BIO Integration

BIOI Virtual Academic Series PART 1: Multidisciplinary Integration in Academia

Received: August 5 2020; Revised: August 22 2020; Accepted: August 24 2020
Published Online: August 31 2020

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As science and technology progresses, we are confronted with an emerging and important phenomenon: integrative sciences. Scientist and clinicians are now competing with each other in the publishing "rat race" and therefore require more insights in both research and clinical domains. As we pointed out in our previous publication:

> "*Scientific problems are complicated and often interdisciplinary, which implies that in-depth collaboration among experts in various fields is vital. Interdisciplinary research is the essence of social development, innovation and to gain a broader perspective in problem solving. The mission of interdisciplinary integration is to break down barriers, reorient the insights and produce significant breakthroughs in academic research*" [1].

Since its launch in April 2020, *Bio-integration* (*BIOI*) has published at least 10 integrative scientific papers, including original articles, opinions, commentaries, reviews, and a clinical case report [1–10]. These articles originated from scientists and physicians from around the globe, using multidisciplinary approaches to tackle global crises, unsolved problems of drug resistance after chemotherapy, and creating an automated discriminating score for Parkinson's disease, among others. These publications have opened out eyes to the endless possibilities when integrating multiple fields into scientific publications.

With this in mind, *BIOI* has launched a series of virtual academic conferences to tackle the ambiguities in effective integration in academia. Our first conference was held on June 25th, 2020 on Zoom platform. Four international speakers shared their thoughts on how multidisciplinary integration could be achieved, and how it will shape and impact the quality of publications in the near future.

Xiaoyuan Chen

Professor Chen is now the Director of the Laboratory of Molecular Imaging and Nanomedicine (LOMIN) at the National Institute of Health (NIH), Bethesda, MD, USA. In his talk at the conference, Professor Chen used peptide receptor radionuclide therapy (PRRT) as an example for radiotheranostics. The images of ^{68}Ga-DOTA-TATE (Dotatate gallium Ga-68) [for positron emission tomography–computed tomography (PET/CT)] and ^{177}Lu-DOTA-EB-TATE showed high efficacy in the treatment of liver cancer and could prolong a patient's survival [11]. Professor Chen introduced the "autologous tumor cell vaccine" as an example for immunotheranostics. He concluded that blocking phosphatidylserine (PS) exposure on dying tumor cells *in vivo* as a means to convert apoptosis into secondary necrosis could be a promising strategy to prepare an *in situ* autologous tumor cell vaccine [12]. For photodynamic therapy, Professor Chen introduced his paper on "Aggregation-induced Emission Gold Clustoluminogens for Enhanced Low-dose X-ray-induced Photodynamic Therapy [13]".

Professor Chen proposed that global developments in science and technology will bring about more surprises. In the future, research will be globalized and will flourish. He emphasized three reasons: 1) as ideology fades, technology will drive development; 2) as economies open, invention will flourish; and 3) as research grows, everyone will benefit. Professor Chen pointed out that translational research will be vital in the future. Researchers need to find the best way to translate their research into practice. Through all this, he envisioned great changes in the future of science: 1) scientists working without borders; 2) broadening experiences in scientific training; 3) collaboration; and 4) scientists must rise above politics – and restate their value to society.

Professor Chen also emphasized that *BIOI* could be a platform to solve these problems in the following ways: 1) interdisciplinary co-operation allows researchers in different disciplines to meet at interfaces and to cross the borders to form new disciplines; 2) *BIOI* may serve as a forum to bring researchers together across organizations, disciplines, and great distances to match needs with resources to benefit mankind.

Farrukh Rafiq Ahmed

At the conference Professor Farrukh from the University of Lahore, Pakistan talked about computational statistics and design in basic research. At the nanoscale level, relationships among input design parameters and process or product outputs are often complex. Slight miscalculations can have detrimental effects on the synthesis and design of nanomaterials. Furthermore, it would be time consuming to manually perform all of the combinatorial possibilities in order to fully

https://bio-integration.org doi: 10.15212/bioi-2020-0031

comprehend these relationships. Professor Farrukh introduced a methodology called the statistical design of experiments (DoE). DoE is a unique technique that can be used to efficiently explore the relationships of different materials and for researchers to develop a greater understanding of their physical and chemical relationships. Consequently, DoE is now becoming central to the advancement of nanotechnology and development of novel drug products.

