

The *Better Book* Approach to Closing Equity Gaps in STEM

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Three main points:

1. Goal
2. Theory
3. Approach

We study how to help people learn things that are hard to learn.



*Thanks to
our funders:*

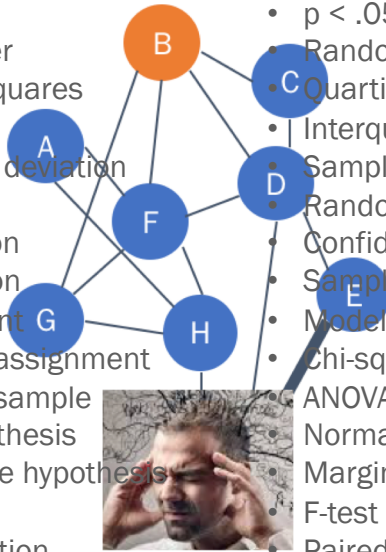


Theory

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The practicing connections **hypothesis**: teach connections that make knowledge flexible and coherent.

A common approach is to teach the “basics” – the bits – and then hope for transfer. Our approach is to practice transfer from the beginning.

- Statistic
 - Parameter
 - Sum of squares
 - Variance
 - Standard deviation
 - T-test
 - Correlation
 - Regression
 - Experiment
 - Random assignment
 - Random sample
 - Null hypothesis
 - Alternative hypothesis
 - Z-score
 - Z distribution
- 
- $p < .05$
 - Random variable
 - Quartiles
 - Interquartile range
 - Sampling distribution
 - Randomization test
 - Confidence interval
 - Sampling variation
 - Model
 - Chi-square
 - ANOVA
 - Normal distribution
 - Margin of error
 - F-test
 - Paired t-test

Deliberate practice of connections among core concepts, representations, and the world.

Theory

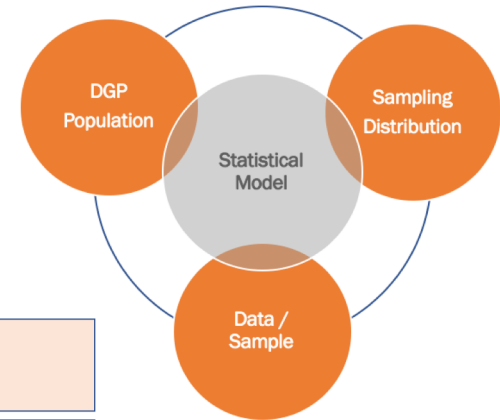
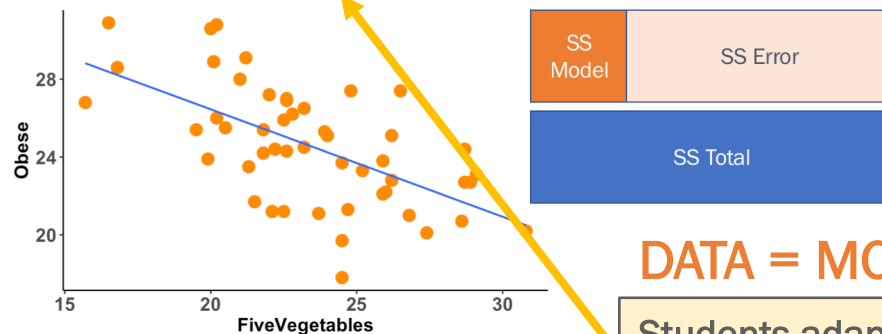
Repeated practice representing, coordinating, and adapting a small number of core concepts to a new situation

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```
SDb1 <- do(10000) * b1(Obese ~ shuffle(FiveVegetables), data = USStates)
```

	SS	df	MS	F	PRE	p
Model (error reduced)	166.31	1	166.3092	27.734	0.3662	.0000
Error (from model)	287.84	48	5.9966			
Total (empty model)	454.14	49	9.2683			

$$Y_i = b_0 + b_1 X_i + e_i$$

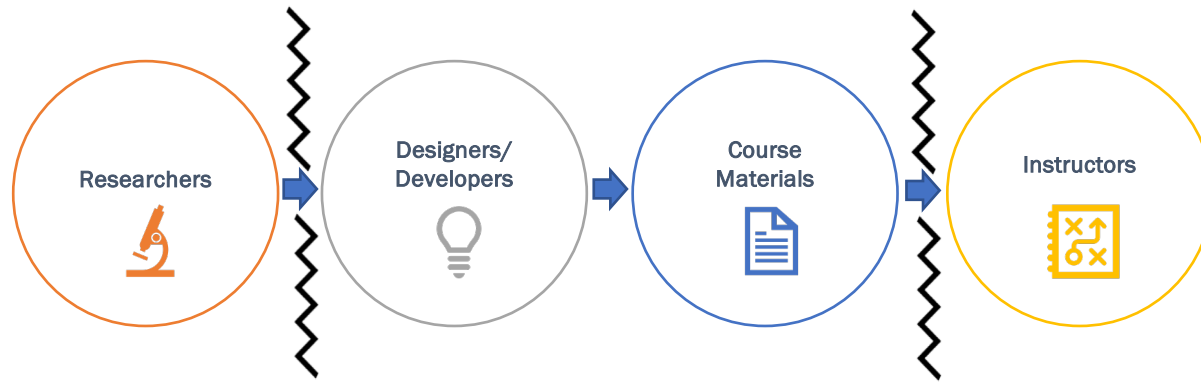


DATA = MODEL + ERROR

Students adapted interpretation of b_1 to new context.

Approach

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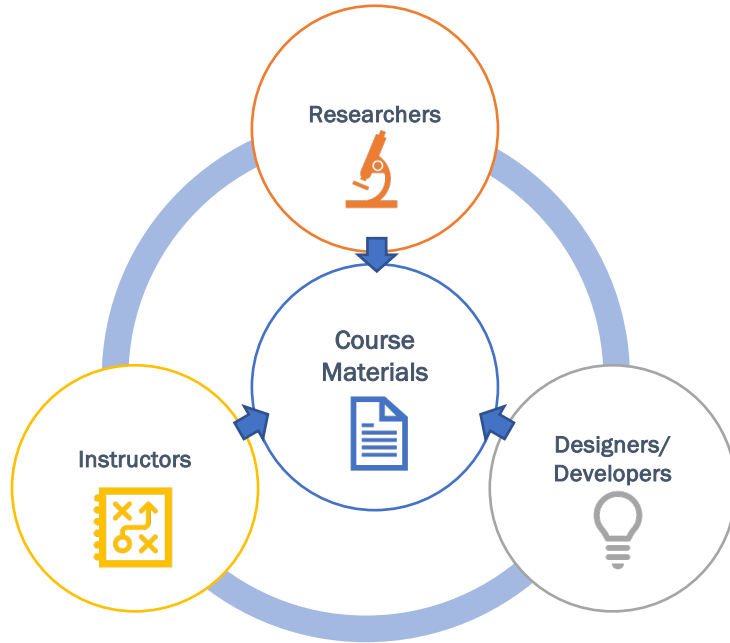


Currently:
Silos, with
most variation
in student
outcomes left
unexplained.

How do we close the research / practice gap?

Approach

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Build R&D communities around development and continuous improvement of high-impact college-level courses

- Ongoing collaboration among researchers, designers/developers, instructors
- Focus on improving online course materials
- *Increase learning, decrease variation*
- Guided by theory

Approach

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Start with fully instrumented interactive textbook

