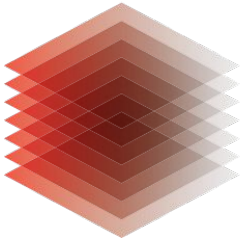

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The Neverending Story of a Holistic Research Infrastructure for Mathematics

Mila Runnwerth
Joint Mathematics Meeting 2020
17th January 2020

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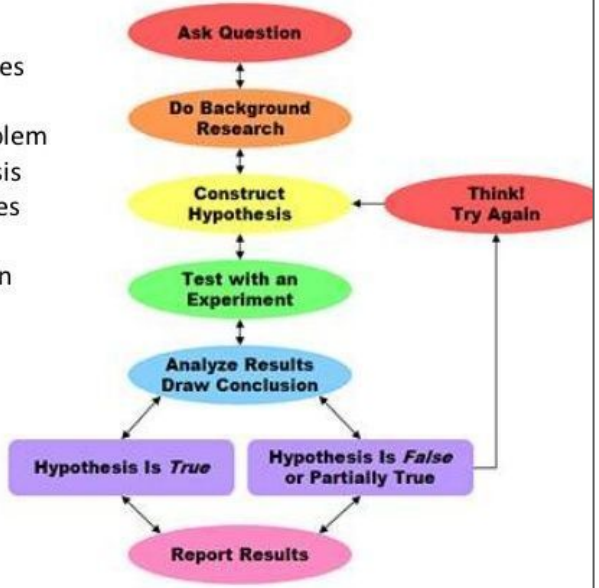
The Traditional Research Process

Research Process

- The Research Problem
- Formulation of Research Objectives
- Review of Related Literature
- Delimitation of the Research Problem
- Formulation of Testable Hypothesis
- Identification of Research Variables
- Construction of Research Design
- Designing Tools for Data Collection
- Designing Plan for Data Analysis
- Collection of Data
- Data Processing
- Data Analysis and Interpretation
- Drawing Conclusions and Recommendations
- Writing of Research Report
- Reporting of Research Findings



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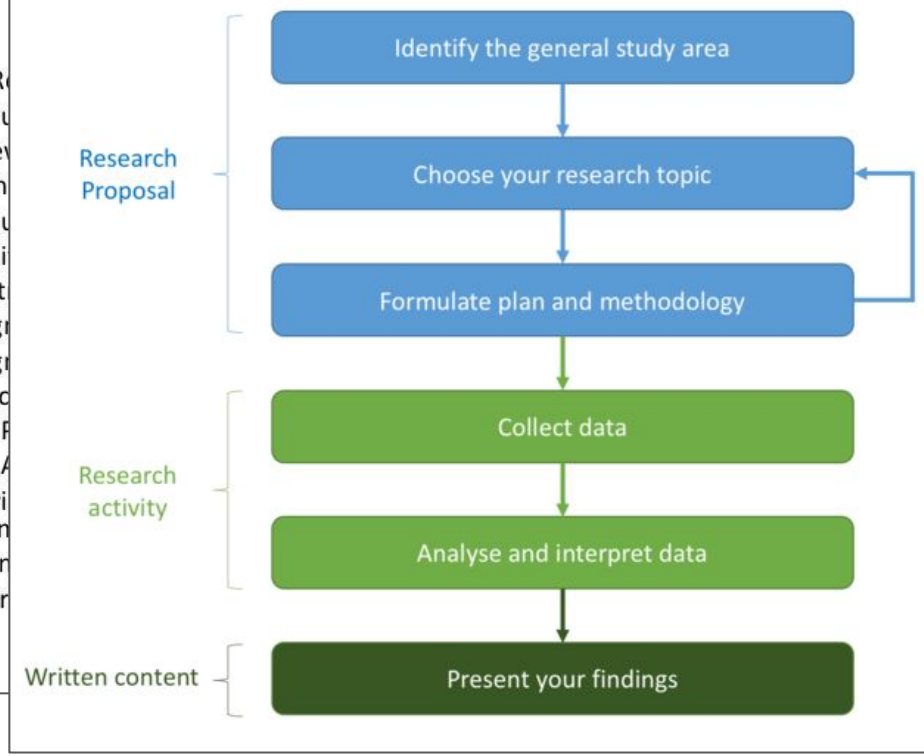

