The Pros & Cons of Interdisciplinary Research

Stephen Gilbert, Ph.D.

Human Computer Interaction
Industrial & Manufacturing Systems Engineering
Psychology

April 4, 2014
If your research question is:

“Why are most U.S. elementary teachers female?”

Which data are more useful?

24 personal journals from teachers

statistics on teacher hiring

Strober, 2011
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Differences in research methods
Resilient Interdependent Infrastructure Processes and Systems

...principal investigators should represent three or more distinct disciplinary areas as described in this solicitation (computer science; engineering; social, economic, and behavioral sciences).
Resilient Interdependent Infrastructure Processes and Systems

Differences in knowledge and skills

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“Unfortunately, much of the published literature on KF is in the engineering journals…and uses a language, notation, and style that is alien to statisticians.”

Meinhold & Singpurwalla (1983)
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What is Interdisciplinary Research (IDR)?

Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.

NAS, 2004
300s BC: Aristotle

- Theoretical: theology, mathematics, physics
- Practical: ethics, politics
- Productive: fine arts, poetics, engineering

Strober, 2011
300s BC: Aristotle

Philosophy

Theoretical
theology, mathematics, physics

Practical
ethics, politics

Productive
fine arts, poetics, engineering

Strober, 2011
300s BC – Aristotle

Middle Ages

*Trivium*

grammar, rhetoric, dialectic

*Quadrivium*

arithmetic, astronomy, geometry, music

Learn it all. No disciplinary specialization.
300s BC – Aristotle

Middle Ages

1500s-1600s – Scientific Revolution

New idea

You could gain new knowledge by limiting the questions you focus on.
300s BC – Aristotle
Middle Ages
1500s-1600s – Scientific Revolution
1700s – Enlightenment

**New idea**

Humans can answer complex problems with their own reasoning.

So, let’s organize knowledge systematically into categories.

Prototype of research university arises in Germany.
300s BC – Aristotle
Middle Ages
1500s-1600s – Scientific Revolution
1700s – Enlightenment
1880s-1890s

25 disciplinary associations formed in U.S.

U.S. universities restructure into disciplines, distinguish undergraduate and graduate.

Journals become arbiter of quality.
300s BC – Aristotle
Middle Ages
1500s-1600s – Scientific Revolution
1700s – Enlightenment
1880s-1890s
1940s-1950s – Manhattan Project
300s BC – Aristotle
Middle Ages
1500s-1600s – Scientific Revolution
1700s – Enlightenment
1880s-1890s
1940s-1950s – Manhattan Project
1970s-2000 – IDR growth

U.S. Interdisciplinary degree programs grew from 674 - 1,633 (250% increase).
Enrollment grew only 18%.

Increased IDR funding, associations, journals.
Fundamental Challenges of Society

Education
Health
Cooperation and Conflict
Societal Resilience and Response to Threats
Creativity and Innovation
Energy, Environment and Human Dynamics

NSTC, 2009
What makes IDR hard?
What makes IDR hard?

Learning each other’s disciplines.

Four founders of Stanford’s Bio X met weekly for two years before beginning collaborative projects.
What makes IDR hard?

Learning each other’s disciplines.

Coordinating with each other.
What makes IDR hard?

- Learning each other’s disciplines.
- Coordinating with each other.
- Dividing up the money.

<table>
<thead>
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<th>Grant Amount</th>
<th>Duration</th>
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<th>Estimated Salary</th>
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<td>$2,400,000</td>
<td>3 yrs</td>
<td>2 Partner</td>
<td>~$83,000/yr</td>
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Coordinating with each other.

Dividing up the money.

Difficulty publishing.
What makes IDR hard?

Learning each other’s disciplines.

Coordinating with each other.

Dividing up the money.

Difficulty publishing.

More complex tenure case.
What makes IDR hard?

Learning each other’s disciplines.

Coordinating with each other.

Dividing up the money.

Difficulty publishing.

More complex tenure case.

Talking with IDR colleagues.

*Strober’s *Interdisciplinary Conversations*, 2011
Sociolinguistic rules within communities

Hymes, 1972

Is interrupting ok?

How do you arrange speaking turns?

What do you say outright vs. subtly?

How do you question people?

Do you present with slides? Notes?
Useful Traits of an IDR Researcher

Lyall et al., 2011

flexibility, adaptivity, creativity

curiosity about other disciplines

good communication & listening skills

willingness to tolerate ambiguity

ability to bridge theory & practice

good team-worker

willingness to admit limitations of your disciplinary knowledge
Strategic Plan

Goal:

Foster a university culture and work environment that … inspires individuals to work together to achieve at the highest level of their abilities.
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Cluster Hires!

12 faculty in Big Data
8 faculty in Translational Health
IOWA STATE UNIVERSITY

18 Interdisciplinary Graduate Programs


Interdisciplinary Graduate Studies
IOWA STATE UNIVERSITY

Presidential Initiative for Interdisciplinary Research

biomedical science + veterinary microbiology + animal medicine
seed science + animal science
chemistry + medicine + engineers + economists
applied linguistics + machine learning + education
IOWA STATE UNIVERSITY

SciEthics Interactive

Larysa Nadolny
School of Education

Eliot Winer
Mechanical Engineering

Stephen Gilbert
Industrial & Manufacturing Systems Engineering

Matthew Pierlott
Philosophy
West Chester University

Seth Kahn
English
West Chester University

Brian J Arnold
Information & Media Systems
National University

Jodi Reeves
Applied Engineering
National University
Song Zhang
Mechanical Engineering

Scott Chumbley
Materials Science & Engineering

Manipulative virtual tools for tool mark characterization
Elena Cotos
Graduate College

Carol Chapelle
Applied Linguistics

Stephen Gilbert
Industrial & Manufacturing Systems Engineering

Jivko Sinapov (postdoc)
Computer Science & HCI

Evgeny Chukharev-Khudilaynen
Applied Linguistics

Eliot Winer
Mechanical Engineering
The transfer of testing effects in online test format in the general chemistry settings
IOWA STATE UNIVERSITY

Sarah Nusser
Statistics

Les Miller
Computer Science

Project Battuta:
Bring emerging technologies to mobile field data collection.

Mike Goodchild
Geography
UCSB

Keith Clarke
Geography
UCSB

NSF
IOWA STATE UNIVERSITY

10+ REU Sites
Research Experience for Undergraduates
Centers - just a few

Center for eDesign
Center for Biorenewable Chemicals (CBiRC)
Virtual Reality Applications Center (VRAC)
Pappajohn Center for Entrepreneurship
Leopold Center for Sustainable Agriculture
Center for Transportation Research and Education (CTRE)
Center for Food Security and Public Health (CFSPH)
IOWA STATE UNIVERSITY

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What IDR will you do?
References


Thank you

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