Critical Voter Lesson Plan – Mathematical Deception

This week's audio lesson begins by providing an example of how to use the principles of Information Literacy studied last week (Locating Information, Evaluating Information, etc.) to analyze an actual news event. After that, we take a look at numbers and how the gap between our perception of numbers as being perfect and their ambiguity in the real world can lead to misunderstandings, fallacies and vulnerability to manipulation.

In the abstract, numbers are some of the only perfect things we encounter in life. People, places, even the meaning of words may change, but 2 + 2 will always equal four. But when numbers are used to describe real-world things (such as the length of a piece of wood or weight of a car), there will always be a degree of inaccuracy (such as that alleged two-inch piece of wood that is actually a tiny fraction of an inch longer).

Our perception that numbers should be perfect leads people to put more faith in quantitative information than in other types of information. This is why the media and public are so fascinated by polls, since they seem to provide us quantitative proof of what is happening in the world (even if similar polls turned out to have disappointed us or led us astray in the past). This faith in numbers can also create crises and cost millions, especially when it is put into believing that an unknowable value (like the "actual" vote count in the 2000 Presidential election) can be determined accurately (even when the margin of victory is within the margin of error for the process of tallying millions of ballots).

The gap between the abstract perfection of numbers and their grubbier earth-bound reality is also why those trying to manipulate us often use quantitative information to do so, using numbers to make false comparisons (i.e., comparing apples to oranges), selecting just the numbers that support and argument and ignoring others (i.e., cherry picking) and performing other mathematical fallacies.

Terminology

Important vocabulary terms used in this lesson include:

- Halo Effect
- Objective Based Education
- "Proofiness"
- Pythagoras
- Margin of error
- Unit Fallacy
- Comparing Apples to Oranges
- Cherry Picking

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Goals

The goal of this lesson is to give students an understanding of:

- The gap between our perception of numbers as being perfect and the ambiguity of numbers and quantitative information in the real world
- How even simple mathematical operations (such as counting) can lead to error, especially when human beings are involved
- How a default belief in quantitative information can cause us to go to extremes to find a "true" number, even when a margin of error means such a "true" number may not exist
- That surveys include a statistical margin of error, but that this may not be the only source of error within a survey or poll
- The type of mathematical fallacies committed by people who misuse quantitative information to argue a point (including the unit fallacy, comparing apples to oranges, and cherry picking)
- That quantitative information (such as statistics relating to jobs growth) needs to be understood in a wider context (such as the ups and downs of the economy)

Primary Resources

The following resources are available at the www.criticalvoter.com web site to support this lesson:

- **Critical Voter Podcast 009 – Mathematical Deception**: A 30 minute audio lesson covering information literacy

- **Quiz** – A short quiz designed to determine if someone has listened to and understood the podcast.

- **Blog Entries** – The Critical Voter blog contains multiple blog entries dealing with the issues covered in the podcast (look for entries the week of September 30, 2012 or use the categories menu to look for stories in the category of Mathematics).

Additional Resources

Links to additional information can be found on the Critical Voter Resources page.

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Suggested Activities

Activity	Notes on this activity
Have students listen to the podcast and answer the quiz questions to ensure they have listened to and understood the concepts covered in the lesson.	The podcast can be played in class or assigned as homework. The quiz is made up of four questions which were designed to be easily answerable by anyone who has listened to the podcast lesson in its entirety.
Research a news story using the principles of Information Literacy, using the example that begins this week's podcast to model how to locate and evaluate information.	While performing this exercise, students should focus on: • Creating a question to be answered that will serve as the foundation for research • Searching for information in places other than the Open Web (such as library databases) • Looking beyond the first page of search results (such as checking subsequent search pages, reviewing the resource section of sites found during a search, or communication with direct participants in the story being researched) • Selecting sources based on perceived levels of bias, who has first-hand vs. second-hand experience of the story being covered, etc. • Determining when you have obtained sufficient information to answer your question
Hand out several decks of cards and ask students to count them and let you know if the deck is complete or not. In cases where someone thinks the deck is incomplete, have another person repeat the count to see if they get a different answer.	This exercise is designed to show that even the simple act of counting can lead to error. The results can be used as the basis to discuss other events involving counting (or more complex mathematical operations) which demonstrate that numbers may not be as perfect in the real world as they are in the abstract. Some variations on this exercise include:

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Activity	Notes on this activity
	• Ensuring some of the decks you hand out are incomplete or contain extra cards • Announce to students beforehand that not every deck contains 52 cards to see how this knowledge influences their counting • Have them perform their count within a short time limit
Look at one or more surveys appearing in a newspaper or online news source (such as the Real Clear Politics compilation of Presidential survey research). Review the sample size and margin of error for each survey and discuss what these values mean. Determine other potential sources of error for the type of survey you are reviewing.	You can also review historic surveys that were wrong or failed to predict accurately (such as the famous 1936 Literary Digest poll that failed due to systemic error in the way data was collected). Discuss other examples of when polls failed to predict accurately and try to find the sources of error that led to this mistaken result.
Review a speech or debate performance by one or more Presidential candidates and highlight places where quantitative information was used to make points about jobs, the economy, or other matters where numbers were invoked to support a claim.	Using these examples, determine if the speaker is engaging in one or more mathematical fallacies (such as "cherry picking" positive numbers and ignoring negative ones that would not support the candidate's claim). Use the Information Literacy tools studied earlier to perform research on one or more of these quantitative claims to determine if they are true or not.