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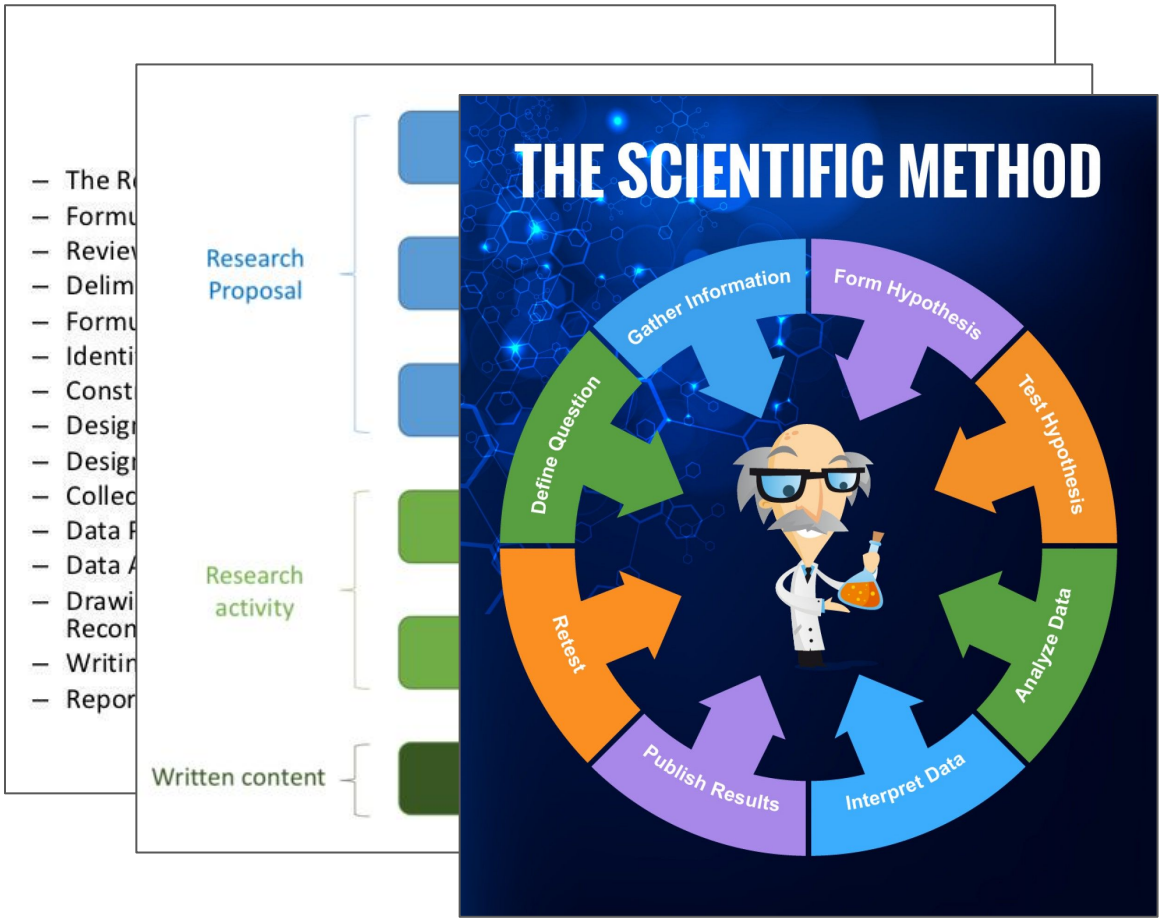
