental shortcuts' that govern our decision-making, which to a large extent relies on existing frameworks of thought. This also means that heuristics are also susceptible to biases, which may eventually lead to incorrect conclusions and consequently erroneous decisions. These existing frameworks of thought are often developed over many years spanning different formative phases of a person's life. Thus, it is unsurprising that several studies in psychology and science communication suggest that often, the heuristic-driven decisions made based on existing knowledge tends to disregard new information even if it is well-evidenced, and especially if it is at odds with what the listener accepts to be basic truths.

In addition to being equipped with rational thought, decision-making is also guided by emotions. In modern scientific methodologies, objective assessment is a positive and at times necessary quality. But in human society, the value of logical thinking devoid of emotion is challenged by neuroscientists such as Antonio Damasio. He argues that emotion is integral to the process of reasoning, based on studies on individuals who lose their ability to make rational decisions along with their ability to process emotion normally because of neurological damage in specific regions of the brain. The individuals were observed to still possess the ability to tackle the logic of a problem. However, decisions they made were irrational, and often disadvantageous to the individual and to others. He further compares this to the actions of sociopaths with self- and socially-destructive behaviours that are intelligent and logical but do not have normal emotional processing, concluding that emotions are necessary to guide reasoning.

This then leads to the strategies in persuasion and the use of logos (logic), pathos (emotions) and ethos (trust) to influence how people think and receive the messages that we intend to deliver. These include

1. pre-conditioning the audience to mentally accept a proposition before it is said
2. sharing identity with the audience to increase influence,
3. directing their focus and attention to a particular aspect to raise its importance
4. maintaining audience attention by making the message relate directly to them, and
5. building sense of trust by associating ourselves and/or our message with elements or persons for which the audience already has an established sense of trust.

Thinking about how people think:
The influence of culture, beliefs, and identities

Earlier we established that emotions, instead of being contrary to, is in fact an important part of reasoning. Additionally, psychologists such as Haidt further suggest that when it comes to moral judgments, there is less reasoning than there is motivated reasoning. This implies that a person's final action or decision often follows how they feel about a piece of information regardless of how objective or seemingly unbiased this information is presented. This idea of motivated reasoning highlights an important aspect of audiences, in that any information presented must be provided in the context of specific values to reach the audience.

But what motivates different ways of reasoning and influences decision-making? While these factors are difficult to definitively pin-down, research has suggested that culture, religious and political beliefs appear to triumph over science literacy. In a study on climate change denial, Kahan found that study participants' beliefs on whether climate change was human-caused were deeply divided along political ideologies and the most climate-science literate participants were even more politically polarised. Like other discussions of science that are heavily entrenched with social implications, such as genetically modified foods, stem cell research, and vaccination among others, positions on climate change have become proxies for allegiances in politico-cultural conflicts that are beyond and at times entirely removed from science.

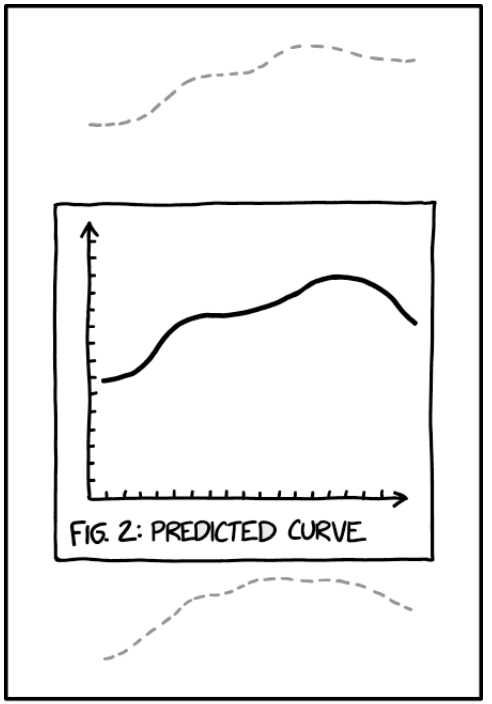
Another key example of this includes the growing numbers of people who are against vaccination, often citing that vaccines are unsafe, cause autism, or that they are part of conspiratorial plots of big pharma or certain powers to enslave people. Such claims persist despite the wealth of evidence to reassure people that vaccines are safe, that they do not cause autism (and the one fraudulent study that first brought rise to these claims has been disproved and retracted), and absence of evidence for other wild claims. Such claims again underscore the strength of pre-existing worldviews, shaped by various beliefs, cultures and identities, for which facts and figures alone cannot influence or alter.

Current norms or political climate, age and/or life stage, as well as geographics are also factors that influence how different people process information they receive. Several linguistic nuances can shape the interpretation of the same scientific information translated into different languages, as do current events of a particular geographical area may momentarily influence opinion on a timeless topic. Similarly, the angle of interest for the same scientific information would vary depending on daily life concerns of the individual— whether they are teenagers grappling with issues of adolescence, family life and school; middle aged adults grappling with career and earning enough to to sustain their families; or elderly people concerned with fulfilling life and maintaining health. These are only some of the factors that we need to contend with when trying to advocate for scientific evidence.

