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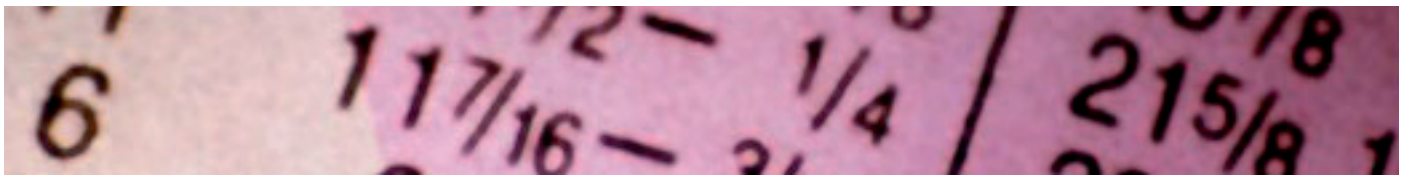
Breaking boundaries: patterns in interdisciplinary citation

Research Trends Editorial Board

The value of bibliometric measures



Breaking boundaries: patterns in interdisciplinary citation

Science today is separated into many areas that relate to each other in different ways. But are there any areas of research that cross the boundaries of science? Which are the most interdisciplinary areas of research?

This article investigates the major subject areas identified in Scopus that are cited by other subject areas, and attempts to identify those that show the most interdisciplinary citation patterns. We have taken articles published in each subject area between the years 1996–2000 and 2003–2007 and measured citations to these from other subject areas within the same two periods. We can then compare the percentage of citations received by other subjects across both time periods to determine which areas showed the biggest shift in citation patterns.

The results were mixed. For instance, medicine showed very little variation in citation patterns between the two periods, with the majority of citations coming from other medical fields and those in associated life sciences (see Figure 1).

A similar pattern was seen in other medical and life science areas, including biochemistry, neuroscience, nursing, and pharmacology and toxicology. Areas such as arts and humanities, social sciences or psychology also indicated no significant shift in the citation patterns of these fields, although it is worth mentioning that some of these subjects are already diverse by nature.

Branching out...

In contrast, fields such as computer science, engineering, energy and mathematics all showed a great deal of change in the subjects that cite them. Figure 2 illustrates the pattern for mathematics and Figure 3 for computer science.

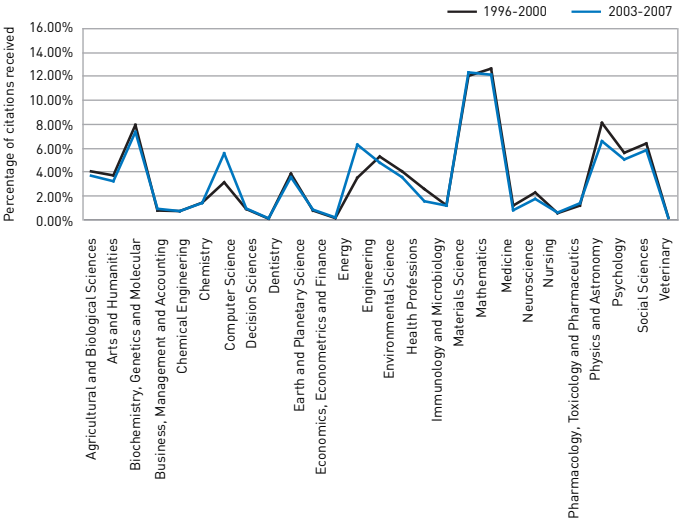


Figure 2: Differences in citations to mathematics from other subject fields.

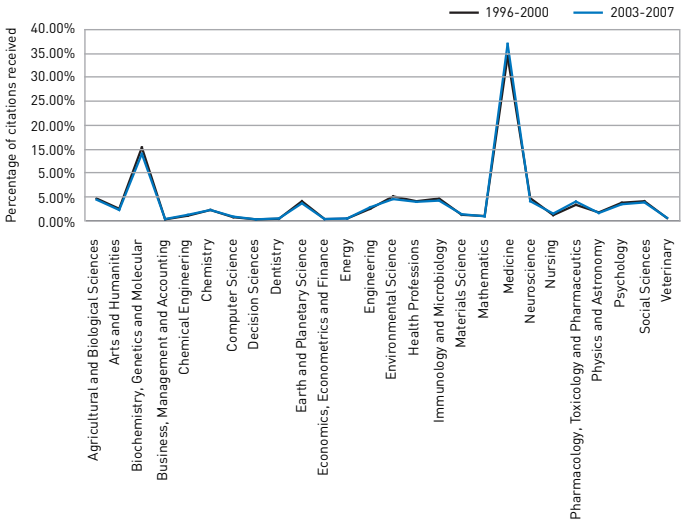


Figure 1: Differences in citations to medicine from other subject fields.

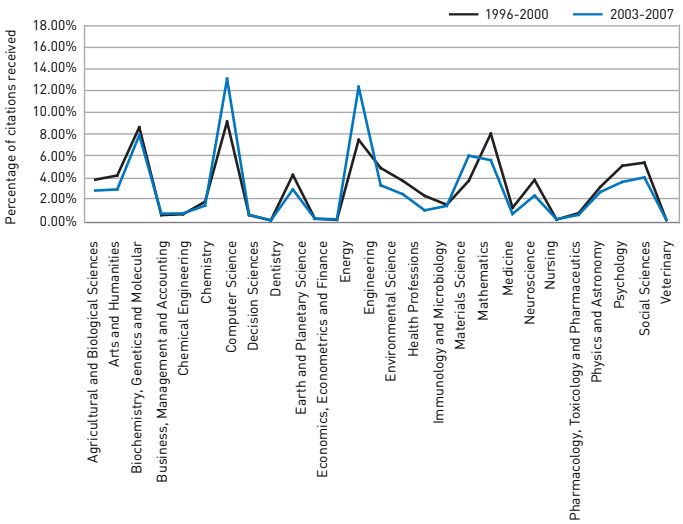


Figure 3: Differences in citations to computer science from other subject fields.