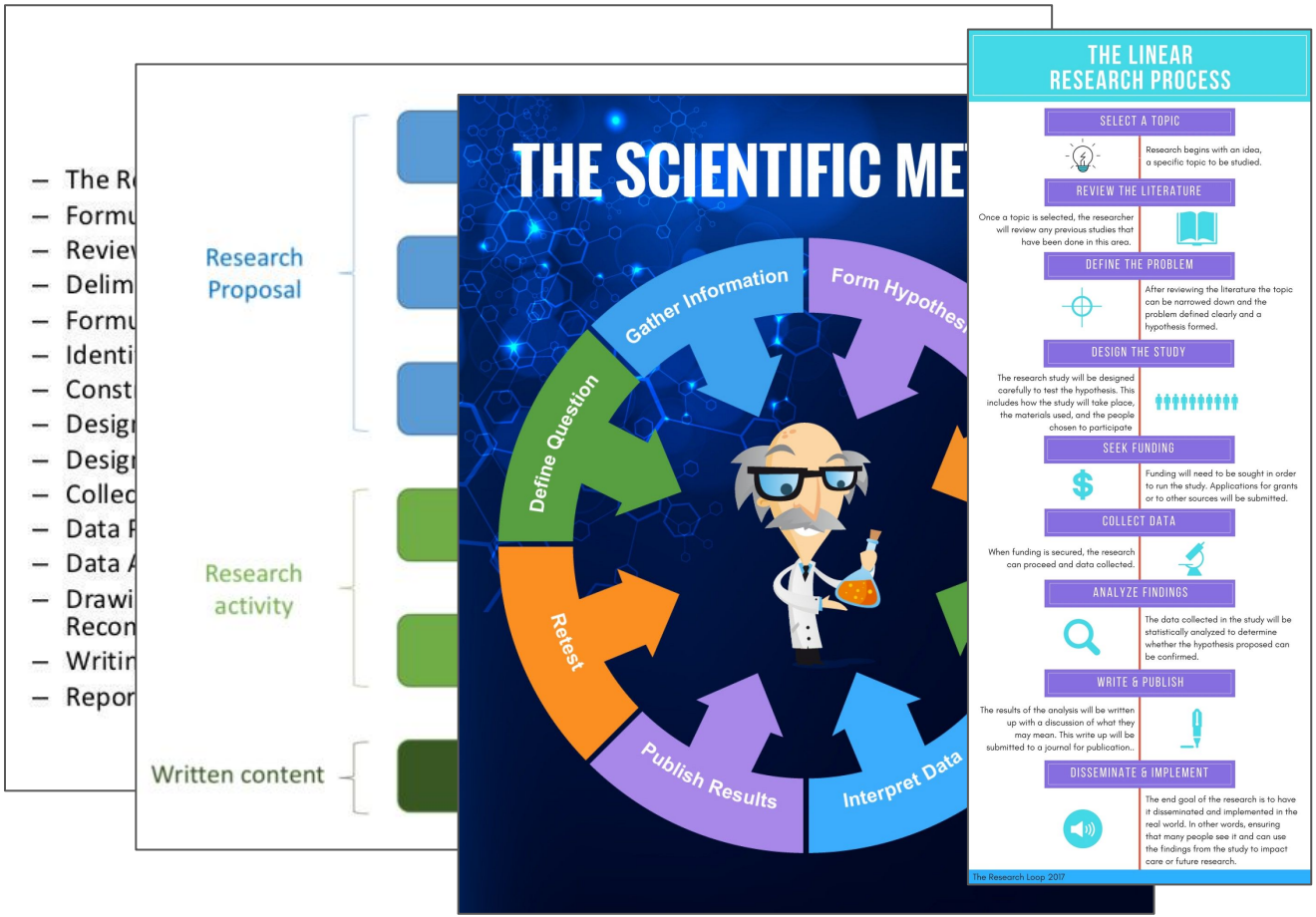
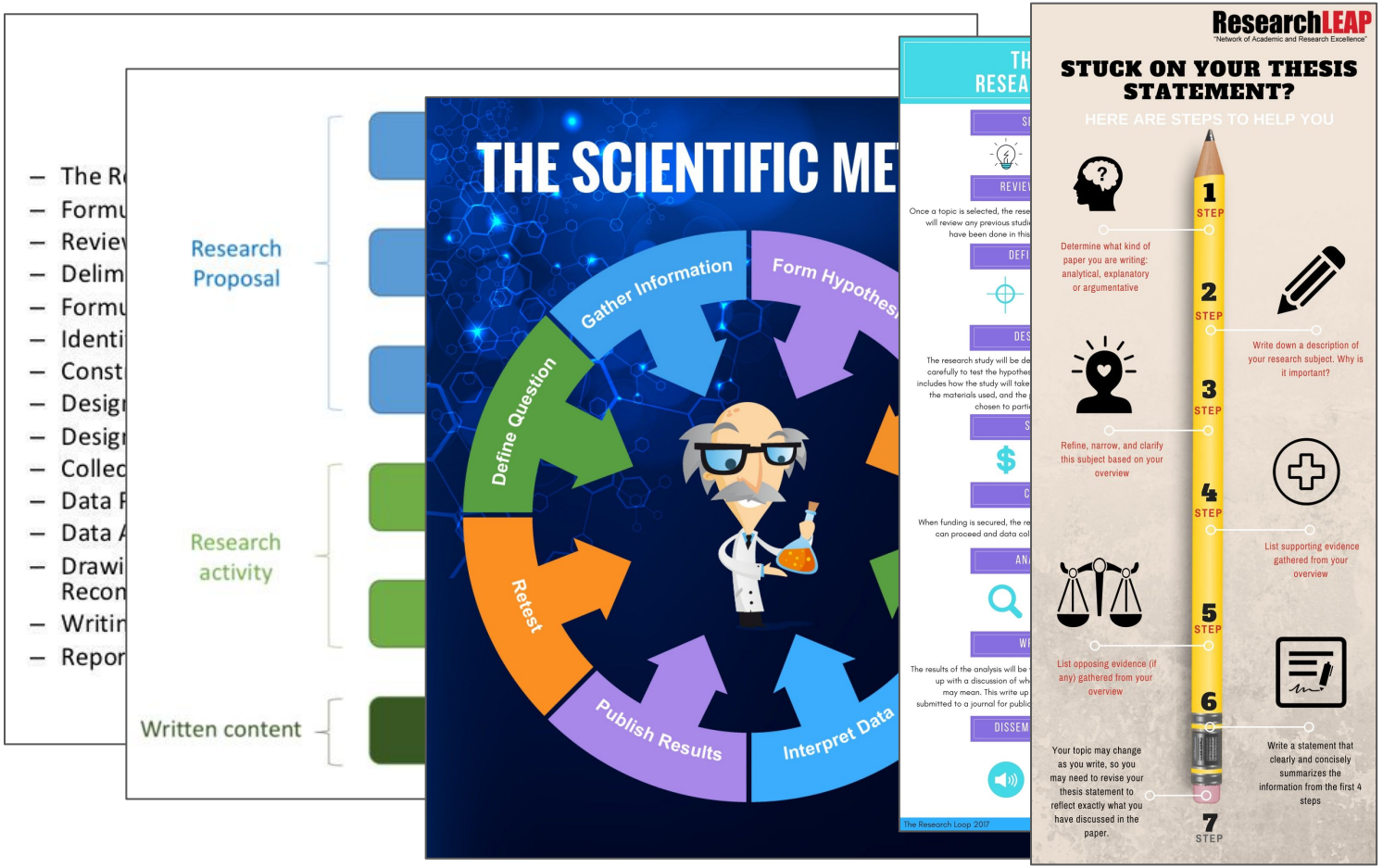