However, Professor Farrukh feels that there are gaps and challenges: 1) pharmaceutical dosage is trying to catch up with the developments in the field of structural biology, immunology, proteomics, genomics, etc. 2) A new field of integrated/interdisciplinary sciences called "pharmacometrics" has recently emerged yet its boundaries are still limited to the clinical evaluation of drugs. 3) There has been a substantial reduction in funds amid the global research crisis especially in the post-COVID pandemic era. Professor Farrukh urged academia to work efficiently, focusing on the values that must remain intact, with more integration of complimentary fields while being objective oriented. Professor Farrukh thinks that *BIOI* could solve these problems as integration of various sciences in the basic and applied pharmaceutical and biopharmaceutical sciences is becoming more evident. It is high time that academic disciplines be dynamically modeled; and *BIOI* provides a remarkable platform with its aims to address the issues pertaining to transformative and integrated research studies.

Michiel Postema

In his lecture at the conference, Professor Michiel explained what a tattoo is and the transient nucleation of black tattoo ink from the perspective of multidisciplinary integration. Through many dynamic microscopic images, he showed us that under a sound field of sufficient pressure amplitude, tattoo ink particles, as a hydrophobic solid particle, can act as a cavitation nucleus, producing a cavitation effect and bursting to force the hydrophobic carbon black ink suspended in water using ultrasound. However, after sonication, the carbon black ink particles lose their acoustic activity due to the gas on the surface of the particles dissolving in water. Finally, based on the effect of ultrasound on tattoo ink particles, Professor Michiel suggested ultrasound could be an interesting tool for tattoo modification [14].

Professor Postema received an MSc in Geophysics from Utrecht University, The Netherlands, in 1996, a PhD in Physics from the University of Twente, The Netherlands, in 2004, and the Habilitation à Diriger des Recherches (DSc) in Life and Health Sciences from the University of Tours, France, in 2018. He was appointed Professor of Experimental Acoustics at the University of Bergen, Norway, in 2010, Professor of Ultrasonics at the Polish Academy of Sciences in 2016, and Distinguished Professor of Biomedical Engineering at the University of the Witwatersrand, Johannesburg, South Africa, in 2018. With extensive experience in physics, geophysics, acoustics and health sciences, he now chooses to integrate all his expertise to work with medical microparticles under sonication and in high-speed photography [6, 15, 16]. As can be seen from Professor Postema's lecture, one can appreciate his vast knowledge and summarize that he is a cross-disciplinary researcher, using novel techniques that are unique to the medical field.

Wai Kit Ming

Professor Ming is a clinician and scientist, with degrees in Public Health, Computer Science, and Economics from Oxford University, Harvard University, and Massachusetts Institute of Technology (MIT). Professor Ming opened his talk at the conference with the current COVID-19 pandemic as a starting point and described the current research status and trends of digital epidemiology in public health emergency management. Professor Ming discussed that as a result of the global impact of infectious diseases and health problems in urbanization, the task of disease prevention and control is very important in the new era. With the continuous development of the Internet, digital epidemiology is emerging which is an interdisciplinary research field (which includes public health and preventive medicine, communication, public administration, public crisis management, and sociology) that can be used to carry out disease prediction, disease monitoring, and medical resource allocation, so as to provide a theoretical basis and intellectual support for digital decision-making on public health events. Furthermore, Professor Ming described in detail the successful use of digital models in previous studies to predict the number of isolation wards and analyze medical resource allocation schemes such as masks, which provided advice for government decision-making and proved the advantages of digital epidemiology [17–19]. Through his lecture, we can fully realize the significance and impact of multidisciplinary integration in curbing a global epidemic. In conclusion, Professor Ming emphasized the future of science requires close partnership and interdisciplinary research.

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