The language bias:

How do humans process uncertainty of scientific facts ?

An added challenge in using science to influence decisions is the fact that scientific facts are often flanked by uncertainties, modified by circumstances, and often limited by exceptions to the general rule. Compare, for example, the statement: "My sister had a severe allergic reaction to vaccines as a child" with the statement "Vaccines may cause adverse reactions in very rare cases". Recent research in neuroscience has shed some light on how speaking in language that distinguishes reality from possibility impacts our brains. The study shows that the brain responds differently to words that talk about 'here and now' (i.e.,"factual") compared to words that talk about things that 'may happen' (i.e.,"modal"). "Factual" sentences increased more measured brain activity, which occurs in the right temporo-parietal areas when such sentences update the representation of someone else's beliefs, and in the frontal medial areas for one's own beliefs. There are two points to consider here. Firstly, while the earlier statement on vaccine safety is an anecdote of one person, and the latter statement is driven by more data, many people may find the personal anecdote more compelling because the language used conveys more certainty. Secondly, the way our brain processes new information is already biased towards what we currently believe. Taken together, these differences in how our brains process "factual" versus "modal" statements may explain how messages using personal anecdotes and decisive language are more likely to re-enforce tacitly held ideas and preconceptions compared to data-based assertions, which will always be limited by uncertainties.



CONTENT MATTERS

By Murni Wan Mohd Nor and Danial Abdul Rahman

Everybody communicates for a reason. Educators communicate to spread knowledge; politicians communicate to gain support, lawyers communicate to uphold justice, and religious leaders communicate to affirm beliefs.

In the context of scientists and science communication, they communicate in order to inform society of new discoveries (like new planets or galaxies), advances in medical sciences (vaccines and new life-saving surgeries), convey warnings (like climate change) and more.

From educators to scientists, the common theme is that all of them require content when communicating. Content is sometimes referred to as "matter" or "evidence". It encompasses both "hard content" (facts, data or statistics) or "soft content" (stories, analogies and more).

LEARNING OUTCOMES

At the end of this chapter, trainees will be able to:

- Understand the different types of content and how to identify trustworthy content
- Analyse, evaluate and use different types of content to communicate effectively
- Teach others the importance of content in communication

Earth is flat... Isn't it?

Since we were young, we have been taught that planet Earth is not flat, but rather, circular (or 'oblate spheroid'). This knowledge is rooted not just in science, but also history and religion. As technology advances, this fact becomes more and more certain (check out Google Earth and photos taken by astronauts from outer space).

Nevertheless, for some reasons— there are groups that doubt this, labelling themselves as 'flat earthers'. Now, while we may enjoy a conspiracy theory from time to time, it can have detrimental effects, especially when it rejects scientific evidence and research. For example, diseases such as polio are making a return and measles are on the rise due to anti-vaccine propagators; our habitat is becoming less inhabitable due to climate change denial; and our health is being jeopardized due to the sale of vital supplements promising fake benefits.

Things get even more dangerous when misinformation is shared by certain people – especially in places like family WhatsApp groups. Even worse is when content appears to be shared by legitimate organisations, which are actually not. Disinformation can be distinguished with misinformation, because the former refers to information that is false and deliberately created to harm a person, social group, organisation or country. While there is a tendency to blame "less educated" or "young people" for spreading disinformation, studies show that professionals and educated people are just as vulnerable. Indeed, people most likely to share disinformation were those who believed the content to be true, or who had pre-existing attitudes consistent with the content of the disinformation. Given that we live in an age of information freedom and social media, the so-called 'infodemics' have become a serious cause for concern and more concerted action, especially in recent times due to public interest and concern over the Covid-19 pandemic in 2020.

DELIVERING SCIENCE BY WRITING

by Mohd Bakri Bakar and Rosdiadee Nordin

According to Dale's cone of learning, reading is the least efficient process and accounts for just 10% of retention rates. We can imagine how challenging this will be, particularly for science-based content that tends to be complex and specialized. Thus, how can we address this issue? In what way will science articles draw and sustain a reader's interest? This module provides some answers to these questions by outlining the general basis of writing popular science articles.

In planning, implementing and enhancing the quality of science articles, we offer structured and guided tools that cover stepwise writing strategies. This module targets scientists who wish to communicate their scientific findings for consumption and general reading by the public and policymakers. Nevertheless, this writing module can also be extended to others not directly involved in science as a career but with experience writing science-related content, such as journalists, reporters and corporate communication officers that are involved in science and technology reporting.

LEARNING OUTCOMES

At the end of this chapter, trainees will be able to:

- Identify important elements in a popular science article.
- Use appropriate techniques in writing effective popular science articles.
- Enhance the story, structure and style of popular science articles.

All science communication endeavours begin with a specific goal or aim. The common aims of writing popular science articles are to educate, share, influence, persuade, enculturate, explain scientific issues and provide solutions. One of these reasons may at least have inspired us to write for people outside of the typical academic audience. However, motivation alone is not sufficient; attempts to write popular science articles should be connected to our interest, knowledge and experiences.