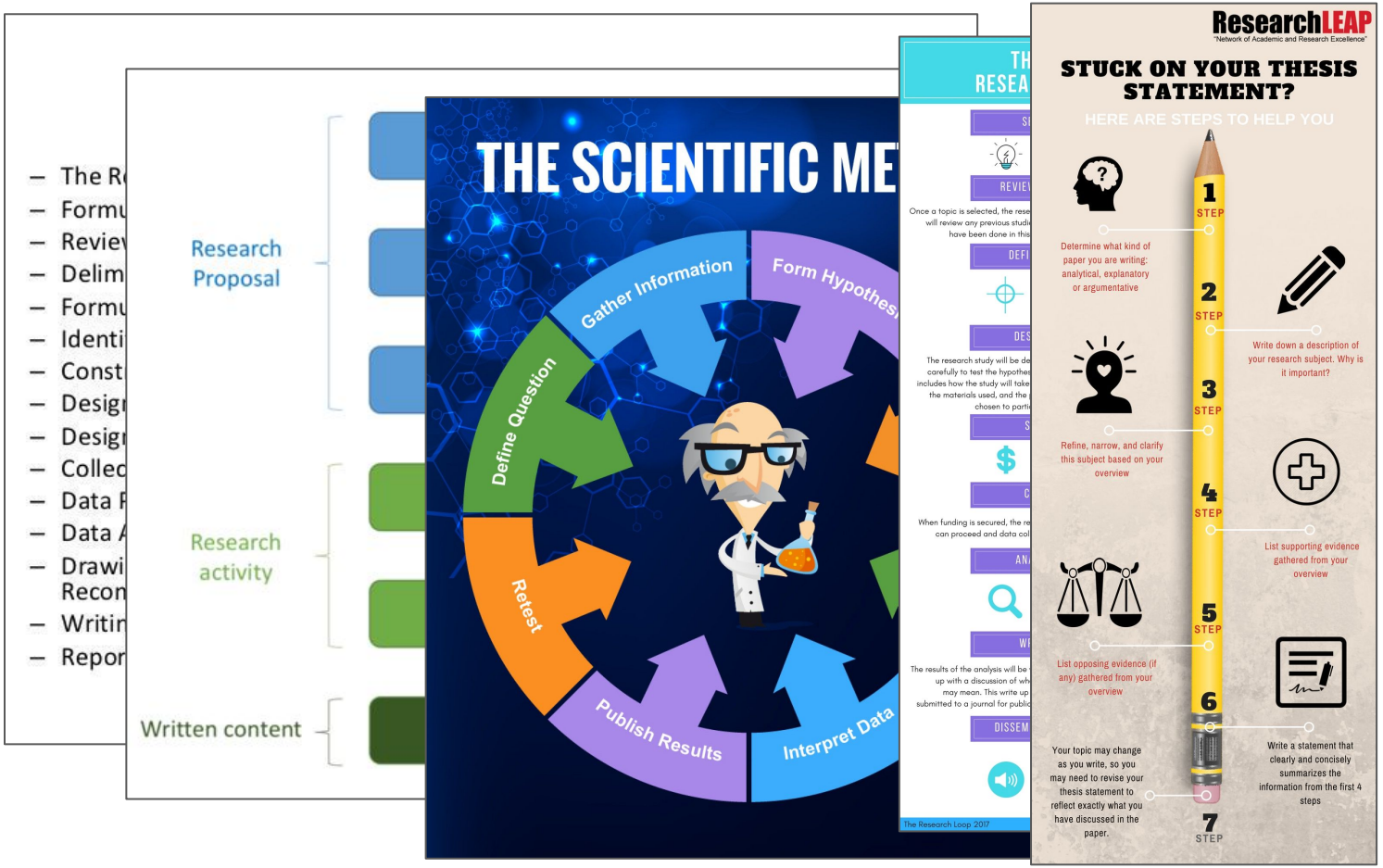
The Traditional Research Process



The Traditional Research Process



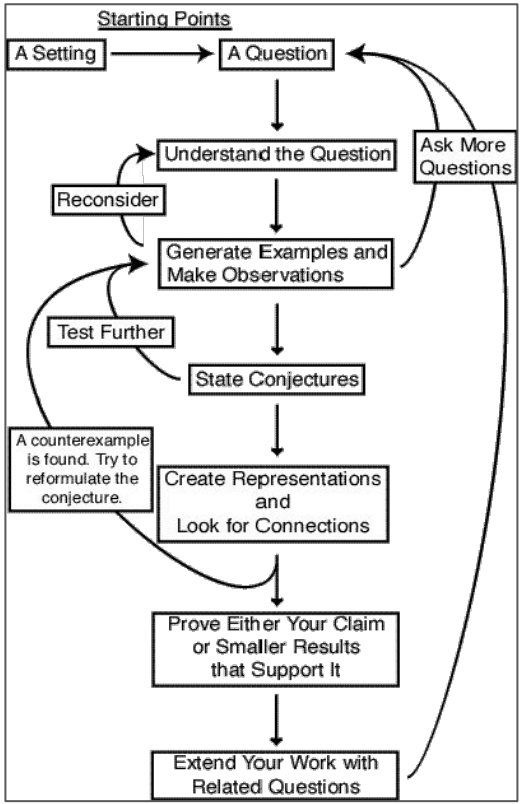
The Traditional Research Process



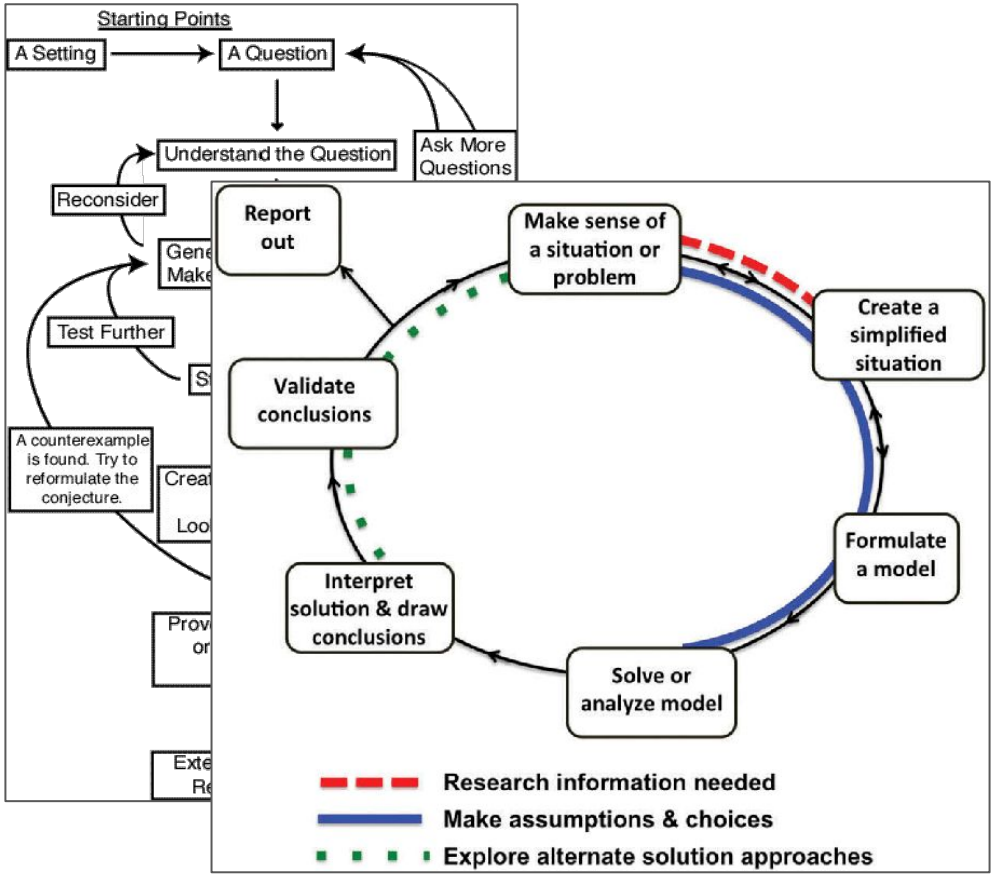
The Mathematical Research Process

as I see it

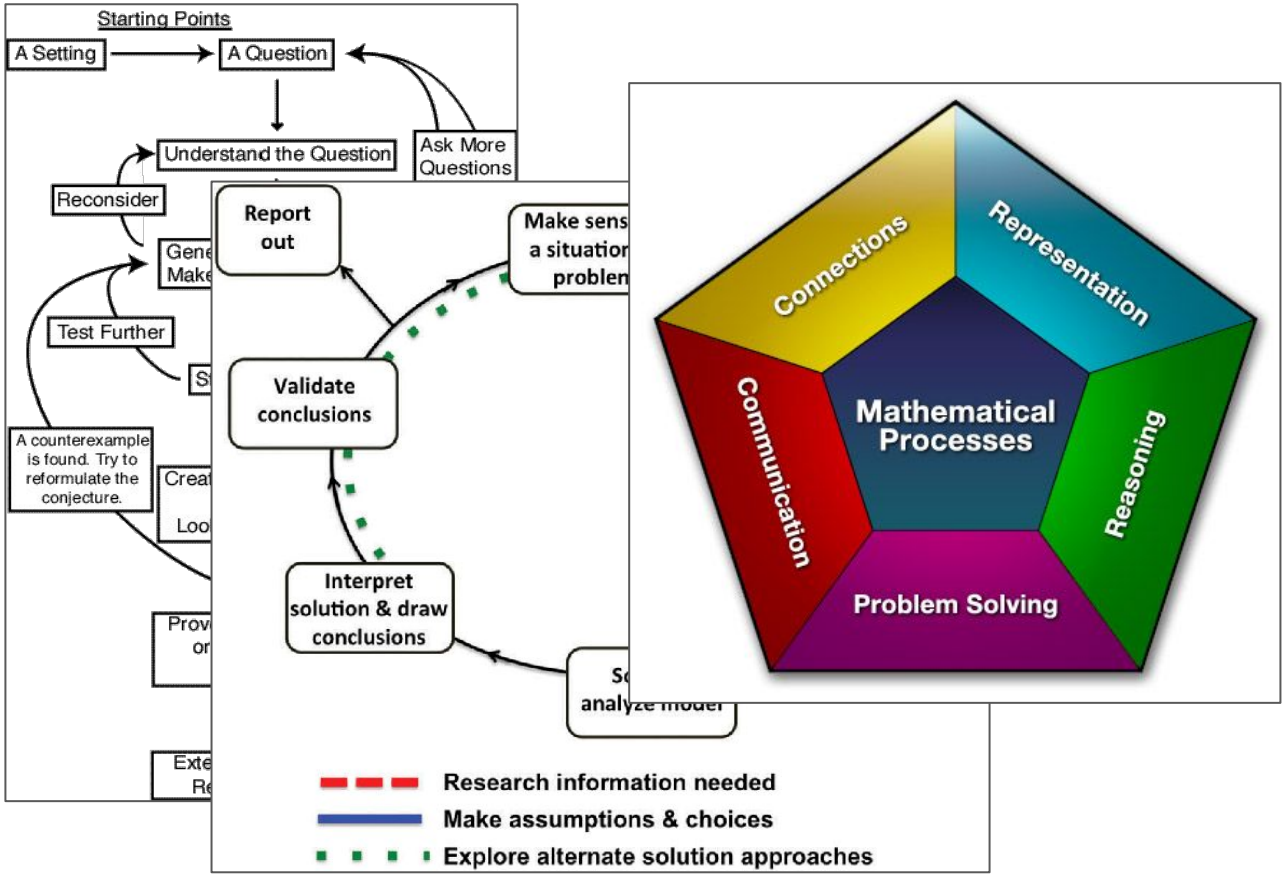
The Mathematical Research Process



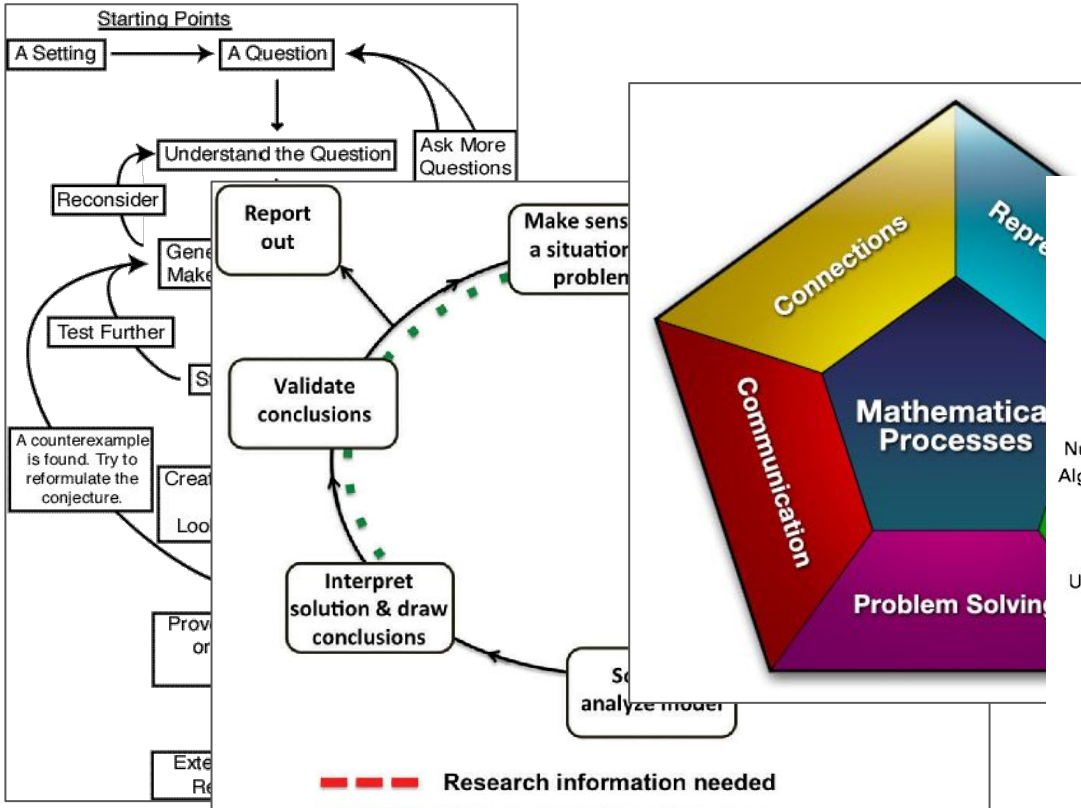
The Mathematical Research Process

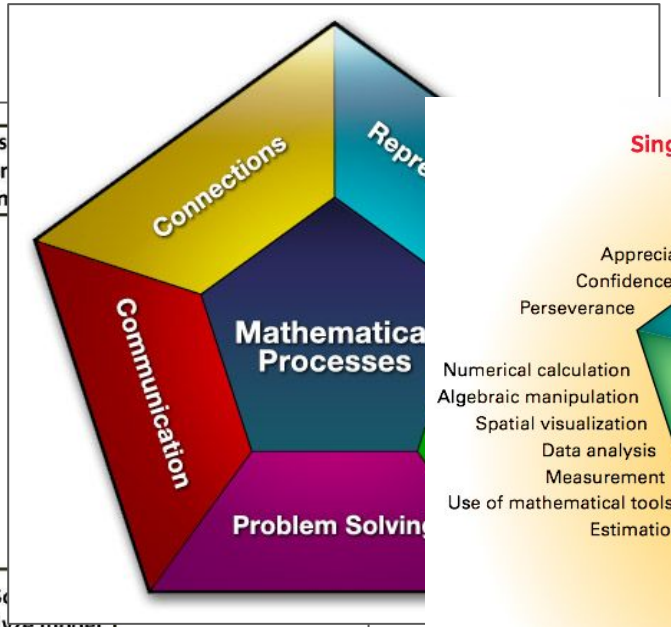


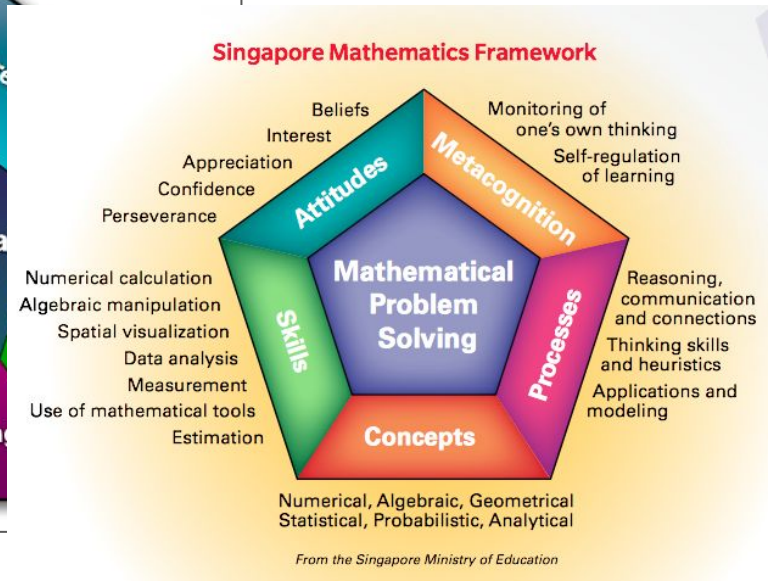
The Mathematical Research Process



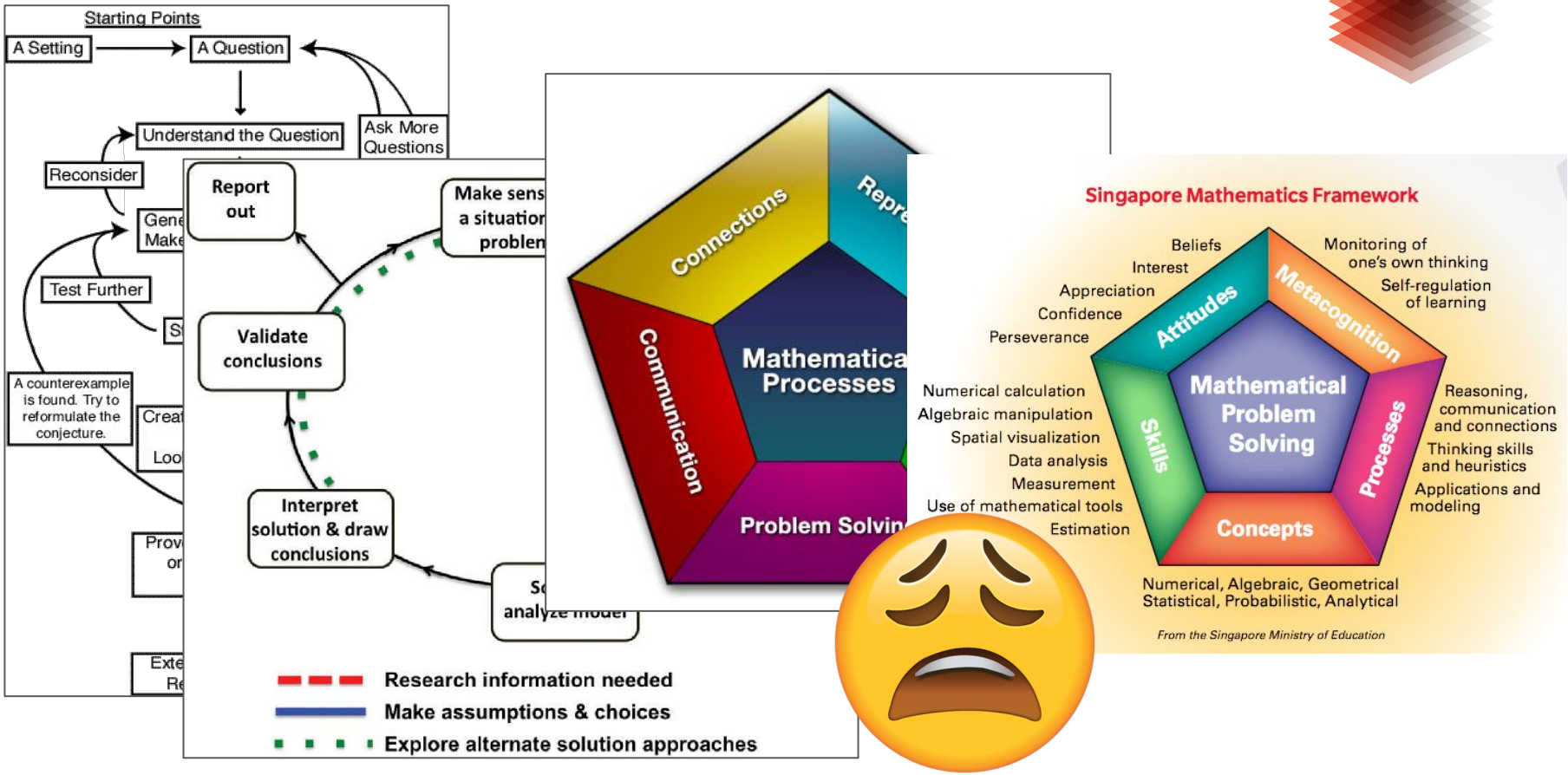
The Mathematical Research Process







The Mathematical Research Process



A Compromise

101 Innovations in Scholarly Communication

Jeroen Bosman @jeroenbosman
Utrecht University Library

The Changing Research Workflow

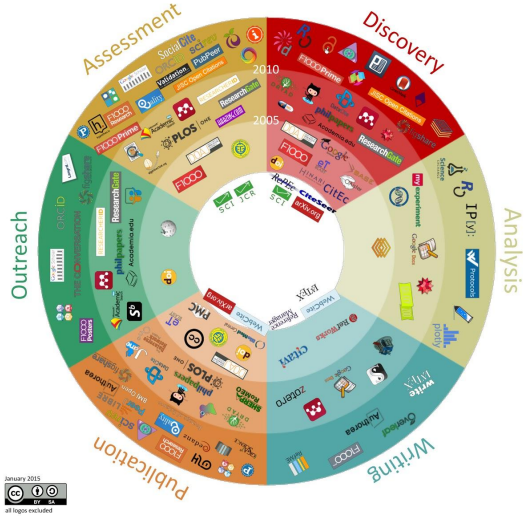
Bianca Kramer @MsPhelps
Utrecht University Library

innoscholcomm.silk.co

Science is in transition. This poster gives an impression of the exploratory phase of a project aiming to chart innovation in scholarly information and communication flows from evolutionary and network perspectives.

We intend to address the questions of what drives innovation and how these innovations change research workflows and may contribute to more **open, efficient** and **good** science.

101 Innovative tools and sites in 6 research workflow phases (< 2000 - 2015)



