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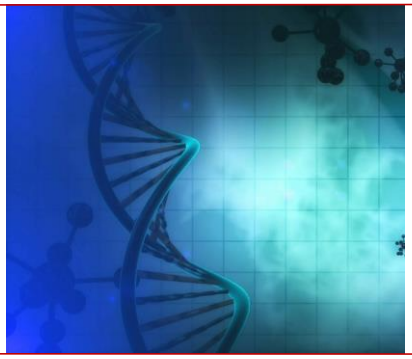

Ensuring Societal Advancement through Science and Technology: Pathways to Scientific Integration

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In an increasingly digitised world, those within STEM fields have a responsibility to communicate their research in an accessible manner to the funders and end-users of their innovation. Steps should be taken to incentivise improved scientific communication by scientists via social media, open source publishing and outreach programs. In this way, we can ensure equal access to research across society, and increased acceptance of innovation, whilst avoiding costly delays to their implementation.

The scientific field was built upon the basic core principles of collaboration and distribution. With the digital age came renewed opportunities for integration with the community. Now, the foundations of science and healthcare are once again changing, as paradigm-shifting technologies such as AI-powered healthcare solutions and genomic medicine become the norm. If our communities do not understand and accept these new services, any positive impact is significantly limited. In order to find a resolution to this problem, we need to focus on improved scientific communication and education, through re-examined frameworks for scientific impact and funding.

Current issues in science communication

In 2016, the UK Government promised yearly increases in research funding until 2020, and to spend £12.5 billion on R&D in 2021/2022[1]. This substantial public investment is made, not merely to support intellectual advances, but also with the belief that funded research will benefit the public. With Innovate UK chief executive, Dr. Ruth McKernan CBE, stating that '*Research and innovation has never been higher on the agenda*'[2], and the director of the Campaign for Science and Engineering, Dr. Sarah Main, claiming that '*Such sizeable public investment brings a responsibility to spend it effectively*'[3], one cannot deny the increasing expectation for STEM fields to deliver results. But what do we accept as responsible propagation and dissemination of our research in 2018? While advances in scientific research are published in scientific journals, only a selection of these findings ever reaches the general public.

Adler et al. previously outlined the impact of education, occupation and income on disparities in population health[4]. Research suggests that scientific literacy may also become a contributing factor. With reports suggesting that workers in STEM industries are currently earning approximately 29% more than their non-STEM counterparts, and projections for increased employment and job growth in STEM fields, policy makers must be proactive to minimise the practical inequities created by a shifting balance of power[5]. Due to current shortcomings in the dissemination of research to the wider community, those who have a formal scientific education, and access to scientific publications, may benefit from medical or healthcare research findings before they are

translated into healthcare policy and practice. Without the non-technical, layperson communication of science, we could face demographic-based isolation from science and technology innovations, as they become more prevalent in future.

A major issue facing scientific communication and outreach is the distortion of scientific findings for mass media, both intentional and accidental. As journalists reporting research discoveries traditionally have little-to-no scientific research experience, their reporting of scientific research is often inaccurate[6]. Even with increased focus on the scientific education of journalists, and increased specialist journalists, inaccurate reporting of research continues, placing credible and robust scientific findings in serious danger of being labelled 'fake news'.

Given that tax contributions and charitable donations fund the majority of scientific research, it is the responsibility of scientists to improve the dissemination of their research in order to educate their communities and maximise the societal value of their work.

The potential benefit of direct science communication by researchers

Direct communication between scientists and the general public has the potential to reduce the reliance on easily accessible, low-quality sources of information. Questions that necessitate a sound scientific understanding are traditionally either left unanswered or answered poorly online by the ill-informed. Direct communication by scientists may also increase the validity and integrity of scientific communication as a whole, since fewer errors would be made in the translation and reporting of their work. This could, in turn, result in greater trust and acceptance of legitimate, but controversial research findings. In this way, scientists would be able to communicate their research in a manner that is impactful, and positive.

