



**Creating a Learning Progression
to Support Secondary
Mathematics Teachers to Develop
a Critical Statistical Literacy**

Travis Weiland
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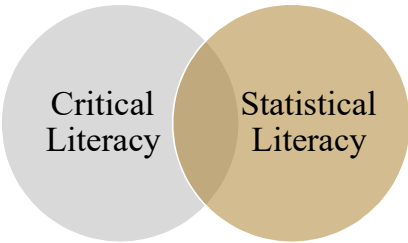



Positioning

- Education is political, with multiple competing goals, public and private. (Labaree, 1997)
- Situated in goal of democratic equality, preparing students to be active critical citizens in society.
- Many different views of what makes a “good” citizen (Westheimer & Kahne, 2004)
- Critical citizens should participate actively in their community/government, but should also interrogate the structures at play within their community/government.

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Critical Statistical Literacy



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Critical Literacy

- Reading and writing the word and the world (Freire & Macedo, 1987; Gutstein, 2006)
- Reading
 - Making sense of symbol systems
 - Identifying and interrogating social structures in the world
- Writing
 - Creating and communicating one’s own meaning through symbol systems
 - Actively influencing and shaping structures in society

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Statistical Literacy


- Reading (Gal, 2002)
 - Making sense of and critiquing statistical information and data based arguments
 - Evaluating the source, collection and reporting of statistical information
- Writing (Franklin et al., 2007; Wild & Pfannkuch, 1999)
 - Formulating statistical questions
 - Collecting or finding relevant data
 - Analyzing data using appropriate graphical and numerical methods
 - Interpreting the analysis addressing the statistical question(s) being investigated

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Reading Intersection

Identifying and interrogating social structures which shape and are reinforced by the data based arguments.


Examples: gap gazing, gender as a binary, race/ethnic categories.

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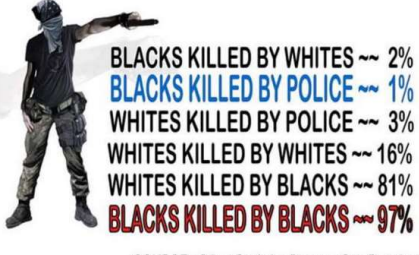
Writing Intersection


Using statistical investigations to communicate statistical information and arguments in an effort to destabilize and reshape structures of injustice.

Examples: showing unjust voter redistricting, destabilizing notions around health care in non-western nations.

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USA CRIME STATISTICS ~ 2015



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Research Questions

- How can we foster a critical statistical literacy in school mathematics teachers?
- How do we prepare school mathematics teachers to create learning environments for their students that foster a critical statistical literacy?

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What is a Learning Progression?

- Learning progression research “aims for a systematic, detailed description of the likely progression of children’s reasoning about big ideas of mathematics over long periods of time” (Confrey, Maloney, & Nguyen, 2014, p.xvi)
- This involves the starting point where students are coming in from, a progression of concepts through tasks and design of learning environments to move from naive to more refined understandings, and the end point or refined understandings you are aiming towards.

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Epistemology

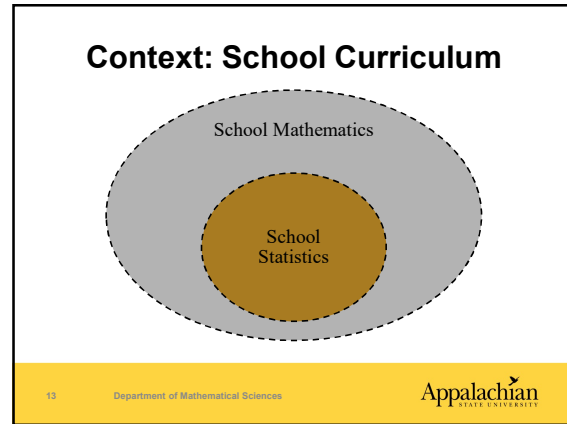
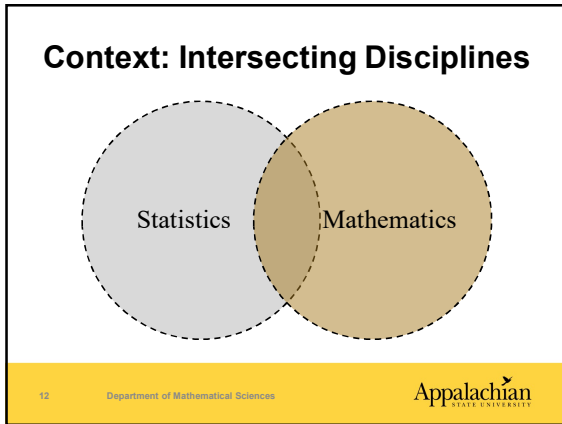
- Knowledge or “truth” is socially constituted by discourses. Various “regimes of truth” are created through rules and regularities in statements in discourses that are historical and situated in context (Foucault, 1972; Walshaw, 2007)

