

# **Statistical Literacy Textbook Design**

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**Milo Schield**

ASA Fellow

Visiting Professor: New College of Florida

*Statistical Literacy:  
Critical Thinking about Everyday Statistics  
Kendall-Hunt 2023*

*[www.StatLit.org/pdf/  
2023-Schild-Textbook-Design-Slides.pdf](http://www.StatLit.org/pdf/2023-Schild-Textbook-Design-Slides.pdf)*

# What is Statistical Literacy?

## Usage vs User

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The ability to understand and critically evaluate statistical results that permeate our *daily lives*. Wallman (1993)

Basic skills for critically interpreting the sorts of statistics we encounter in *everyday life*. Best (2004 MDLS).

To make [*everyday*] *decisions* based on logic and quantitative information. Moreno (2002)

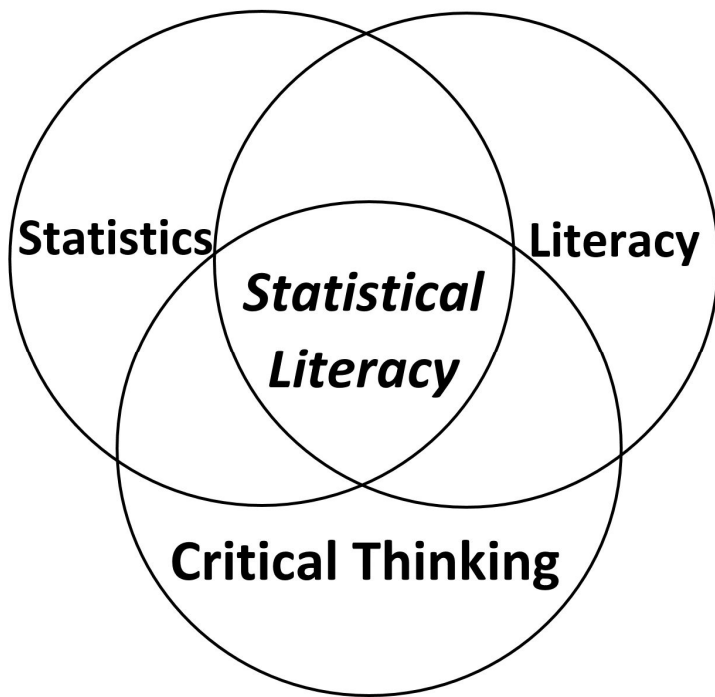
What *every educated person* should know. Moore (1998)

A key ability expected of *citizens* in information-laden societies. I. Gal (2002)

# Statistical Literacy: What is it?

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Critical thinking about *everyday statistics* Schield (2023)  
(how statistics are constructed and manipulated)



Statistical literacy is closer to:

- \* words than to numbers
- \* critical thinking than to math
- \* induction than to deduction

Statistics: *Not data summaries*

Statistics: *Not sample summaries*

# **Statistical Literacy: Different by Design**

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*Statistical Literacy is different!*

Less than a 30% overlap with traditional statistics

Three big differences:

1. Different *audience*
2. Different *statistics*
3. Different *inference*

# Statistical Literacy is Different:

## 1. Different Audience

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Traditional statistics is designed for RESEARCHERS  
(*students in quantitative majors: math, business, etc.*)

Statistical Literacy is designed for CITIZENS (*students in non-quantitative majors: history, law, English, etc.*)

Good for students in *quantitative observational majors*:

- non-STEM quantitative majors: sociology & social work, business & economics, pre-med & nursing, social psychology
- STEM majors: statistics, epidemiology & public health, geoscience & meteorology, ecology & evolutionary biology, neuro & cognitive science, astronomy & astrophysics.

# **Statistical Literacy is Different:**

## **2. Different Subject**

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Traditional statistics studies MATHEMATICAL STATISTICS:  
quantitative summaries from samples (random).