January 2015
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Most important developments in 6 research workflow phases

	Discovery	Analysis	Writing	Publication	Outreach	Assessment
Trends	social discovery tools	data-driven & crowdsourced science	collaborative online writing	Open Access & data publication	scholarly social media	article-level (alt)metrics
Expectations	growing importance of data discovery	more online analysis tools	more integration with publication & assessment tools	more use of "publish first, judge later"	use of altmetrics for monitoring outreach	more open and post-publication peer review
Uncertainties	support for full-text search and text mining	willingness to share in analysis phase	acceptance of collaborative online writing	effect of journal/publisher status	requirements of funders & institutions	who pays for costly qualitative assessment?
Opportunities	discovery based on aggregated OA full text	open labnotes	semantic tagging while writing/citing	reader-side paper formatting	using repositories for institutional visibility	using author-, publication- and affiliation-IDs
Challenges	real semantic search (concepts & relations)	reproducibility	safety/privacy of online writing	globalization of publishing/access standards	making outreach a two-way discussion	quality of measuring tools
Most important long-term development	multidisciplinary + citation-enhanced databases	collaboration + data-driven	online writing platforms	Open Access	more & better connected researcher profiles	importance of societal relevance + non-publication contributions
Potentially most disruptive development	semantic/concept search + contextual/social recommendations	open science	collaborative writing + integration with publishing	circumventing traditional publishers	public access to research findings, also for agenda setting	moving away from simple quantitative indicators

Typical workflow examples

101 Innovations in Scholarly Communication - the Changing Research Workflow, Boseman and Kramer, 2015, http://figshare.com/articles/101_Innovations_in_Scholarly_Communication_the_Changing_Research_Workflow/1286826

Stages

- search (lit/data/patents/code)
- get access
- get alerts / get (reading) recommendations
- reference management
- read / view
- annotate/tag (during/after reading)

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

Discovery

Analysis

Writing

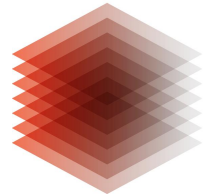
Publication

Outreach

Assessment

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5ddcssk1XBTiLHniD0d3nDqo/edit

Stages



TIB

Discovery

Analysis

Writing

Publication

Outreach

Assessment

- experiment & collect/mine/extract data
- share notebooks / protocols / workflows
- analyse

