POGIL-STYLE ACTIVITIES IN INTRODUCTORY STATISTICS

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INTRODUCTION
FOUR NEW LEARNING ACTIVITIES

- Applies recommendations from the original GAISE College Report and GAISE 2016
  - Teach statistical thinking
    - Teach statistics as an investigative process of problem solving and decision making
    - Give students experience with multivariable thinking
  - Focus on conceptual understanding
  - Integrate real data with a context and purpose
  - Foster active learning
  - Use technology to explore concepts and analyze data
  - Use assessments to improve and evaluate student learning

INSPIRED BY RESEARCH

- POGIL – Process Oriented Guided Inquiry Learning
- Statistical Education Research shows students struggle with terms and concepts
  - "random" and "confidence" (Kaplan, Fisher and Rogness, 2009)
  - Understanding histograms (Kaplan, Gabrosek, Curtis, and Malone, 2014)
  - Sampling distributions (Chance, DelMas, and Garfield, 2004)

THE SETUP - FINGERPRINTING

- Each person has a unique fingerprint.
- If we look at the fingerprint of the thumb, there are three common characteristics: loops (lines that bend back on themselves), whorls (such as circles or ellipses) and arches (wave like patterns).
- In the United States, 60% of the population has loops, 35% whorls, and 5% arches.
- In the bin of beads, each bead represents an individual with a certain type of pattern on their thumb: White for loops, Yellow for whorls, and Black for arches.

ACTIVITY ONE

Investigation Questions

- *If you were to take a random sample of American adults, would the sample proportion of individuals with whorls change from sample to sample; if so by how much?*
- *What are typical values of the sample proportion?*

ACTIVITY TWO

Investigative Question

- *What are the center, shape, variability, and outliers of the distribution of loops, whorls, and arches for different sample sizes?*

ACTIVITY THREE

Investigative Questions

- *What is the sampling distribution of the sample proportion of fingerprints with loops for n = 40 and n = 100?*
- *How do the mean, standard deviation, and shape for sampling distributions change as sample size is increased?*
- *What is the difference between the population distribution, sample distribution, and sampling distribution?*

ACTIVITY FOUR

Investigative Questions

- *What is a reasonable estimate for the population parameter?*
- *Why is a confidence interval a better estimate than a sample statistic for the population parameter?*
- *Will a confidence interval always contain the true population parameter?*
- *What are margin of error and standard error?*

NOW, ITS YOUR TURN.

EARLY RESULTS

WHAT DID WE LEARN ABOUT THE STUDENTS?

COMPARISON OF LEARNING GAINS

PRE ASSESSMENT

	Percent (n = 41)
Center	29.2%
Min	43.9%
Max	21.9%
Range	41.4%
Outliers	39.0%

POST ASSESSMENT

	Percent (n = 43)
Center	37.2%
Min	81.3%
Max	79.0%
Range	65.1%
Outliers	53.4%

COMPARISON OF LEARNING GAINS FOCUSING ON SHAPE

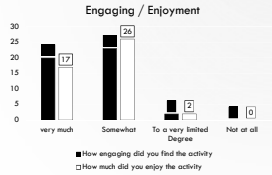
PRE ASSESSMENT

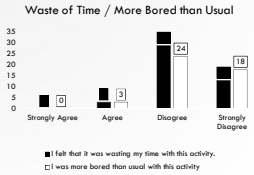
	Percent (n = 41)
Bell Shaped only	9.7%
Symmetric only	2.4%
Both	0%

POST ASSESSMENT

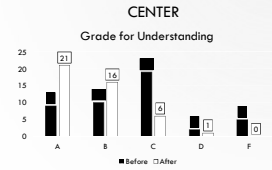
	Percent (n = 43)
Right Skewed only	6.9%
Unimodal only	18.6%
Both	16.2%

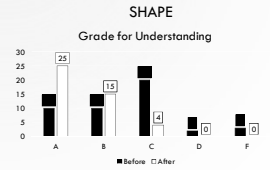
STUDENT BELIEFS ABOUT ACTIVITY TWO





STUDENT SELF ASSESSMENT OF MATERIAL BEFORE AND AFTER THE ACTIVITY





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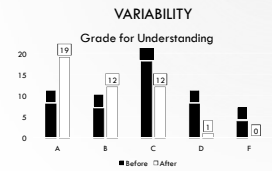
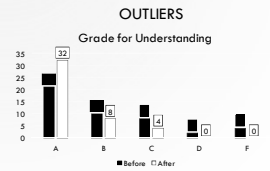
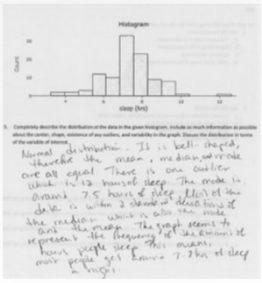
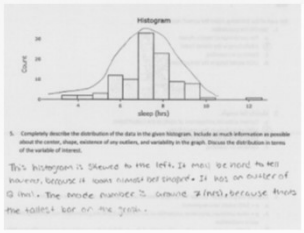




UNIT EXAM EXEMPLARS #1



UNIT EXAM EXEMPLARS #2



REFERENCES

- Aliaga, M., Cobb, G., Cuff, C., Garfield, J., Gould, R., Lock, R., … Witmer, J. (2005), *Guidelines for assessment and instruction in statistics education: College report*. Washington, DC: American Statistical Association. Available at: *http://www.amstat.org/asa/education/Guidelines-for-Assessment-and-Instruction-in-Statistics-Education-Reports.aspx*
- Bonwell, C. C., & Eison, J. A. (1991), Active learning: Creating excitement in the classroom [Monograph]. Retrieved from *http://eric.ed.gov/*
- Carver, R., Everson, M., Gabrosek, J., Horton, N., Lock, R., Mocko, M., … Wood, B. (2016). *Guidelines for assessment and instruction in statistics education: College report 2016*. Washington, DC: American Statistical Association. Available at: *http://www.amstat.org/asa/education/Guidelines-for-Assessment-and-Instruction-in-Statistics-Education-Reports.aspx*
- Chance, B., DelMas, R., & Garfield, J. (2004). Reasoning about sampling distributions. In: D. Ben-Zvi & J. Garfield (Eds.), *The challenge of developing statistical literacy, reasoning, and thinking* (pp. 295-323). Dordecht, Holland: Springer.

REFERENCES (CONT'D)

- Kaplan, J., Fisher, D., & Rogness, N. (2009). Lexical ambiguity in statistics: What do students know about the words association, average, confidence, random and spread? *Journal of Statistics Education, 17*(3). Available at: http://ww2.amstat.org/publications/jse/v17n3/kaplan.html
- Kaplan, J.J. , Rogness, N., & Fisher, D. (2014). Exploiting lexical ambiguity to help students understand the meaning of random. *Statistics Education Research Journal, 13(1),* 9-24. Available at: http://iase-web.org/documents/SERJ/SERJ13%281%29_Kaplan.pdf
- Kaplan, J., Gabrosek, J., Curtiss, P., & Malone, C. (2014). Investigating student understanding of histograms. *Journal of Statistics Education, 22*(2). Available at: http://ww2.amstat.org/publications/jse/v22n2/kaplan.pdf

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