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Sociopolitical Perspectives on Learning

- Sociocultural lenses involve the consideration of knowledge, practice, and identity (Boaler, 2002; Boaler & Greeno, 2000)
- Sociopolitical lenses then bring in the consideration of power relations in learning (Walshaw, 2007; Gutierrez, 2013)
- In the lens of a learning trajectory there then needs to be consideration of knowledge, practice, identity, and agency.

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- ### Knowledge
- Strongly held understandings of individuals that are consistent with the regimes of truth formed by the disciplines/discourses they are positioned by.
 - Developing Essential Understandings of Statistics (Kader & Jacobbe, 2013; Peck, Gould, & Miller, 2013)
 - GAISE Framework (Franklin et al., 2007)
 - Statistical Education of Teachers (Franklin et al., 2015)
 - National, State, and Local Education Standards
 - Pro-Civic-Stat Conceptual Framework (Nicholson, Ridgway, & Gal, 2018)
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- ### Practice
- Repeated actions used by individuals when situated in particular discourses.
 - PPDAC Cycle (Wild & Pfannkuch, 1999)
 - Adult Statistical Literacy (Gal, 2004)
 - Critical Statistical Literacy (Weiland, 2017)
 - GAISE Framework (Franklin et al., 2007)
 - Statistical Education of Teachers (Franklin et al., 2015)
 - Pro-Civic-Stat Conceptual Framework (Nicholson, Ridgway, & Gal, 2018)
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- ### Identity
- The subject positions that individuals create for themselves in relation to others and the discourses they are subjected to and positioned by.
 - There is little research in this area in the context of statistics education.
 - Beliefs and attitudes (Chick & Pierce, 2008; Estrada & Batanero, 2008; Gal & Ginsburg, 1994; Gal, Ginsburg, & Schau, 1997; Harrell-Williams et al., 2017; Pierce & Chick, 2011; Ramirez, Schau, & Emmioglou, 2012; Schau, Miller, & Petocz, 2012)
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- ### Agency
- The power an individual has, either perceived or afforded by the context they are situated in, over their own action or control over a situation.
 - Similar to identity there has been almost no work done on agency in statistics education.
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Generative Themes

- Freire discussed generative themes as a starting point for his approach to literacy
- Generative themes are salient “things” from people’s lived reality.
- Start from a general understanding that a group of people hold and then use that to work towards a more technical understanding.
- Working from a person’s reading of the world to their reading of the word.

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Generative theme

- Freire often focused around the broad generative theme of domination which is in dialectic tension with liberation.
- For the consideration of sociopolitical issues and the discipline of statistics I propose working around the generative themes of representation, difference, uncertainty, and patterns.
- Additionally in the context of teachers is teaching a generative theme?

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Progression

- Reading the World
 - Individual
 - Community
- Reading the Word
 - Sample
 - Population
- Reading the Word and the World
 - Anecdotal vs. Systematic
 - Interrogating Structures/Systems
 - Action for Justice

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Structures/Systems to Investigate

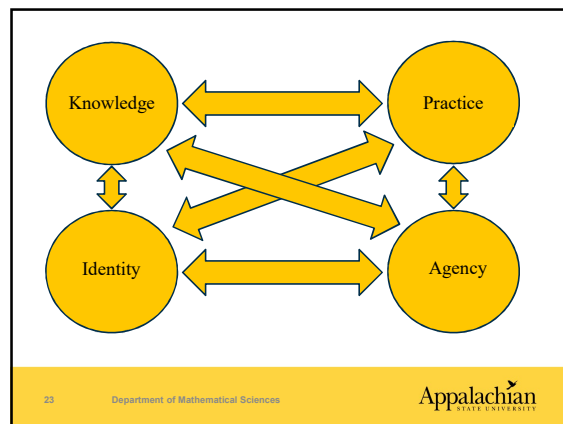
- Government (i.e state and federal legislatures, supreme court, executive branch, etc)
- Education Systems