But what is a popular science article and in what ways are such articles different from an article published in an academic journal? In short, popular science articles aim to excite the intelligence of the public by using simple, yet effective words to create an interest or awareness on certain science topics. On the other hand, academic articles aim to challenge the intelligence of a specific research community by using very technical jargon with lengthy discussions and complex visuals (such as graphs and tables) to report a progress or breakthrough in a specific scientific discipline. The following are several key features that differentiate between popular and academic writing (Table 1).

TABLE 1: KEY DIFFERENCES BETWEEN ACADEMIC WRITING AND POPULAR WRITING

ACADEMIC WRITING	POPULAR WRITING
Main target reader is the research community	Main target reader is the general public
Main purpose to report breakthroughs in the scientific field, such as significant findings, extension in the body of knowledge or theory and latest development/innovation in various applications	Main purpose to educate, create awareness and sharing of information, knowledge and even research experience to the public
Very lengthy with and extensive use of scientific jargon (varies; but on average between 10,000 to 50,000 words)	Very short with words for casual read (between 500–1,000 words)
Supported by detailed and at times complicated charts, graphs and tables	Supported by easy-to-digest, simple and interesting visuals, such as photos and videos
With long list of references to establish accuracy and reliability of information	Minimal references if necessary
Peer review by experts in scientific fields	Review by the editor, who is not a subject matter expert. Validation with experts if necessary

In order to write a popular science article, the know-how of basic writing techniques is vital. Thus, this module provides a structured tool to establish the basics of writing, while including tips and strategies to boost the quality and interest of popular science articles. The techniques are generally applicable to various types of publications such as features, personal opinions, news, background or profiles and interviews.

Published articles can be a crowd-puller by practising the outlined stepwise strategies. The stepwise strategies also highlight features in constructing an attractive and interesting article. Towards the end, an effective written piece can become integral in promoting science education and science enculturation, especially to the masses.

Writing Stepwise

This section outlines practical writing modules starting from finding an idea and structuring the contents to making the closing statement. The stepwise strategies also highlight features in constructing an attractive and interesting article.

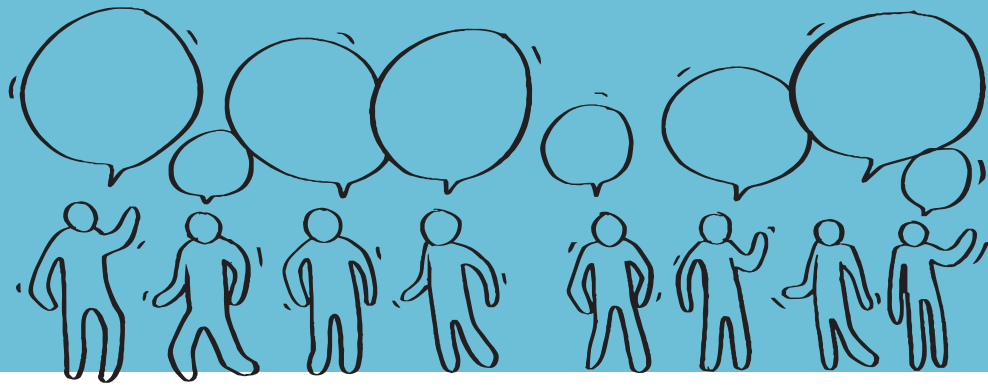

ORAL COMMUNICATION
by Khayriyyah Mohd Hanafiah and Wan Abdul Matiin

There are a variety of mediums to transmit information and deliver messages to an audience. This chapter covers the basics of oral communication, discussing its strengths and limitations, best practices and nuances of different forms of oral communication. This chapter further provides several modifiable training exercises that can be used to increase trainee proficiency and achieve learning outcomes outlined below.

LEARNING OUTCOMES

At the end of this chapter, trainees will be able to:

- Describe and differentiate different forms of oral communication such as unilateral and bilateral/multilateral communications and outreach/public engagement activities, including their strengths and limitations.
- Apply key strategies and best practices in achieving effective oral communication.
- Assess whether effective oral communication was achieved.

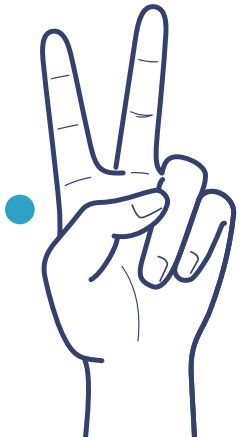


What is it?

Oral communication is the process of expressing information or ideas through spoken words. When discussing delivery of science communication, we distinguish techniques that involve oral communication into three main types: unilateral or one-way communication, bilateral or multilateral communication, and outreach and public engagement activities.

unilateral / one-way communication

bilateral / multilateral communication



outreach & public engagement activities

Strengths and challenges

"I think that preaching should grow out of the experiences of the people. Therefore, I, as a minister, must know the problems of the people that I am pastoring. Too often do educated ministers leave the people lost in the fog of theological abstraction, rather than presenting that theology in the light of the people's experiences. It is my conviction that the minister must somehow take profound theological and philosophical views and place them in a concrete framework. I must forever make the complex the simple."

Martin Luther King Jr.