In order to create an environment and culture of outreach amongst the scientific community, it must be incentivised by government, and funding bodies. Most funding bodies already have established public engagement policies, such as the UK Research and Innovation's '*Pathways to Impact*' policy[8]. While these policies are designed to facilitate community involvement, and recognise the benefit and responsibility of such initiatives, more could be done to engage scientists in scientific outreach beyond their basic funding obligations.

Research policy solutions to increase community outreach

Research policy solutions to increase scientific communication may act to increase research impact. Current funding policies encourage publishing in open access journals[7], but publishing research in non-technical modes, and writing in clear language, would make publicly funded research more accessible to the general population. In the case of research that warrants education campaigns, such as those that influence lifestyle and health changes, government-verified social media engagement may provide opportunities to rely on free advertisement provided by the masses. Short easily digestible articles and 'viral' stories may provide avenues for mass distribution of scientific findings in simple, but accurate formats. In this way, government bodies could save money on education campaigns, health and lifestyle interventions, and even medical treatment. Saved revenue could be directed back into further scientific research.

Direct communication of science by researchers may also protect against low adoption rates of cost-saving innovations, due to public distrust of modernisation.

Through increased societal integration of STEM researchers, governments may be able to adopt cost-saving modernisations and increase efficiency on much shorter timescales.

To this end, I propose the creation of an '**Office for Community Innovation**'. The remit of this office would be to connect researchers with members of the community who can facilitate their outreach initiatives, in order to promote social connectivity through the propagation of research and education. As well as researching opportunities for cross-communication, this office would provide three main services:

1) **Community contact** – community organisations would be able to contact the office to request scientists to come and speak to them on topics relevant to their field

2) **Researcher contact** – researchers would be able to contact the office to request community contacts for education initiatives

3) **Researcher-to-researcher connection** – the office would act as a conduit to connect with other researchers with complementary objectives that could be met through joint education initiatives

Imagine that elderly members of the community living in a retirement home would like to know more about how their medicines work. The administrator of the retirement home could contact the **Office for Community Innovation** to request a pharmacologist to speak about the basics of their work. Other examples may include medical researchers visiting hospitals, environmental scientists visiting companies interested in increasing their environmental awareness, or physicists speaking about the applications of their work to school children. By engaging scientists to assist in community education, they would also be given the opportunity to share their research to people who would otherwise not get that chance to learn about it. Moreover, through getting information first-hand, our citizens would be better informed on important issues, and more actively invested in the furtherance of science.

Researchers would be incentivised to attend these community engagements, on a basic level, as they would provide the opportunity to meet funding quotas for such outreach. The opportunities provided by the **Office for Community Innovation** would also allow researchers to build their communication and presentation skills, and to engage with the real-world applications of their work. Community members are likewise incentivised to attend these engagements to learn more about how research advances will affect their career, healthcare, and day-to-day lives in the future.

Increasingly, journals are printing a '*plain language summary*' of research papers along with standard abstracts. By adjusting existing policies to include explicit requirements to publish research findings in lay language on non-technical platforms, engage with outreach initiatives, and maintain social media presence, the real-world impact of scientific outreach will become apparent. Stricter funding guidelines and requirements, along with review processes set up to ensure these new criteria are met, will ensure rapid adoption of these new principles. Implementing a rating system for researcher engagement would also provide a clear, real incentive to comply.

By encouraging STEM outreach, governments and funding bodies may renew the spirit of collaboration (and competition) between laboratories and offices. There may also be more direct rewards. Increased research exposure would result in public consideration like never before. This unprecedented access to research may also increase collaboration between science and

industry, ensuring rapid translation of research into beneficial outcomes. Optimised industry engagement may result in a higher diversity of channels in which research can progress to the point of benefiting those who are ultimately funding these discoveries.

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Stephanie Bazley is completing her MPhil in Medical Science (Clinical Neurosciences) at the University of Cambridge, working in collaboration with University College London. She is currently investigating the degradation of hippocampal replay in Alzheimer's disease. Prior to her current research, Stephanie obtained a research Honours degree from the University of Queensland, working as a part of the Perinatal Research Centre. Stephanie is currently a digital healthcare policy researcher for Polygeia, and Head of the Cambridge Division of the Science Innovation Union.