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Hypothetical Learning Trajectory

	Reading the World		Reading the Word		Reading the Word and the World		
	Individuals	Community	Sample	Population	Anecdotal vs. Systematic	Interrogate Systems	Action for Justice
Representation							
Difference							
Uncertainty							
Pattern							
Teaching							

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Next Steps

- Synthesizing research and hypotheses on knowledge, practice, identity, and agency for the various stages of the learning progression aligned with the generative themes.
- Create a progression of tasks for teachers based on the hypothetical learning trajectory.
- Design a research framework around the trajectory to systematically study hypotheses.
- Implement progression with school mathematics teachers.

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Acknowledgments

- I would like to thank Dr. Walter Stroup in helping me to initially think about the idea of generative themes in the context of statistics.

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References

- Boaler, J. (2002). The development of disciplinary relationships: Knowledge, practice, and identity in mathematics classrooms. *For the Learning of Mathematics*, 22(1), 42–47.
- Boaler, J., & Greeno, J. G. (2000). Identity, agency, and knowing in mathematics worlds. In J. Boaler (Ed.), *Multiple perspectives on mathematics teaching and learning* (pp. 171–200). Westport, CT: Ablex Publishing.
- Chick, H., & Pierce, R. (2008). Teaching statistics at the primary school level: Beliefs, affordances, and pedagogical content knowledge. *Proceedings of the ICM Study 18 and 2008 IASE Round Table Conference*. Presented at the Monterrey, Mexico. Monterrey, Mexico: International Commission on Mathematical Instruction and International Association for Statistical Education.
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- Estrada, A., & Batanero, C. (2008). Explaining teachers' attitudes towards statistics. *Proceedings of the ICM Study 18 and 2008 IASE Round Table Conference*. Presented at the Monterrey, Mexico. Monterrey, Mexico: International Commission on Mathematical Instruction and International Association for Statistical Education.
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References

- Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2007). *Guidelines for assessment and instruction in statistics education (GAISE) report: A pre-K–12 curriculum framework*. Alexandria, VA: American Statistical Association.
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- Gal, I., & Ginsburg, L. (1994). The role of beliefs and attitudes in learning statistics: Towards an assessment framework. *Journal of Statistics Education*, 2(2). Retrieved from <http://www.amstat.org/publications/jse/v2n2/gal.html>
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Reference

- Gutiérrez, R. (2013). The sociopolitical turn in mathematics education. *Journal for Research in Mathematics Education*, 44(1), 37–68.
- Gutstein, E. (2006). *Reading and writing the world with mathematics*. New York, NY: Routledge.
- Harrell-Williams, L. M., Lovett, J. N., Lee, H. S., Pierce, R. L., Lesser, L. M., & Sorto, M. A. (2017). Validation of scores from the high school version of the Self-Efficacy to Teach Statistics Instrument using preservice mathematics teachers. *Journal of Psychoeducational Assessment*, 0734282917735151.
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Reference