Reflecting on speeches such as the Reverend Dr Martin Luther King (MLK) Jr.'s "I have a dream", few can deny the power and impact of a well delivered, aptly contextualized, and timely speech in rousing nations into meaningful action. But long before he delivered that historic speech in Washington DC, Rev. MLK Jr. had already identified key elements in effective communication for the masses: providing context and simplifying language. These elements are as relevant for preaching justice and religion as they are in communicating evidence-informed practices in science.

Who can forget the first time they (often as a child) truly connected with a new concept or idea thanks to an inspiring parent, teacher or volunteer?

Positive engagement is marked by the learner's success in learning, understanding, and internalizing new knowledge, made memorable by strong feelings of triumph. Such an experience may spark new interests and love in science, pushing individuals into new paths, unleashing new worlds of possibilities and purposes they never considered before.

Far too often scientists and researchers discuss their specific scientific topics neglecting the experiences of the non-expert audience (who may have expertise in other areas instead), rendering the message lost in a fog of scientific abstraction. Worse still, the use of technical terms without sufficient explanation of complicated concepts in simple language widens the distance between the speaker and the audience. Hence, the essence of what we consistently refer to as science communication in this module is basically an empathetic audience-centred communication spoken as simply as possible .

However, a key limitation to oral communication (particularly live presentations) is the fact that their effectiveness relies significantly on the ability and performance of the speaker at the time of presentation. While ability to perform can be improved with preparation and practice, performances can also be influenced by several factors beyond anyone's control, such as technical difficulties, issues with sound (low speaker volume, high background noise), and physical discomfort at the venue. Any interruption or elements that may compromise clarity of the message may likewise breed misunderstandings that may be difficult to rectify later on.

Furthermore, oral communication requires active attention and receptivity on the part of the receivers/audience, which may be influenced by the factors mentioned above and other individual sources of distraction. Arguably, the biggest challenge in oral communication, especially in one-way communication, is to maintain engagement with the audience in a given span of time. We will address strategies to overcome these challenges specifically in the following modules.

Main forms of oral communication

A good speaker may be able to deliver their speech "naturally", but it is rare that even the best speaker can by nature alone speak effectively.

Today, with ever growing forms of video platforms particularly on social media, public speaking is no longer limited to live presentations. Many presentations can now be rehearsed, recorded, edited and vetted prior to release to the audience. Further to the list are speeches that are more "impromptu", given in response to specific prompts or questions during interviews or moderated panel discussions. Finally, there are more intimate "presentations" done in small group or one-to-one conversations, such as at outreach or social engagement events.

While these platforms share common strategies of effective communication, they each afford some key differences in the interaction between presenter and audience that require nuanced evaluation. For each different form of oral communication, it is critical to begin first by thinking about the target audience and purpose, which will aid in design and delivery of the communication. (Refer to Chapter 1: Audience Profiling)

For the purpose of this chapter, the different main forms of oral communication will be presented separately. Undoubtedly, there may be many more iterations of oral communication (such as animation videos, podcasts etc.) that are not covered in this chapter.

However, in the following modules, we will cover the basic ideas, issue-related case studies and/or context, and corresponding exercises for:

1. **Unilateral communication:**
   Live and recorded presentations
2. **Bilateral/Multilateral communication:**
   Interviews, Panel Discussions
3. **Outreach/Engagement:**
   Often involving a team of communicators working together with smaller groups of audiences

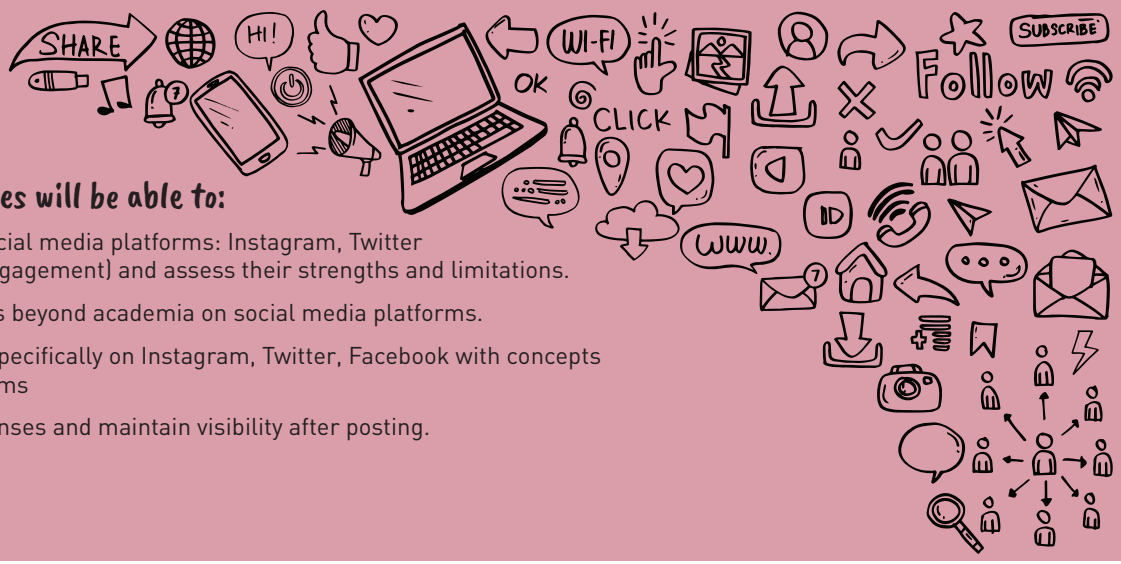
These forms of communication are the typical types of oral communication that a majority of researchers and science communicators may engage in their efforts to reach a public audience.