Statistical Literacy studies EVERYDAY STATISTICS:  
Numbers in context (descriptive or non-random)

Statistical educators may say:

‘statistics in everyday media’ or ‘statistics for all’

They may mean ‘mathematical statistics.’

Their audience may hear ‘everyday statistics.’

One sign of the difference is the absence (math stats)  
or presence (statistical literacy) of confounding.

# **Statistical Literacy is Different:**

## **3. Different Inference**

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Traditional statistics studies DEDUCTION: statistical or population inference, sufficient. 95% of 95% confidence intervals will include the population parameter.

Statistical Literacy focuses more on INDUCTION: causal inference, not necessary or sufficient. Smoking *causes* cancer.

Math is deductive: there is no operator for causation.

Mathematical induction is really deduction.

Everyday statistics are often used as evidence of causation, so StatLit focuses more on induction.

See Schield (1999)

# **Students need Guidance: Rules and Formula**

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Guidance (no Algebra)

1. Rules: times as much vs. times more than.
2. Formula: standardizing a comparison of ratios
3. Rules: percent and percentage grammar
4. Rules: reading percentage tables
5. Rules: comparing percentages with likely grammar

By proving a single-sheet review page, memorization is not required. Key ideas in chapters 1 and 2 are on the inside covers. Elaborate glossary and index.

# **Focus on what students find important and difficult**

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## Practice

1. Students see ‘Take CARE’, Association-Causation and ‘Statistics are numbers in context’ as the MOST IMPORTANT ideas. Connect everything to these.
2. Student find these topics (standardizing, part-whole distinction, percent-percentage grammar and reading tables) to be the MOST DIFFICULT items.
3. Find examples of each of the above from the everyday media. Fresh examples are best.

# **Align course topics with prevalence in everyday media**

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*Quasi-experiments and observational studies are most common, most provocative and most easily influenced.*

Quasi-experiments are experiments that aren't ideal and don't involve random assignment. Quasi-experiments are common in business, education, politics and epidemiology

Observational studies are studies that involve just seeing.

*“a clear understanding ... of statistical issues in observational data is needed for statistical practice in the real world.”* Stroup et al. (2004).

# **Q1. Is Statistical Literacy College-Level Math?**

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Q/L is “sophisticated reasoning with elementary mathematics rather than elementary reasoning with sophisticated mathematics”. Steen (2004)

Statistical Literacy deals with multivariable reasoning: ‘taking into account’. Students work problems controlling for confounder influence when predictor and confounder are binary. No other statistics course does this today.

## Q2. Isn't Algebraic notation necessary?

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Using ordinary English is more common (and more difficult) than using Algebraic notation.

SpaceX improved landing accuracy by 1000X.

‘1,000 times *smaller*’ is ‘one 1,000<sup>th</sup> of’

“The percentage of men *who* run” is different from “the percentage of men *among* runners.”

Kia is the car *most frequently* stolen;

Cadillac is the car *most likely* to be stolen.

## **Q3. Is Statistical Significance included?**

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A. Yes, but taught without using p-values.

If 95% confidence intervals (two sample means) don't touch, difference is statistically significant.  
[Sufficient but not necessary.]

Confidence interval:

sample mean  $\pm$  Margin of Error

Margin of Error: often given at bottom of survey.

## **Q4. Is Statistical Literacy really Philosophy of Science?**

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A. Yes! But the focus is on observational science and observational causation.

Observational studies are quicker and cheaper. Results are ‘journalistically significant’.

Students need a bridging course to prepare them for advanced inductive reasoning. Statistical Literacy provides that course.

# Restating the Goal of Statistical Literacy

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Statistical Literacy may be viewed as  
'quantitative rhetoric.' Schmit (2010)

The goal is to help students '*argue with* statistics:'

How to:

- *analyze* arguments *that use* statistics (critical thinking)
- *make* arguments *using* statistics (creative thinking)

# **Review the Supporting Material**

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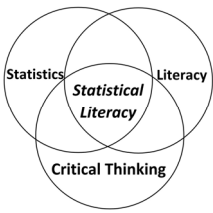
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