- Pierce, R., & Chick, H. (2011). Teachers' beliefs about statistics education. In *Teaching statistics in school mathematics—Challenges for teaching and teacher education: A Joint ICM/IASE Study: The 18th ICM Study* (pp. 151–162). Retrieved from http://link.springer.com/chapter/10.1007/978-94-007-1131-0_17
- Ramirez, C., Schau, C., & Enmioglu, E. (2012). The Importance of Attitudes in Statistics Education. *Statistics Education Research Journal*, 11(2). Retrieved from [https://iase-web.org/documents/SERJ/SERJ11\(2\)_Ramirez.pdf](https://iase-web.org/documents/SERJ/SERJ11(2)_Ramirez.pdf)
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- Westheimer, J., & Kahne, J. (2004). What kind of citizen? The politics of educating for democracy. *American Educational Research Journal*, 41(2), 237–269.
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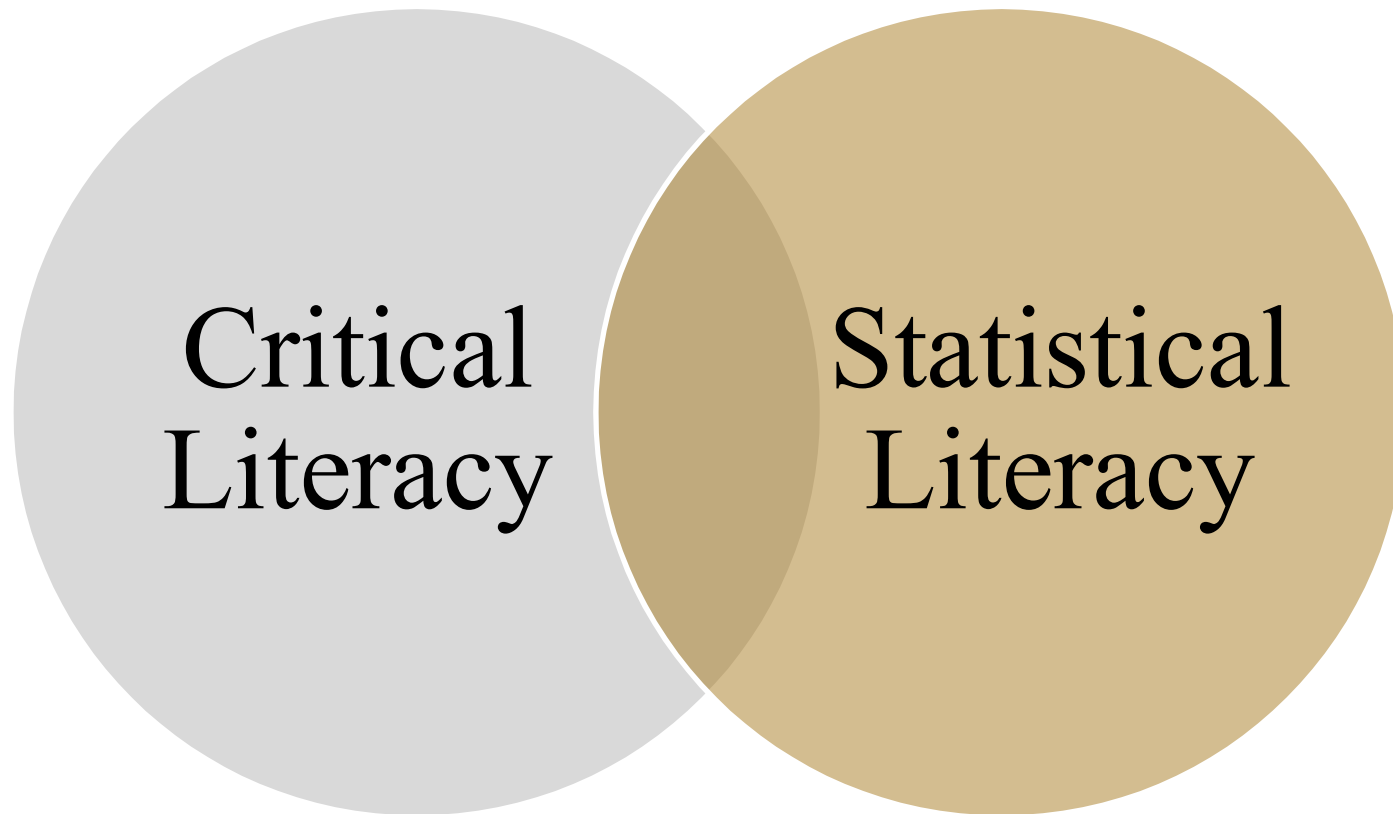
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USA CRIME STATISTICS ~ 2015



BLACKS KILLED BY WHITES ~~ 2%
BLACKS KILLED BY POLICE ~~ 1%
WHITES KILLED BY POLICE ~~ 3%
WHITES KILLED BY WHITES ~~ 16%
WHITES KILLED BY BLACKS ~~ 81%
BLACKS KILLED BY BLACKS ~~ 97%