SCIENCE COMMUNICATION VIA SOCIAL MEDIA

by Magaret Sivapragasam and Fatimah Salim

The main purpose of science communication is to simplify complex concepts to everyday terms; with the intention of helping researchers to demonstrate the findings of their work to a wide range of stakeholders including the public and the press. The common ways of communicating science are through oral, written and visual mediums. The medium or platform that is used to communicate science also differ based on the purpose and targeted audiences. In the current boom of the digital evolution, social media has become a powerful platform for sharing ideas, thoughts, and information- including those that are science-related.

LEARNING OUTCOMES



At the end of this chapter, trainees will be able to:

- Evaluate science communication via social media platforms: Instagram, Twitter and Facebook (duration, publication, engagement) and assess their strengths and limitations.
- Design ways to share scientific contents beyond academia on social media platforms.
- Choose and pitch appropriate content specifically on Instagram, Twitter, Facebook with concepts applicable to other social media platforms
- Adapt and engage with audience responses and maintain visibility after posting.

Social media refers to two-way interactive websites or application platforms that host virtual networks and communities. Social media platforms provide a space for conversation between people from diverse backgrounds. There are many social media platforms available, however, the most popular platforms in Malaysia are Facebook, YouTube, Instagram, LinkedIn, Twitter, Tik Tok, WhatsApp and Telegram. Social media is designed to allow users to communicate or deliver content spontaneously via a computer, tablet or smartphone, from anywhere in the world. Scientists typically prefer to use professional platforms such as ResearchGate, LinkedIn or Mendeley, which are considered (-by some) to be more professional scientific social networks . However, the point to note here is that scientific platforms such as these only target the scientific community making the communication of science within these platforms somewhat "gated".

Since science affects everyone, the goal of science communication is to make science accessible to all, including non-experts who may be more adversely influenced by miscommunicated news, misinformation and/or pseudoscience. This requires more scientists to communicate science on social media as it falls under the scientists' duty to educate and disseminate knowledge with their community, particularly to combat misinformation. "Sharing" is the essence of the social media platforms. They bring down barriers for the dissemination of scientific information across various stakeholders, so it becomes available to more people. Additionally, scientists also can inspire and ignite fascination by sharing their personalities and providing direct access to science through social media platforms.

As scientists, many of us are used to writing for a particular audience and would use words and terminologies that are common in our field. When we want our message to reach a wider audience and pique the interest of the public, we must be prepared to change our approach to translate jargon to meaningful ideas relatable to the people we want to reach. Thus, we believe the targeted training exercise in this module will help scientists to communicate their research and assess the results of their communication to the public effectively.

While there are many references available on the use of social media for different purposes, this chapter is an introduction on how to use social media for science communication. Specifically, the modules address strategies for communicating science to a public non-expert audience using popular social media online platforms such asInstagram, Twitter and Facebook. Some tips such as the "do's and don'ts" in creating content and adapting with audience responses to postings are also included.

Module 6.1
Understanding social media platforms

Finding the right platform which suits you begins with knowing your objectives, identifying your target audience, and understanding your content format/style. Social media platforms are not created all the same. Each platform has its own strengths and limitations. The key here is to find a platform that fits your needs at maintaining an online presence. In choosing a social media platform that works best for you, ask yourself these questions:

* Why are you communicating science via social media?
* Who are your target audiences?
* What will be the language of your posts?
* What type of content would you want to create?
* What kind of activities do you want to be engaged in?
* How much time are you willing to invest (in a day/a week)?

It is important to write well on your social media platform, as this could make or break the success of your page. You would need to pack as punchy a content within the respective word count limits for certain platforms without diluting its value. Aim to write to build a connection and establish relationships over time as social media users typically share posts of other people, they feel connected to or from groups they are a part of. Social media users also tend to share posts that are more likely to start a conversation or trigger a response/reaction.

6.1.1 Optimising post content with visuals

The use of relevant images such as infographics should be fully utilised to allow someone the ability to visualise the message being relayed. This can assist someone to understand and internalise the message in a more effective way. In your infographics, try to adhere to these guidelines:

- A catchy (but not misleading) headline
- Attractive visuals, such as contrasting colours and interesting use of fonts
- Explain the three W's (What, Why, Who). What is the issue about? why does it matter? Why is it important to know? Who are the affected persons?
- Design it for sharing. One the most important reason for using infographics is to make an issue easier to understand, as well as allow it to be shared widely.
- Put thought into the design of the infographics so that it is not too wordy, explain in point forms where possible.
- Include the relevant #hashtags to allow the public to view and access the related trends online.
- It is important to put the logo of your organisation and reference to relevant websites/social media pages so people will know this is a credible infographic poster made by professionals in the field. However, bear in mind that appropriate logo usage will be subject to approval from your organisation. When in doubt, ask someone from your corporate communication department.

