The Harmony and Conflict Arising from an Interdisciplinary Future for Science

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1. Introduction

Throughout history, in every aspect of academia, as a society, we tended to break areas of study down into smaller factions, until they are so niche only several professionals in the world carry expertise in that area. From an early age we learn in clusters, 'Mathematics', 'Science' and 'English'; science is then broken down into 'Biology', 'Chemistry' and 'Physics', eventually becoming a greater number of specific areas at higher education-level, 'Molecular Biology', 'Bioengineering', 'Medical Physics', 'Materials Science' and so forth.

Is this separation "irrelevant" and "unnecessary", or does it allow us to bring a distinct, adept set of tools to a research table? We can appreciate that domains of knowledge have the ability to cross-over and give-way for what is known as 'convergence science'. But does this necessarily mean that sorting science into factions should now be null and void? One might believe so, however, the separation of disciplines might be counterproductive to the progress in answering pressing scientific questions. It appears as if a larger number of scientists in this century are addressing these questions and issues in between the boundaries of disciplines, as a realisation has set that we need to comprehend information and data outside of our realms of knowledge and what we are typically familiar with. Branching science out into smaller niches, when we already have such a great separation between the physical and life sciences, can present us with more problems than solutions. It is not solely a matter of having different departments and research teams, it's also having to split funding greatly and compromise efficiency through having multiple disciplines study similar theories and matters, rather than merging these groups and working on scientific research interdisciplinarily.

This essay will discuss the societal, economic and strategic standpoints of the statement in question and present readers with a clear view of 'convergence science'.

2. Welcoming 'Convergence Science'

Scientists across the globe have been nurturing convergence science, an example being the opening of the Convergence Science Centre at the Institute of Cancer Research UK, in 2019.[1] It is an avenue for physicists, biologists, bioinformaticians and other disciplines to merge their work and strive towards a common goal. The 'Convergent Science Physical Oncology' journal launched in 2015[2], presenting research that has been conducted in the advancement of cancer research. Notable studies from this journal include using mass cytometry and high-definition single-cell analysis for liquid biopsies[3] and perceiving cancer as a "system disorder of algorithms", attempting to use bioelectrical networks and programming as a way to better understand and tackle the disease.[4]

The Rosalind Franklin Institute (RFI) is a medical research centre that focusses its work around interdisciplinary research and convergence science. Mass spectrometry is a typically a technique used in chemistry to determine molecular weight and the RFI have adopted this and amalgamated it with biology – hence Biological Mass Spectrometry.[5] This enables research in this area to transcend the notion of disciplines and allow for optimised research. The research being carried out will ultimately allow for a greater understanding of the supramolecular structures and the structural characterisation of biological issues, using chemical procedures.[6] It appears as if disciplines have a natural tendency to converge to tackle some of science's biggest problems: bioinformatics, bioengineering, health informatics etc. A book written by the National Research Council in 2014 stated the following, "Convergence among the biomedical, technological, clinical and regulatory fields could help create a knowledge network for precision medicine that integrates these multiple sources of information".[7] Convergence science is about being able to access a bank of information that otherwise would not be available in one place at any given time. It is about not having to bargain with experts in different fields to receive the correct information and data for a separate research group's work. It is about facilitating an environment where the physical and life sciences promote collaborative research, in which everyone is working towards a common goal. These are the chief principles of convergence science.

Even though this seems like the direction science is heading in, there are still many complications to interdisciplinary research. We must contemplate what convergence science will bring to us, but also what it will take away from us.

3. Oppositions to 'Convergence Science'

Becoming an eminent character in one's field is not something that occurs overnight. It requires years upon years of dedication, enthusiasm and experience. Steven Breckler, former Executive Director of the American Psychological Association expressed, "The concept of a scientific discipline is an important and enduring one. It implies there is a body of knowledge to master and skills

to be acquired before one can proclaim disciplinary expertise."[8] His statement elucidates that disciplines allow for extensive research within the confines of those sub-disciplines. We cannot expect individual scientists to obtain knowledge on every single branch and sub-branch within science. This itself then creates problems with the global education system and its inherent formation of scientific divisions – it is what we are comfortable with and all we have ever known.

'Research at the Intersection of the Physical and Life Sciences' discusses the difficulties that already exist in attributing credit to scientists involved in research projects, particularly in the life sciences[9], and so convergence science would pose a more intricate dilemma in terms of giving credit where its due in interdisciplinary work. We award prizes and congratulate professionals based on their discipline, making it easier for the general public to assimilate the role that they have played in their work. Moreover, alternative structures would have to be put in place to support scientists who cannot allocate their work to a specific department and will not be able to have access to all the resources they require in one department.

We can further consider the economic gain from having disciplinary science; companies are better able to capitalise off disciplines that could seemingly be merged. There is an effect of an increase in competition for the acquirement of knowledge, as even in the same disciplines this capitalistic competition exists between businesses. One of the more prominent examples being transnational pharmaceutical companies. The top 10 global companies had an estimated combined revenue of $304 billion in 2019[10-14], approximately 15% more than the revenue of the highest-earning company.[15] If these co-operations fostered a 'convergence' mindset, with economic and departmental divisions deemed nugatory, the pharmaceutical stock market, investing and division of profit amongst workers would all have to change drastically. Even though this pertains to more intradisciplinary competition, if we look at the biotechnology company Neuralink and the healthcare company Novartis, the same principle applies. Neuralink's core goal is to develop brain-machine interfaces to restore sensory and motor function in those who suffer from neurological diseases.[16] Novartis is tackling this same issue, but through the means of drug therapy, such as the development of Mayzent® to treat secondary progressive multiple sclerosis in adults,[17] which is a neurological condition characterised by a loss of control of motor functions.[18] Thus, wouldn't the logical step to take be integrating biotechnology (physical-based) and healthcare (life science-based) companies into one entity, allowing progression more quickly towards that common goal?

4. Conclusion

It is apparent that there will always be some complications when the time comes to fully migrate to scientific research wholly based on the principles of convergence, whether this is financial, moral or strategical. However, all of this recent movement towards interdisciplinary research shows that there is a growing demand for the physical and life disciplines to, at the very least, work in the same departments, and the same groups. The integration of disciplines begins with professionals finding similarities between one another's work and appropriating it to accommodate their interests – eventually, these professionals being able to carry out their work together in the same environment under the support of an institution. It is problematic to embody a 'black-and-white' approach when dealing with science's most pressing questions, and researchers are finding themselves in situations that leave them reliant on experts in disciplines different from their own. This is not a weakness, only an opportunity for optimisation, and science should be centred around embracing optimisation.

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