Google Books[1] vs. MathSciNet[2]

Scott Guthery

Introduction

For over 150 years progress in mathematics has been guided by the twin values of generalization and abstraction. Mathematical research is, as a result, characterized by a short memory and even shorter bibliographies. And yet exactly because mathematics has been guided by generalization and abstraction, mathematical constructs have very long histories.

While academic mathematicians need only consider the current version of a construct to begin building the next, there are mathematics communities—for the most part wholly ignored by the American Mathematical Society—that benefit from considering the long tail of mathematics, including but by no means limited to mathematical practitioners, independent scholars, students,[3] and authors writing for the general science reader.

Until very recently, the long tail of mathematics was inaccessible to these nonacademic mathematicians. Books, manuscripts, and journals containing the history of mathematics were locked away in research libraries and off-site, faculty-only depositories. On the theory that today's publications encapsulate all of the past, it is not unknown that these works disappear altogether. The American Mathematical Society remaindered the Society's mathematics library so carefully collected and curated by the Society's librarians.[4]

Fortunately, this situation is being rectified. Google Books is the most widely known but by no means the only on-line, full-text, open-access, searchable archive of the long tail of mathematics. In this short note we consider, by way of example only, why the long tail of mathematics is so keenly of interest to two particular communities, practitioners and independent scholars.

Practitioners

Mathematical practitioners use mathematics to erect "jigs" to hold nonmathematical problems. The mathematical constructs in the jig enable the practitioner to represent, study, and manipulate key aspects of the problem. Insights gained by casting a problem mathematically and seeing how facets of the problem connect to one another surprisingly often lead the way to a solution.[5]

The most compelling and most efficient solutions to a problem turn on grasping, understanding, and harnessing critical aspects of the problem

Scott Guthery is a publisher, editor and author at Docent Press. His email address is `scott@docentprpress.com`.

[1]Google Books is used here as a generic term for all open-access, full-view resources containing mathematics literature including but by no means limited to Haithi Trust, Gallica, GDZ, and WDML.

[2]MathSciNet is used here to refer specifically to the restricted-access database of telegraphic summaries of scholarly mathematics maintained by the American Mathematical Society.

[3]See Ranjan Roy, "Learning by Reading Original Mathematics", *Notices of the AMS* **58** (2011), 1285-1287.

DOI: http://dx.doi.org/10.1090/noti883

[4]See "The Library", 90–95 in R. C. Archibald, *A Semicentennial History of the American Mathematical Society: 1888–1938*, American Mathematical Society, 1938.

[5]See I. Grattan-Guinness, "Solving Wigner's mystery: The reasonable (though perhaps limited) effectiveness of mathematics in the natural sciences", *The Mathematical Intelligencer* **30** (2008), 7–17.

specifics. The mathematical practitioner is laser-focused on particulars, not generalities. From the point of view of the practitioner, the problem at hand is the problem to be solved. It is not a special case of a more general problem.

A practitioner accessing the mathematical literature in order to "stand on the shoulders of giants" is faced with two challenges: First, does a mathematical construct found in the literature capture the problem at hand? Second, are the results associated with the construct relevant to a solution?

From the practitioner's point of view, a discouraging side effect of mathematical abstraction, generalization, and condensation is that scholarly mathematics has to be decompressed before its possible application to a problem at hand can be considered. This decompression process must be carried out in two steps: First, a special case of the abstract space has to be crafted to fit the problem into. Second, the general results in the abstract space have to be down-translated into this special-case space.

Rather than becoming entangled in this mathematical puzzle, the practitioner has found an alternative strategy. Using Google Books, today's practitioners can search through uncondensed mathematical constructs of yesteryear. They can consider the readily understood formulations of Lagrange, Laplace, and Sylvester. They can look for signs of their problem in works of Whitaker, Hildebrand, and Todhunter. They can turn the crank on numerical algorithms of de Prony, Shanks, and Glaisher.

The practitioner doesn't have to decipher arcane language or scrape away layers of gratuitous generality in order to try to find the shoulders of today's mathematicians. Using Google Books, today's practitioner can easily, efficiently, and productively climb up on the shoulders of yesterday's giants.

Independent Scholars

Perhaps more than professionals in any other discipline, academic mathematicians marginalize independent scholars. That an independent scholar might make a worthy contribution to mathematics is simply unimaginable to today's academic mathematician. But there are many disciplines, scientific and otherwise, which actively encourage amateur participation and can cite with ease examples of benefits from having done so.[6] For the purposes of the current discussion it is useful to consider the case of astronomy.

Amateur astronomers are easily differentiated from professional astronomers. They scan the sky in their spare time. Their instruments cost orders of magnitude less to build and operate. They publish their findings in blogs and popular literature. Nevertheless, there is general acknowledgment among professional astronomers that what amateur astronomers are doing is astronomy. It is not unknown that an original sighting by an amateur astronomer is acknowledged, appreciated and even pursued by the professionals.[7]

One reason that the professional astronomers don't shun the amateurs is that the sky is big, the questions are many, and telescope time is limited. Amateur astronomers look in places that the professionals can't afford to look and pursue questions that may not be of grant-worthy interest. The archive of mathematical literature being opened by Google Books is the big sky of mathematics. Independent scholars are reading literature that the professionals have left behind, and they are pursuing topics, conjectures, and open problems that are not of current academic interest. Independent scholars have contributed to mathematics[8] and will continue to do so.[9]

Summary

Generalization and abstraction are linear concepts. Their intrinsic nature is to generate a lock-step sequence of results. Mathematics is not a linear endeavor. One can start with a paper by Lagrange or Glaisher and head off into a myriad of fascinating directions, only a few of which will have been chosen for pursuit by academia.

These untraveled paths are not accessible from today's mathematics literature. The only paths one can see—and even then often dimly—are the paths that led to today's frontiers. Opening up the mathematical literature of the past enables us to go back and explore paths untaken.

Not only are the constructs in the long tail of mathematics of immediate use to today's practitioners and of abiding interest to today's independent scholars, but unearthing these constructs enables everyone to more readily understand and appreciate the work of today's professional mathematicians.

The open access being provided to the mathematics literature of the past by Google Books and others is a positive development for all mathematics communities.

[6]See www.ebird.org for an example from ornithology.

[7]The amateur astronomer Michael Oates has discovered over 130 comets and has one named after him. See www.mikeoates.org.

[8]See J. L. Coolidge, *The Mathematics of Great Amateurs, Second Edition*, Oxford University Press, 1990.

[9]See arxiv.org, eprint.iacr.org, vixra.org, and integers-ejcnt.org as examples of many of the type.