REFERENCES

I think I know what communication is. But what is 'science' communication?

Illingworth, S., Allen, G. (2020), 'Effective Science Communication: A Practical Guide to Surviving As A Scientist (2nd ed.)', Bristol UK, IOP Publishing Ltd, pp. 1–5.

Mohd Hanafiah, K., Ng, C., Wan, A.M. (2021), 'Effective Communication at Different Phases of COVID-19 Prevention: Roles, Enablers and Barriers', *Viruses*, vol. 13, no. 6, pp. 1058-1076.

Naturejobs (2014), 'The Importance of Science Communication'. [online] Available from: http://blogs.nature.com/naturejobs/2014/09/04/the-importance-of-science-communication/ [Accessed on April 2022].

Rengasamy, S., Eimer, B., Shaffer, R.E. (2010), 'Simple Respiratory Protection—Evaluation of the Filtration Performance of Cloth Masks and Common Fabric Materials Against 20–1000 nm Size Particles', *The Annals of Occupational Hygiene*, vol. 54, no. 7, pp. 789-798.

The Spaced-out Scientist (2018), 'Science Communication: Just as Important as Science'. [online] Available from: https://spacedoutscientist.com/2018/10/05/science-communication-just-as-important-as-science/ [Accessed on April 2022]

Audience Profiling

Cialdini, R. (2006), 'Influence: The Psychology of Persuasion', New York, HarperCollins Publishers.

Damasio, A.R. (1994), 'Descartes' Error: Emotion, Reason, and the Human Brain', New York, G.P. Putnam.

Dan, M. K., Hank, J-S., Donald, B. (2011), 'Cultural Cognition of Scientific Consensus,' *Journal of Risk Research*, vol. 14, no. 2, pp. 147-174.

Di Pietrantonj, C., Rivetti, A., Marchione, P., Debalini, M.G., Demicheli, V. (2020), 'Vaccines for Measles, Mumps, Rubella, and Varicella in Children, *Cochrane Database of Systematic Reviews*, no. 4, pp. 1-423.

Gerecke, E. (2019), 'SciComm at School: Science Communication in Undergraduate Education'. [online] Availabe from: https://scicomm.plos.org/2019/10/15/scicomm-at-school-science-communication-in-undergraduate-education/ [Accessed on April 2022].

Haidt, J. (2001), 'The Emotional Dog and Its Rational Tail: A Social Intuitionist Approach to Moral Judgment', *Psychological Review*, vol. 108, no. 4, pp. 814-834.

Kahan, D. (2015), 'Climate-Science Communication and the Measurement Problem', *Advances in Political Psychology*, vol. 36, no. 1, pp. 1-43.

Lee, O. (2001),'Culture and Language in Science Education: What Do We Know and What Do We Need to Know?', *Journal of Research in Science Teaching*, vol. 38, no. 5, pp. 499-501.

Longhenry, P. (2019), 'Now You're Segmenting with Science: How to Use Quantitative Psychology'. [online] Available from: https://contentmarketinginstitute.com/2019/12/segmenting-science-psychology/ [Accessed on April 2022].

Mooney, C. (2011), 'The Science of Why We Don't Believe Science'. [online] Available from: https://www.motherjones.com/politics/2011/04/denial-science-chris-mooney/ [Accessed on April 2022].

Psychology Today, 'Heuristic'. [online] Available from: https://www.psychologytoday.com/intl/basics/heuristics [Accessed on November 2020].

Rao, T.S., Andrade, C. (2011), 'The MMR Vaccine and Autism: Sensation, Refutation, Retraction, and Fraud', *Indian Journal of Psychiatry*, vol. 53, no. 2, pp. 95–96.

Tardi, C. (2022), '80-20 Rule'. [online] Available from: https://www.investopedia.com/terms/1/80-20-rule.asp [Accessed on April 2022].

Tulling, M., Law, R., Cournane, A., Pylkkänen, L. (2020), 'Neural Correlates of Modal Displacement and Discourse-Updating under (un)Certainty, *eNeuro*, vol. 8, no. 1, pp. 1-19.

Wired (2017), 'Biologist Explains One Concept in 5 Levels of Difficulty – CRISPR'. [online] Available from: https://www.wired.com/video/watch/biologist-explains-one-concept-in-5-levels-of-difficulty-crispr [Accessed on April 2022].

Content Matters

Buchanan, T. (2020), 'Why Do People Spread False Information Online? The Effects of Message and Viewer Characteristics on Self-Reported Likelihood of Sharing Social Media Disinformation', *PLoS ONE*, vol. 15, no. 10, pp. 1-33.

Cherlyn, I., Posetti, J. (2018), 'Journalism, Fake News & Disinformation: Handbook for Journalism Education and Training, UNESCO. [online] Available from: https://en.unesco.org/fightfakenews [Accessed on April 2022].

GapMinder. [online] Available from: https://www.gapminder.org/ [Accessed on April 2022].