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

- Discovery
- Analysis
- Writing
- Publication
- Outreach
- Assessment

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

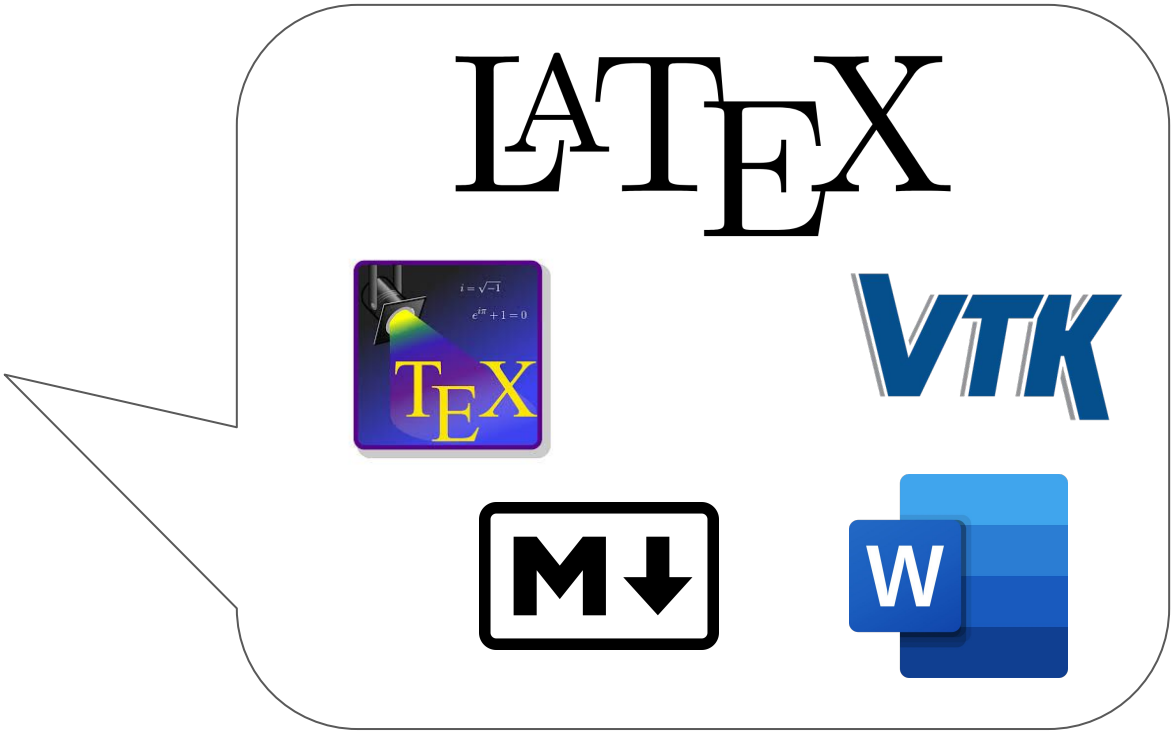
Stages

- visualise
- write & code
- cite
- translate

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

- Discovery
- Analysis
- Writing
- Publication
- Outreach
- Assessment



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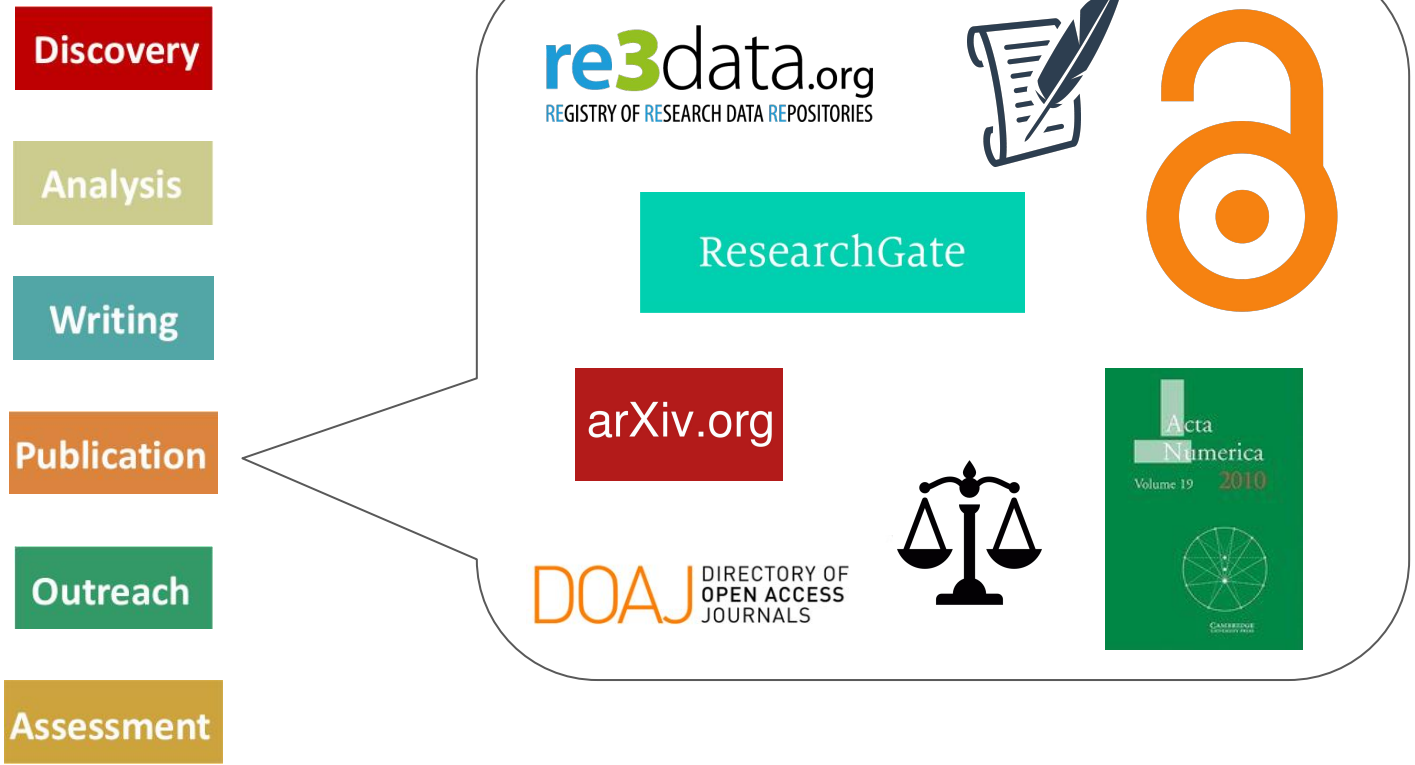
Stages

- archive/share code / data / video / publication / poster / presentation
- present research findings
- peer review and comment/recommend
- select journal to submit to
- publish

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages



https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

- outreach/valorization
- researcher profiling (& social network)

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

Discovery

Analysis

Writing

Publication

Outreach

Assessment

ORCID
Connecting Research and Researchers

ResearchGate

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

- comment
- peer review
- measure impact
- assessment (of researcher/research group)