SOURCE: Crime Statistics Bureau - San Francisco

Research Questions

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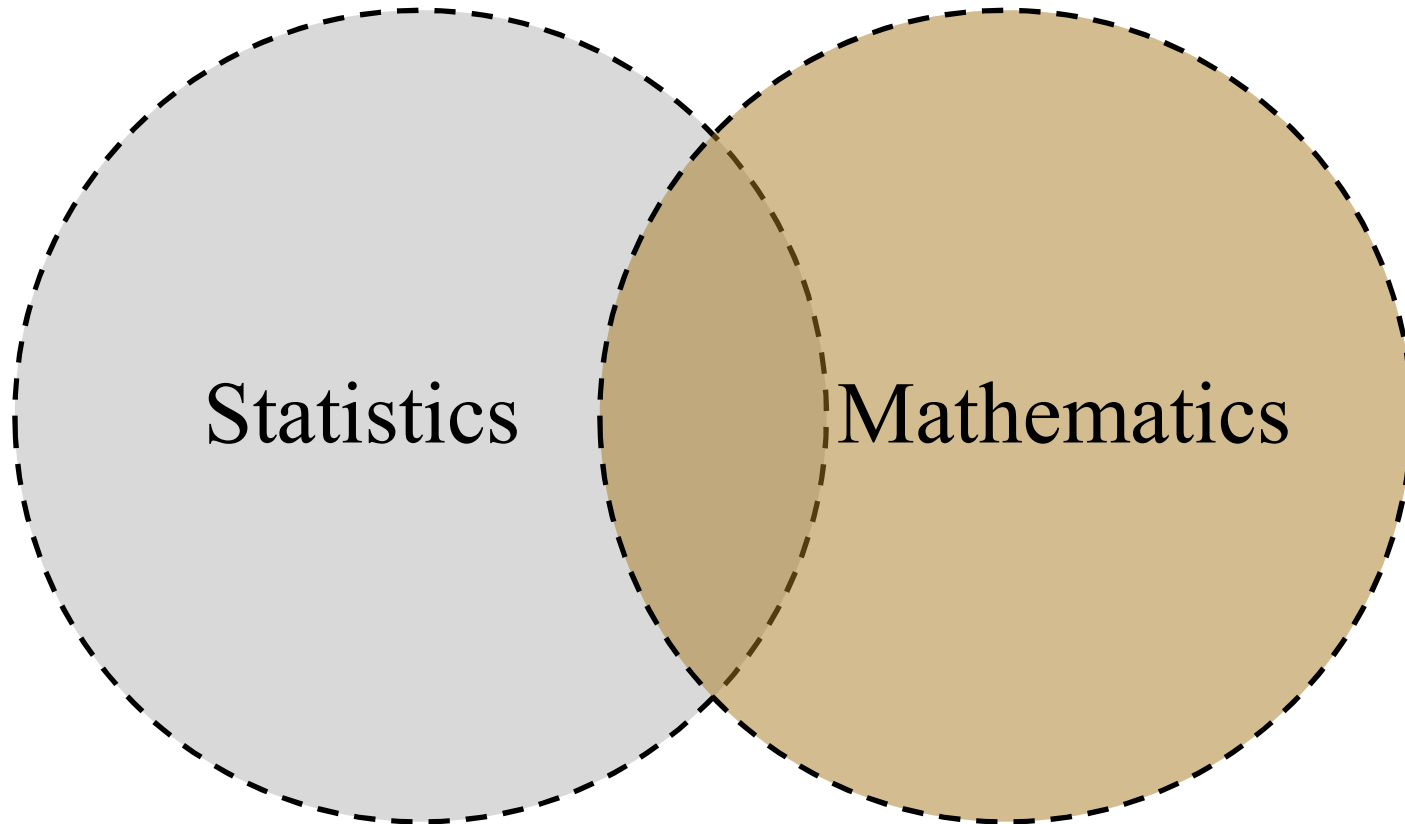