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These results indicate a shift in the citation patterns, with different subject areas making citations to academic literature. It also points to a tendency for changes in the nature of the citation relationships of these fields. Indeed, within computer science, shifts of up to 6% are seen in citation activity to other areas, with the main shifts being evident in citations from engineering and mathematics.

To investigate these shifts more closely we compared the top ten most-citing subjects to two fields that seem to show the highest interdisciplinary origin of their citing articles – energy and engineering. Figures 4 and 5 illustrate the percentage breakdown of citations to these areas.

Both energy and engineering have a diverse citation spread and have shown an increase in the "other" areas that have cited them between the two time periods. Energy has shown a 2% shift in citations from "other" fields, while engineering has shown a 6% shift.

...or converging?

Moshe Kam, Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and Professor at Drexel University, the US, is not surprised by these findings. He says that many research areas that were relatively "isolated" in the past have been developing a stronger interface with disciplines within engineering and computing.

Kam explains: "Rather than interpreting the data as showing increased cross-disciplinary activity, the data may actually indicate that some disciplines and sub-disciplines are converging, or even merging. One example is the increase in the volume of work at the interface of life sciences, computer science, computer engineering and electrical engineering. It is clear from reading papers at this intersection of subjects that many scientists and engineers who were educated in a traditional 'standalone' discipline have educated themselves quite well in other areas. At times it is hard to distinguish between the pattern-recognition specialist, the biological-computation expert and the software engineer. There is much less compartmentalization and much more sharing – not only in the results of tasks divided between researchers, but in actually doing the detailed research work together."

It thus appears that for researchers in certain subjects, the results of research in certain other, complementary fields, are not only of added value; they are becoming essential. If Moshe is correct, the trend is towards convergence rather than cross-disciplinarity for fields that share common research questions and approaches. It remains to be seen whether this will lead to new areas of study at the intersections of complementary fields or greater collaboration between experts within those fields.

Useful links:

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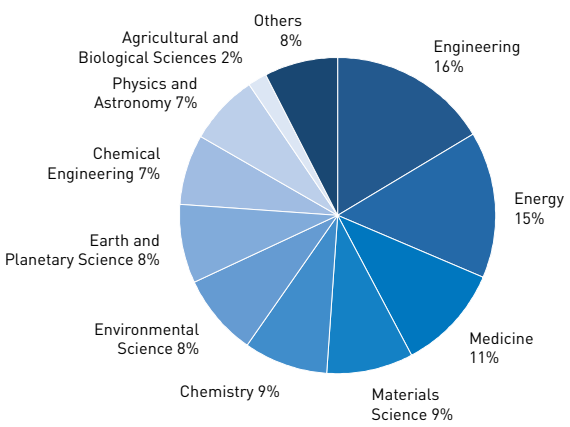
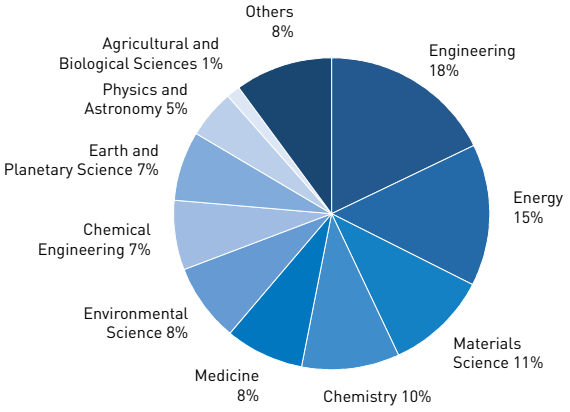
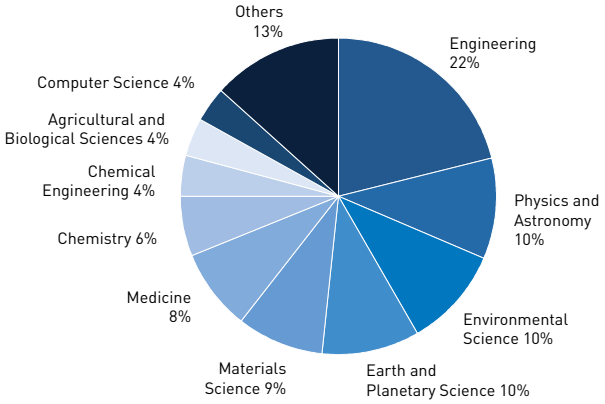
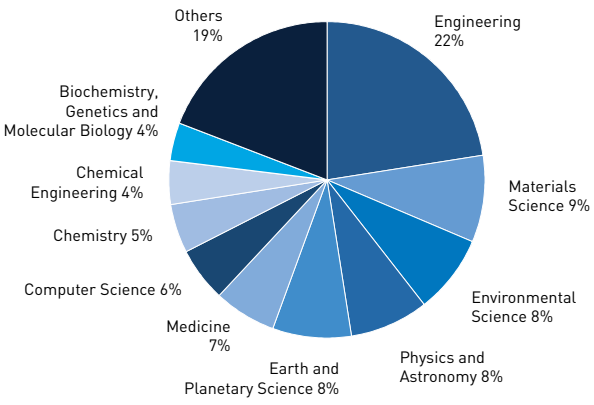




Figures 4 and 5: Comparison of top ten subjects citing the field of energy, 1996–2000 and 2003–2007.





Figures 6 and 7: Comparison of top ten subjects citing the field of engineering, 1996–2000 and 2003–2007.