“So much of the work done in science now requires input from multiple disciplines, that the separation of the disciplines is irrelevant and unnecessary.”

George Booth

To a large extent, I disagree that the separation of scientific disciplines is ‘irrelevant and unnecessary’ despite so much of the work now done in science being cross-disciplinary (involving multiple disciplines in some form whether that be multi-, inter- or trans- disciplinary). (What are cross-disciplinary approaches and how to employ them?, 2018)

Firstly, I think it is important to look at the value of disciplines and why they were first adopted. I like the concept that a scientific discipline is a ‘branch of scientific knowledge’ (Scientific Discipline, 2020) as it describes a discipline as if it were “branching off” from an original source of science. As science grew in size of facts, data and understanding, there was a requirement to split up and sort this unfocused collection of knowledge. This is where disciplines came in.

Disciplines allow different focus areas of science to be gathered and organised by a consensus of general principles, which future advancement or alternate understanding can be built off.

I study the discipline of biochemistry which follows organisms as ‘apparatus that maintain their identity by means of self-controlled physical and chemical changes’ (Biochemistry, Farlex Partner Medical Dictionary, 2012). Therefore, in theory, I can ignore any science regarding non-life, as well as most of inorganic chemistry. I believe that the study of biochemistry gives a much more in depth understanding of such principles including metabolism and enzymatic activity as opposed to a wider study; providing deeper insight into the principles leading to accelerated scientific advancement.

Disciplines are also key in allowing scientific knowledge to be conserved efficiently in the education system of universities. No one person can consume all the scientific knowledge there is and, therefore, disciplining allows academics to become an expert in one field as well as allowing the expansion of this knowledge through scientific research. Disciplining is essential as it allows knowledge to be split into focused manageable amounts that can be retained by academics and passed on to students as future academics.

However, I do believe there are significant disadvantages to disciplines in science. Firstly, disciplines can limit a wider understanding of scientific principles. In contrast to an earlier point, despite providing a depth of understanding in topics, the principles of a discipline are often presented in a way that allows ease of understanding rather than being related to a scientific principle. For example, academic presentation on metabolism often consists of learning the glycolytic pathway as chemical structures. However, missing is the relation of this to a biological system which would aid further understanding. By disciplining, I believe it limits a wider understanding which causes students, as future academics, to find it difficult to relate topics and understand the “bigger picture” of a principle.

As well as limiting the wider understanding of scientific principles, disciplines discourage the integration of these principles. Science does not split up disciplines from a biological process itself, we are doing this to allow a more detailed understanding of certain principles. In academia, a single discipline degree focuses on a subject in an individual context; students do not understand how one discipline impacts another discipline or how each works together. Disciplines are taught in a fragmented manner rather than a way that combines principles seamlessly to allow a deeper comprehension. Therefore, students are not taught to use different aspects of their knowledge in an integrated fashion, potentially preventing them from gaining higher knowledge or presenting their own ideas when it comes to scientific research, as they would be unable to make the link between disciplines. Future academics are also pushed away from the idea of conducting cross-disciplinary work by seeing other disciplines as unrelated when in reality, all disciplines are related.

When it comes to academic research, disciplines can discourage academics from entertaining a different point of view. In academia, a disciplines subject matter has already been chosen according to what academics deem of value for students to learn. Students are not taught to be rational thinkers and are not as independent as they could be in their own learning. The subject-focused discipline produces “clone students” who accept general ideas presented to them and do not push the boundaries, many of whom will not be excited about learning and gaining knowledge via this method of study. These subject-focused disciplines instead foster passivity and discourage new ideas that can push the boundaries of science.

In my opinion, I do not believe the disciplines have ever worked in isolation. As discussed before, I believe the idea of disciplines is to allow different focus areas of science to be gathered and organised by a consensus of general principles (almost as a storage of data, facts and principles that share a common space in science), which future advancement or alternate understanding can be built off. Science is not naturally split up; we do this for ease of understanding. So when it to comes cross-disciplinary work, I believe it is about sharing this collection of knowledge with another to achieve a solution to a problem in return. I believe most scientific findings in history have come through cross-disciplinary work despite being labelled as single-discipline findings due to the unrealised idea that science is all intertwined and has no parameters.

Often, to gain or prove scientific knowledge requires multi-disciplinary work. For example, the requirement of a physical imaging technique designed and engineered by physicists to prove a biological principle; Rosalind Franklin utilised William Henry Bragg and William Lawrence Bragg’s X-ray crystallography technique to produce photo 51 (‘Photograph 51 by Rosalind Franklin 1952’, The Embryo Project Encyclopaedia, 2019) used in discovering and modelling the potential structure of Deoxyribonucleic Acid (DNA). Even to this day, the crossover between physics and biology is crucial in the imaging and screening of biological organisms from a macro-level of biological systems (including X-rays and Magnetic Resonance Imaging (MRI) with human health) down to the micro-level (including imaging cell structures, membranes, ribosomes and other organelles). This crossover of disciplines has led to the creation of the sub-discipline: biophysics; this reinforces the tendency for people to collate and store data, information and facts in a subject-based manner - such as disciplining - making it easier to remember and learn.

As the title statement suggests, multidisciplinary work is prevalent in science today. The EU Framework Programme for Research and Innovation Horizon 2020 shows how cross-discipline work is highly valued and funded, as well as being a flagship project for cross-disciplinary work. An example of this is the Scalable Sepsis Microarray Platform (‘Scalable, point-of-care and label free microarray platform for rapid detection of Sepsis’, 2017) which combines nanotechnology with biomedical sciences to have a social and economic effect, by reducing sepsis deaths coupled with a decreased hospital bed time, saving projected billions per annum. This project alone has received almost three million euros from the EU suggesting a shift in investment from single discipline research to cross-disciplinary research that solves global issues. I believe projects like this will be more common due to the increased value seen in cross-disciplinary work, as well as the ease of communication that allows collaboration globally; an exemplar of this is the global work on climate change by the Centres of Climate Change in which experts from multiple diverse disciplines are brought together to deal with the problem (Vincent, Batalden and Davidoff, 2011).

However, not everyone is sure on the feasibility of cross-disciplinary projects to succeed, especially on how proposals are evaluated and how these projects conflict with 'inflexible governmental funding and evaluation processes' (Woelert P, Millar V, 2013, pp.755-767). As Woelert & Millar (2013) suggest, proposals are not fairly evaluated due to evaluators only being experts from one of the disciplines. Weingart's Interdisciplinarity: The paradoxical discourse (2000) also states that 'The interests of policy in innovation collide with the interests of science in a defined discipline-specific research. In the end, it is science itself that hinders cross-disciplinary research'. This suggests that what governments view in innovation is different to that of science; this difference hinders any progress that cross-disciplinary work may offer. As large sums of funding originate from organisations and governments globally, any discrepancy in 'interest of innovation' between governments and research groups would lead to a loss of funding for any cross-disciplinary research.

Overall, my view is that disciplining science is still required despite so much of the work done in science now requiring input from multiple disciplines. I am confident that disciplines are key to providing a focused study that allows detailed understanding, despite potentially preventing an integrated wider understanding, as well as allowing the next generation of students to become experts in a chosen field. Also, I believe cross-disciplinary work has become more achievable with increased efficiency and ease of communication globally. There is significant necessity, desire and funding which allows the concept of cross-disciplinary projects to succeed and find answers to global issues as well as promoting cross-disciplinary work. I believe that disciplines and cross-disciplinary work can co-exist to provide a framework for future scientific research.

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