```
(resid(TinyEmpty_model))

## 1 2 3 4 5 6
## -4 -2 -1 1 2 6
```

Notice that we get the same numbers. But instead of specifying the data and the model's predictions, we just tell R which model to get the residuals from.

Modify the following code to save the residuals that we get using the `resid()` function in the `TinyFingers` data frame. Give the resulting variable a new name: `easyResidual`.

```
script.R R Console
1 # modify this to save the residuals (calculated the easy way)
2   TinyFingers$easyResidual <-
3
4 # this print TinyFingers
5   TinyFingers
```

Hint Run

Powered by DataCamp

Pages interleave components (narrative, video, R exercises, questions)

1200+ formative assessments

Examine the distributions above.

What does the distribution of **Thumb** (data) look like?

What about the distribution of **Prediction** (model)?

Finally, what about the distribution of **Residual** (error)?

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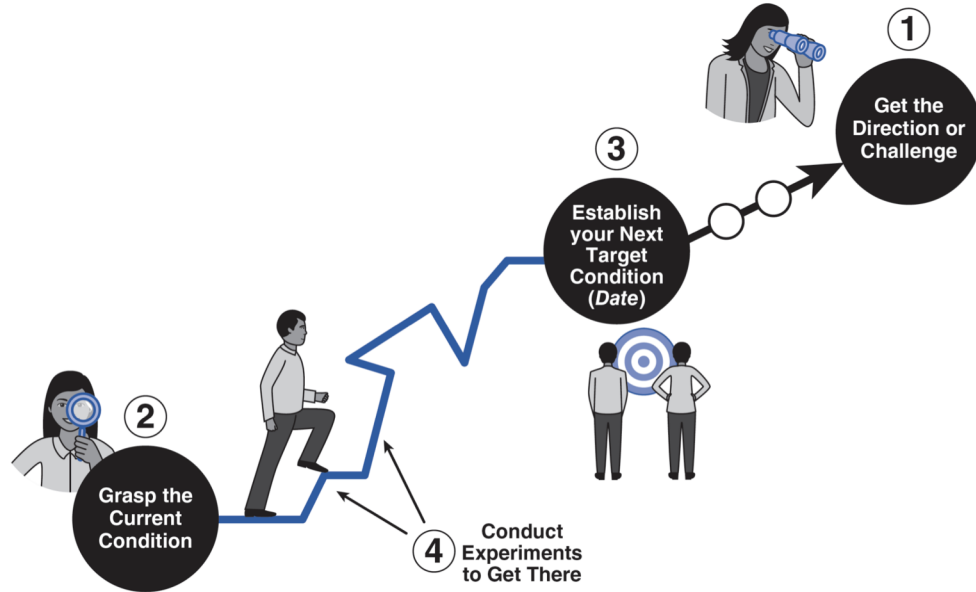
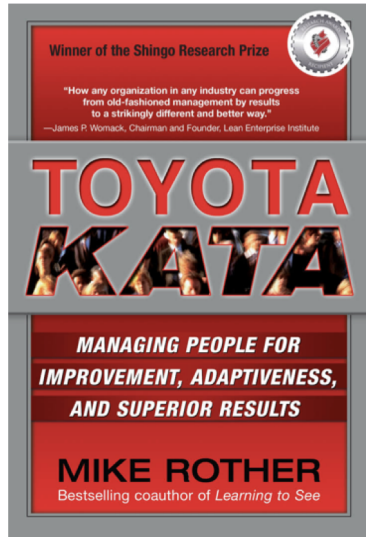
What is different about the distributions of data and error? What is similar?

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Approach

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Apply methodologies for continuous improvement