Gilbert, B. (2019), 'The 10 Most-Viewed Fake-News Stories on Facebook in 2019 Were Just Revealed in A New Report', Business Insider. [online] Available from: https://www.businessinsider.com/most-viewed-fake-news-stories-shared-on-facebook-2019-2019-11 [Accessed on April 2022].

International Federation of Library Associations and Institutions (2005), the Alexandria Proclamation on Information Literacy and Lifelong Learning, Information Literacy, UNESCO. [online] Available from: http://eprints.rclis.org/3829/1/alexfinalreport.pdf [Accessed on April 2016].

Khairul, A.M. (2015), '4 Mt Kinabalu Nudists Remanded', New Straits Times. [online] Available from: https://www.nst.com.my/news/2015/09/4-mt-kinabalu-nudists-remanded [Accessed on April 2022].

Leetaru, K. (2017), 'Lies, Damned Lies And Statistics: How Bad Statistics Are Feeding Fake News', Forbes. [online] Available from: https://www.forbes.com/sites/kalevlee-taru/2017/02/02/lies-damned-lies-and-statistics-how-bad-statistics-are-feeding-fake-news/?sh=26b11eaa50ca [Accessed on April 2022].

Lim, K.S. (2019), 'Former IGP Clueless About Difference Between News and Satire', Malaysiakini. [online] Available from: https://www.malaysiakini.com/news/495740 [Accessed on April 2022].

Murad, D. (2015), 'UK Tabloids Give Sensational Coverage to Nudist's Arrest', The Star. [online] Available from: https://www.thestar.com.my/News/Nation/2015/06/11/UK-tabloids-playing-up-nudist-arrest/ [Accessed on April 2022].

Pitt, F., Lindsay, G-B. (2017), 'The Case for Media Impact: A Case Study of ICIJ's Radical Collaboration Strategy', New York, Tow Center for Digital Journalism, Columbia University.

Rutenberg, J. (2016), 'For News Outlets Squeezed from the Middle, It's Bend or Bust', The New York Times. [online] Available from: https://www.nytimes.com/2016/04/18/business/media/for-news-outlets-squeezed-from-the-middle-its-bend-or-bust.html [Accessed on August 2019].

Sebenarnya.my, [online] Available from: https://sebenarnya.my/page/4/ [Accessed on April 2022].

World Health Organization (2020). Call for Action: Managing the Infodemic. [online] Available from: https://www.who.int/news/item/11-12-2020-call-for-action-managing-the-infodemic [Accessed on April 2022].

Wu, L., Morstatter, F., Carley, K.M., Liu, H. (2019). 'Misinformation in Social Media: Definition, Manipulation, and Detection', *ACM SIGKDD Explorations Newsletter*, vol. 21, no. 2, pp. 80-90.

Delivering Science by Writing

Bown, L., Gawthorpe, A. (2008), 'Get Your Articles Published', Singapore, Hodder Education.

Dale, E. (1969), 'Audio Visual Methods in Teaching', New York, The Dryden Press.

Hancock, E. (2003), 'Ideas into Words: Mastering the Craft of Science Writing', Maryland, Johns Hopkins University Press.

Lund University (2015). 'Academic Writing in English: Popular Science Writing'. [online] Available from: https://www.awelu.lu.se/genres/writing-in-academic-genres/popular-science-writing/ [Accessed on September 2021].

Ruberg, M. (2004), 'Writer's Digest Handbook of Magazine Article Writing', Ohio, Writer's Digest Books.

Salita, J.T. (2015), 'Writing for Lay Audiences: A Challenge for Scientists', *Medical Writing*, vol. 24, no. 4, pp. 183-189.

The Guardian (2014). 'Science Writing Prize'. [online] Available from: https://www.theguardian.com/science/science-writing-prize [Accessed on April 2021].

Oral Communication

Burns, T.W., O'Connor, D.J., Stocklmayer, S.M. (2003), 'Science Communication - A Contemporary Definition', *Public Understanding of Science*, vol. 12, pp. 183–202.

Carney, D.R., Cuddy, A.J., Yap, A.J. (2020), 'Power Posing: Brief Nonverbal Displays Affect Neuroendocrine Levels and Risk Tolerance', *Psychological Science*, vo. 21, no. 10, pp. 1363-1368.

Cho, K.W., Lee, J., Ryu, J.H., Kim, S.J. (2017), 'Effects of Anti-Smoking Public Service Announcements on the Attitudes of Korean College Students toward Smoking', *Osong Public Health and Research Perspective*, vol. 8, no. 6, pp. 397–404.

Damasio, A.R. (1994), 'Descartes' Error: Emotion, Reason, and the Human Brain', New York, G.P. Putnam.

Davies, S.R. (2019), 'Science Communication as Emotion Work: Negotiating Curiosity and Wonder at a Science Festival, *Science as Culture*, vol. 28, no. 4, pp. 538-561.

Elkjær, E., Mikkelsen, M.B., Michalak, J., Mennin, D.S., O'Toole, M.S. (2020), 'Expansive and Contractive Postures and Movement: A Systematic Review and Meta-Analysis of the Effect of Motor Displays on Affective and Behavioral Responses', *Perspectives on Psychological Science*, vol. 17, no.1, pp. 276-304.

