

Engagement and Impact: Pure Mathematics AMSI

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Where to start?

What do we mean by impact and engagement?

Should impact inside the discipline count?

Will intangibles, such as social and cultural benefit, count?



How do I measure thee? Let me count the ways...

(With sincere apologies to Elizabeth Barrett Browning.)

Within the discipline, experts will have an opinion.

Even if we naïvely look at citations on MathSciNet
we would probably all agree that this person

Author Citations for [REDACTED]
[REDACTED] is cited 20 times by 36 authors
in the MR Citation Database

is having more impact than this person

Author Citations for [REDACTED]
[REDACTED] is cited 28 times by 1 authors
in the MR Citation Database

But how do we measure impact outside the discipline?



Challenges

Any attempt to measure the impact of pure mathematics beyond
the discipline faces three challenges. The impact may be

- intangible include measures by proxy of things we value
- far from immediate avoid short-term perspectives
- high return with low probability measure the whole

Each of these comes with a message.



Measure the whole

Pareto principle applied to pure mathematics

Approximately 80% of the impact comes from 20% of the work, but you don't know ahead of time which 20% it will be.

A small amount of pure mathematics produces a high enough return to recover the cost of all funded mathematics.

But you don't know which project will end up having the highest impact.

And we can't learn from the past: areas/projects that did not have impact in the past may have great impact in the future.



Measure things we value by proxy

As an example of what I mean here, consider the National Science Foundation *broader impacts*;

- Advance discovery and understanding while promoting teaching, training, and learning;
- Broaden participation of underrepresented groups;
- Enhance infrastructure for research and education;
- Broad dissemination to enhance scientific and technological understanding; and
- Benefits to society.

See <http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf> and <http://vcresearch.berkeley.edu/brdo/addressing-broader-impacts>



Avoid short-term perspectives

Even with improvements in communication, the impact of pure mathematics is typically less immediate.

Focussing on short-term goals means mortgaging our future.

So we need to measure impact over a long period of time.

The only realistic way to measure long-term impact is to measure it *ab initio*.

Combining this with our previous observation, we should

- measure the impact of all pure mathematics in last fifty years,
- compare this to the investment, and
- ask whether we are happy with that return.

If the answer is yes, then keep doing it. If not, trim carefully!



They include, but are not limited to

- full participation of women, persons with disabilities, and underrepresented minorities in STEM;
- improved STEM education and educator development at any level;
- increased public scientific literacy and public engagement with science and technology;
- improved well-being of individuals in society;
- development of a diverse, globally competitive STEM workforce;
- increased partnerships between academia, industry, and others;
- improved national security;
- increased economic competitiveness of the United States; and
- enhanced infrastructure for research and education.

See <http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf> and <http://vcresearch.berkeley.edu/brdo/addressing-broader-impacts>



Alignment

Whatever we do, we must be careful about the alignment with disciplinary expectations and norms.

If the mathematical community is asked to do something that individuals consider objectionable, then they won't do it. They would rather not be funded, and we would all suffer.

In almost all cases, our allegiance lies first with the discipline.



Any Questions?

Thank you for your attention.



For the record ... impact we value

- deep, interesting, and innovative ideas/results
- invitations to speak, particularly at major conferences and at limited-attendance conferences
- supervision of good students and mentoring of early career researchers

It is also worth noting that

- people may know about your work and not actually cite it
- long delays in publication are common and tolerated partly because of extensive use of the ArXiv
- work may be cited before it has even been accepted for publication and those citations may never be reconciled