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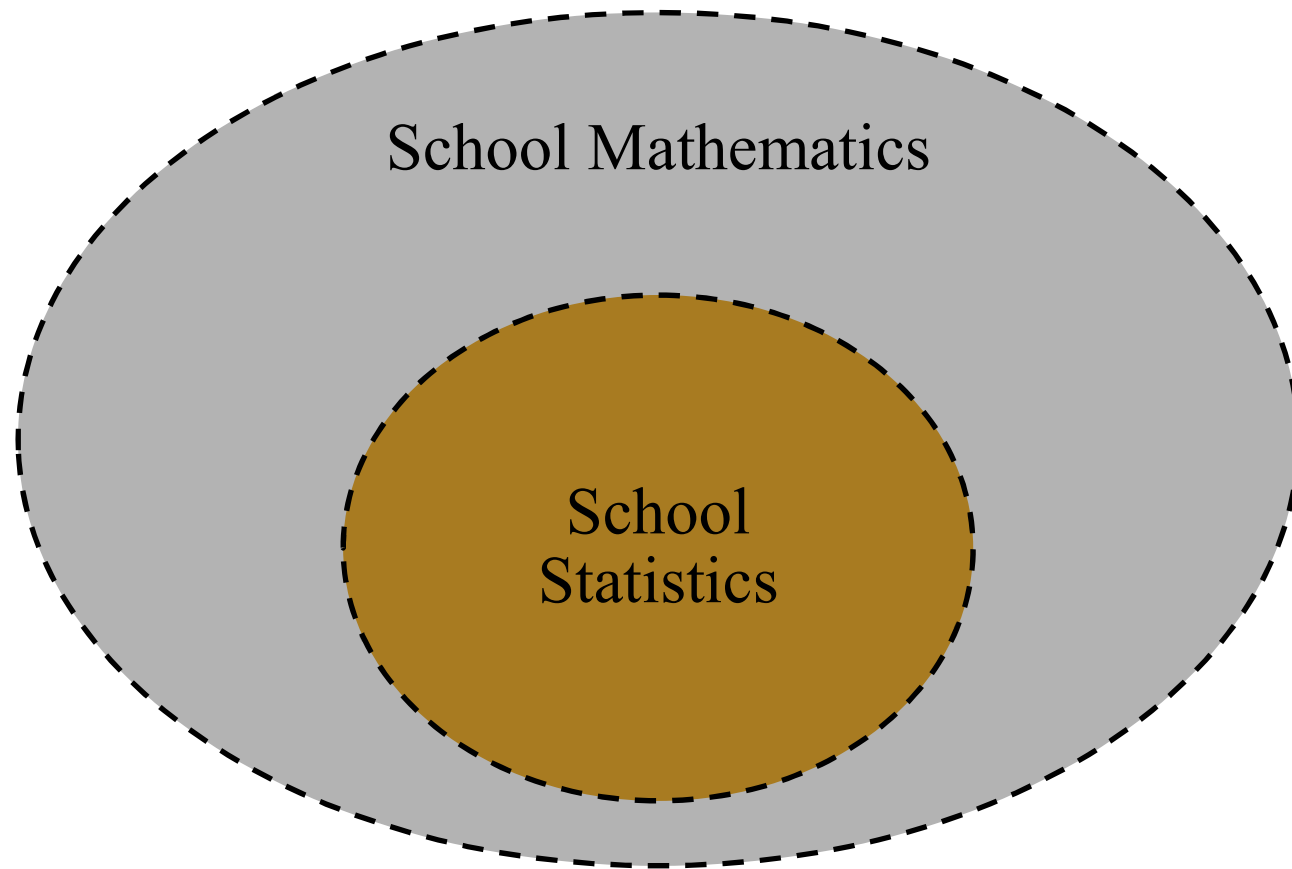
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Context: Intersecting Disciplines