FameLab is the longest running science communication competition in the world with a global alumni of over 10,000 science communicators, owned by Cheltenham Festivals, UK and delivered by British Council internationally.

Kappel, K., Holmen, S.J. (2019), 'Why Science Communication, and Does It Work? A Taxonomy of Science Communication Aims and a Survey of the Empirical Evidence', *Frontiers in Communication*, vol. 4, no. 55, pp. 1-12.

Kim, D.W. (2010), 'The Influences of Tobacco Companies' Anti-Smoking Advertisements on Advertising Effect and The Corporate Images Upon to The Message Types', PhD dissertation. Seoul, Soongsil University.

Lee MC, Na JH, Kim JH. A study on the effects of anti-smoking advertising according to a smoking status and message framing. Korean J Adv Pub Relat. 2006;8:210–36.

Montopoli J. (2017), 'Public Speaking and Fear of Brain Freezes'. [online] Available from: https://nationalsocialanxietycenter.com/2017/02/20/public-speaking-and-fear-of-brain-freezes/ [Accessed on July 2020].

Ramsay, K., 'Cognitive Behavioural Therapy: Chunking Up/Chunking Down'. [online] Available from: https://achology.com/resources/cbt/Chunking-Up-Chunking-Down.pdf [Accessed on April 2022]. Albert Mehrabian's 7-38-55 % rule for spoken words, voice and tone, and body language.

Schwartzberg, L. (2014). Hidden Miracles of the Natural World'. [online] Available from: https://www.ted.com/talks/louie_schwartzberg_hidden_miracles_of_the_natural_world?language=en [Accessed on April 2022]. *At time of writing, the video has had 9.3 million views.*

Spence, C., Parise, C., Chen, Y.C. (2012), 'The Colavita Visual Dominance Effect', In: Murray, M.M., Wallace, M.T., editors. 'The Neural Bases of Multisensory Processes', Boca Raton (FL), CRC Press/Taylor & Francis.

Welbourne, D., Grant, W.J. (2015), 'What Makes a Popular Science Video on Youtube'. [online] Available from: https://theconversation.com/what-makes-a-popular-science-video-on-youtube-36657 [Accessed on April 2022].

YouTube statistics. [online] Available from: https://www.youtube.com/about/press/ [Accessed on April 2022].

Science Communication via Social Media

Bik, M.K., Goldstein, M.C. (2013), 'An Introduction to Social Media for Scientists', *PLOS Biology*, vol. 11, no. 4, pp. 1-8.

Elias, J.S. (2006), 'Science Terms Made Easy: A Lexicon of Scientific Words and Their Root Language Origins (1st ed.)', California, Greenwood Press.

Facebook. 'How to Boost a Post on Facebook'. [online] Available from: https://www.facebook.com/business/help/347839548598012?id=352109282177656 [Accessed on April 2022].

Joinson A.N. (2008), 'Looking At, Looking Up or Keeping Up with People?: Motives and Use of Facebook, *CHI '08: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Florence, Italy.

Kemp, Simon (2020). [online] Available from: https://datareportal.com/reports/digital-2020-july-global-statshot [Accessed on April 2022].

#Metoo and #Blacklivesmatter are social movements which have exploded on twitter with more than 800 tweets per hour (data as of 21 December 2020)

Mohd Hanafiah, K. (2018), 'Communicating Science: A Shared Responsibility', The Malaysian Journal of Medical Sciences, vol. 25, no. 5, pp. 1-5.

Nejad, M.Y., Delghandi, M.S., Bali, A.O., Hosseinzadeh, M. (2020), 'Using Twitter to Raise the Profile of Childhood Cancer Awareness Month', *Network Modeling Analysis in Health Informatics and Bioinformatics*, vol. 9, no. 3, pp. 1-5.

Waechter, F.M. Social Media for Science and Research: Current Trends and Future Possibilities. [online] Available from: https://fmwaechter.com/social-media-science-research/ [Accessed on April 2022].

Walter, S., Lörcher, I., Brüggemann. M. (2019), 'Scientific Networks on Twitter: Analyzing Scientists' Interactions in The Climate Change Debate', *Public Understanding of Science* , vol. 28, no. 6, pp. 696-712.

Very extensive and thorough! I think it's done an excellent job of conveying very practical advice underpinned by sound theory.
Lisa Bailey, President of Australian Science Communicators

A useful guide for academics and other trainees in this area.
Saqib Sheikh, Founder of Urban Hijau

I see this module as the game-changer on communicating science in Malaysia and the ASEAN region.
Tan Su Lin, Founder of Science Media Centre Malaysia

The Science Communication in Practice: A Malaysian Perspective with Global Relevance believes that if everyone could communicate better with each other, the world would be a better place. Designed to be a learning companion, this module features easy to read chapters, rich exercises and relevant case studies to equip readers with effective science communication skills.

The authors were motivated to bridge the communication gap between subject matter experts and the various types of audience in Malaysia. This is the first training-of-trainers module on science communication with examples and context related to the Malaysian scenario.

ISBN 978-983-2915-64-5
9 789832 915645

www.akademisains.gov.my