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

Stages

- Discovery
- Analysis
- Writing
- Publication
- Outreach
- Assessment

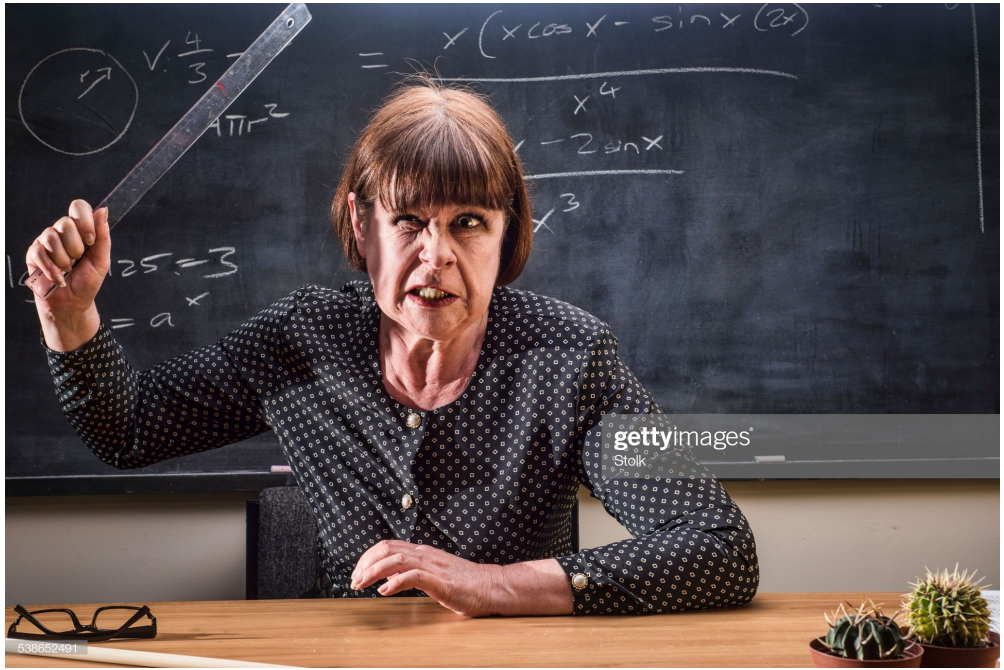
Altmetric

SciVerse Scopus

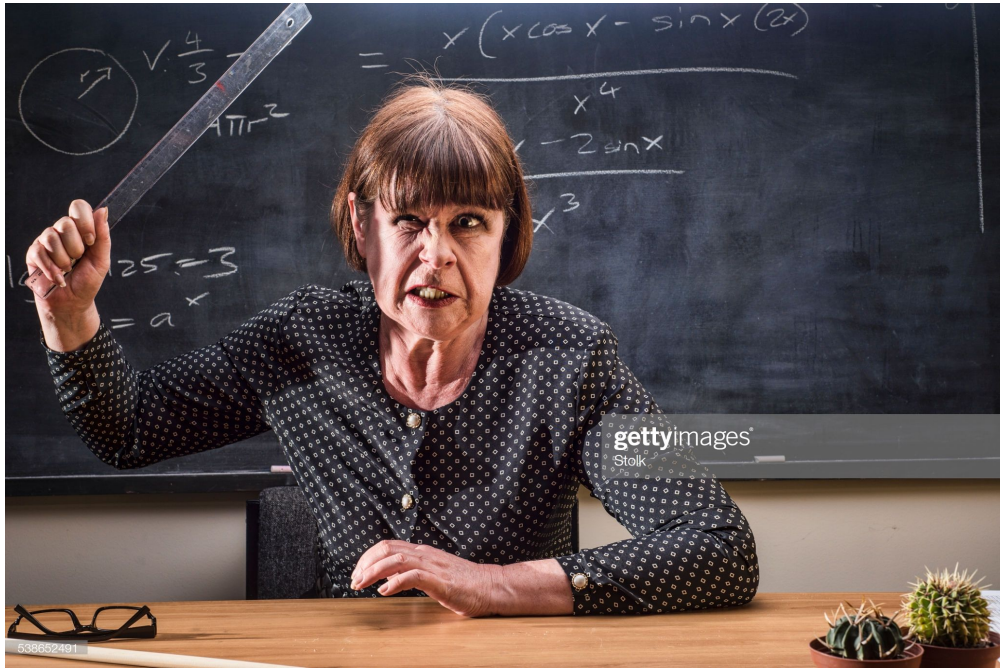
Google scholar METRICS

https://docs.google.com/spreadsheets/d/1KUMSeq_Pzp4KveZ7pb5rddcssk1XBTiLHniD0d3nDqo/edit

A Persona for Maths



A Persona for Maths



Just kidding!

A Persona for Maths

Gabrielle Celeste Brown, 64

High School Mathematics Teacher

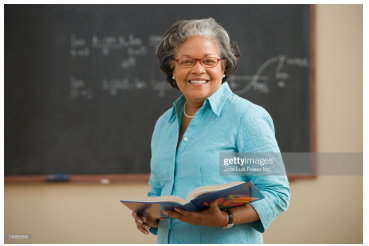
Baltimore, Maryland

Married, two children

Gabriella's Tasks & Tools

Discovery | Analysis | Writing | Publication | Outreach | Assessment

Mental exercise



Another Persona for Maths

Joelle Brooks, 23

Mathematics PhD Student

Ann Arbor, Michigan

Joelle's Tasks & Tools

Discovery | Analysis | Writing | Publication | Outreach | Assessment

Mental exercise

Our Last Persona for Maths

Hideyoshi Yamamoto, 57

Mathematics University Professor

Seattle, Washington

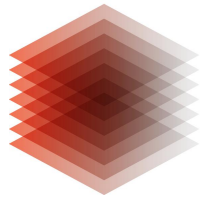
Married, one child

Hideyoshi's Tasks & Tools

Discovery | Analysis | Writing | Publication | Outreach | Assessment

Mental exercise

Handle with care



- The concrete tools change about every two years.
- It is a lifelong learning process which has to integrate slower or old-fashioned learners.
- Services and tools are mostly peer-driven, so we believe in a user-centered approach to develop them. But usability and user experience in maths is “Neuland” as Angela Merkel would say.

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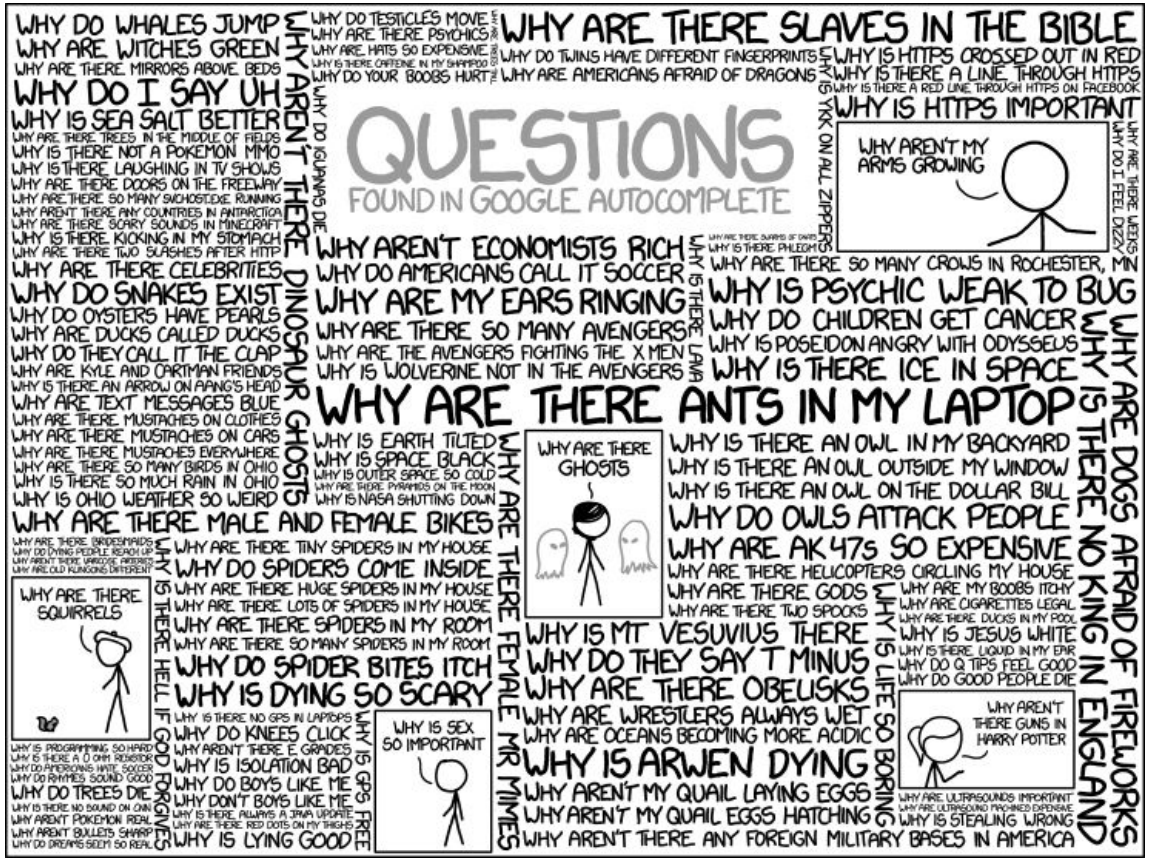
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