Context: School Curriculum



Knowledge

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Progression

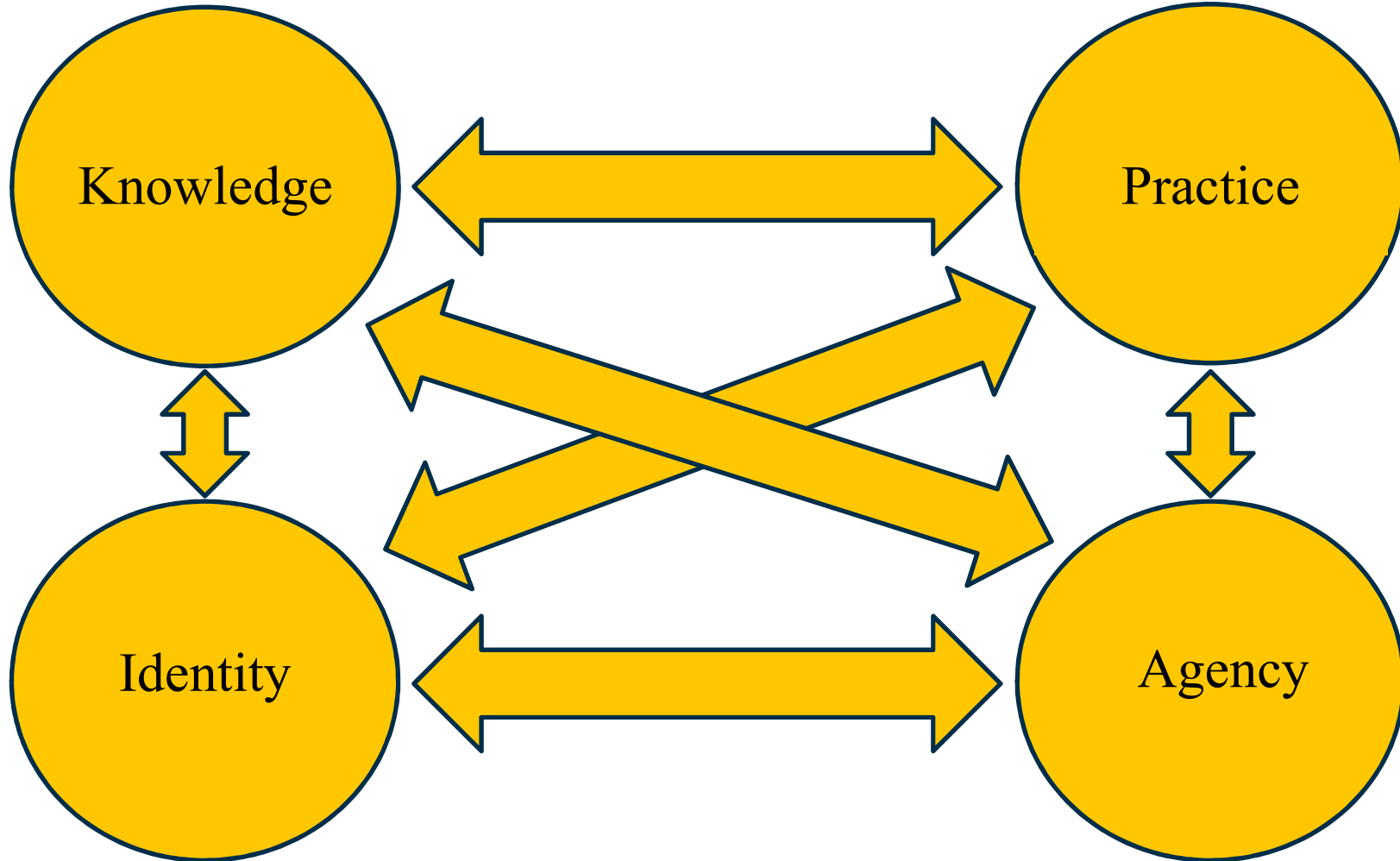
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 - Action for Justice

Structures/Systems to Investigate

- Government (i.e state and federal legislatures, supreme court, executive branch, etc)
- Education Systems

Hypothetical Learning Trajectory

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Difference							
Uncertainty							
Pattern							
Teaching							



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References

- Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2007). *Guidelines for assessment and instruction in statistics education (GAISE) report: A pre-K--12 curriculum framework*. Alexandria, VA: American Statistical Association.
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- Labaree, D. F. (1997). Public goods, private goods: The American struggle over educational goals. *American Educational Research Journal*, 34(1), 39–81.
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- Peck, R., Gould, R., & Miller, S. (2013). *Developing essential understanding of statistics: Grades 9-12*. Reston, VA: National Council of Teachers of Mathematics.

Reference

- Pierce, R., & Chick, H. (2011). Teachers' beliefs about statistics education. In *Teaching statistics in school mathematics-Challenges for teaching and teacher education: A Joint ICMI/IASE Study: The 18th ICMI Study* (pp. 151–162). Retrieved from http://link.springer.com/chapter/10.1007/978-94-007-1131-0_17
- Ramirez, C., Schau, C., & Emmioglu, E. (2012). The Importance of Attitudes in Statistics Education. *Statistics Education Research Journal*, 11(2). Retrieved from [https://iase-web.org/documents/SERJ/SERJ11\(2\)_Ramirez.pdf](https://iase-web.org/documents/SERJ/SERJ11(2)_Ramirez.pdf)
- Schau, C., Miller, M., & Petocz, P. (2012). Research on attitudes towards statistics. *Statistics Education Research Journal*, 11(2).
- Walshaw, M. (2007). *Working with Foucault in education*. Rotterdam: Sense Publishing.
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