

Research Questions	Why do I need to know this?	Who and what can provide the data which will answer the questions ?	Validity Threats	Possible Strategies for dealing with validity threats	Rationale for strategies	Analysis Plans
How deeply do AP Statistics teachers understand statistical inference?	<p>The teachers can only teach what they know. Their depth of understanding will influence the content of their lessons.</p> <p>The link between teacher knowledge and student performance is well established.</p>	Interviews with AP Statistics Teachers	Teachers may be defensive if they interpret my inquiry as judgmental.	<p>Approach teachers as professionals with whom I share concerns. They are the source of insightful commentary and experience which may help me in making a meaningful discovery.</p> <p>Use non-judgmental language in questions, i.e. “How do you address xyz ...?” or “What do you do when teaching xyz ...” instead of “Do you include xyz in your lessons?” or “Do you stress xyz throughout the year or just in its own unit?”</p> <p>Anonymity guaranteed; friendly atmosphere.</p>	<p>Put the teachers in the position of helper, the subject expert with insights which I need, whose expertise can help me uncover connections between classroom practices and student achievement.</p> <p>Teachers are not be judged or scrutinized; they are being asked for their expertise and their insight.</p>	Audiotaping, transcribing, photographs of classroom artifacts (if available and pertinent), assessing breadth of time spent on statistical inference concepts, comparing and contrasting data from different counties or geographic areas maybe?) to look for patterns, outliers, similarities, etc.
How do teachers incorporate the concepts of statistical inference into their AP Statistics curriculum?	The ability to present statistical concepts in multiple ways allows the teacher to reach many students and to		Teachers may incorrectly assess their own understanding.	Teacher self-assessments (from the interviews) will be augmented by the survey and interviews.	Triangulation	

	reinforce concepts for students. If different techniques are used for different topics, there may be a causal link.	Focus Groups	Teachers may be influenced or intimidated by peers	Establish friendly atmosphere Use major themes from interviews as these are likely important points with all AP Statistics teachers. Draw teachers in to discussions of particularly successful lessons, particularly memorable lessons, or personal strategies. Ensure that everyone talks and is recognized. Do not let anyone dominate the conversations.	Give each teacher the knowledge that her/his input is valued. People will not want to talk if they think that no one cares what they say. Strategy here needs to be the opposite... I really care, please talk.	
What level of importance do AP Statistics teachers place on and statistical inference?	Both of these general topics play a role in most AP Statistics topics. However, their importance can be stressed or not. The level of which the teacher utilizes may be key in learning.	Content Knowledge Assessment Instrument	Teachers could possibly guess correct answers on multiple choice questions.	I will use an established instrument and make only minimal adjustments to ensure it focuses on statistical inference.	Proven instrument; no need to reinvent the wheel Will use a sufficiently large sample to minimize chance variation	Statistical analysis of quantitative data; descriptive statistics; coding of narratives
Does the teachers' understanding of statistical inference affect students' performance on statistical inference questions on the national AP Statistics exam?		AP scores for particular teachers	Individual student scores are privacy protected; however, a teacher is free to discuss his/her class mean score. Teachers may be willing to state how their students perform overall; but, this will either be	I may not be able to attain this information at all if teachers are unwilling to provide it. However, some judgment will need to be used in assessing the accuracy of the information. Again, teachers would be assured that there was total anonymity and they were	Overall exam scores are related to the teacher's practice in some way. These scores do not happen without the teacher doing some interventions (hopefully, yearlong). However, teacher knowledge, competence, dedication, etc. are not	

			<p>accurate or inflated.</p> <p>If a teacher's mean score is low, he/she may feel demeaned or threatened.</p> <p>Some students may have received outside tutoring (which is currently a common practice); this could affect their exam score</p>	<p>not being assessed by their students' scores.</p>	<p>the only contributors. Student ability, motivation, time available, social pressures, etc. all contribute to the students' academic performance.</p>	
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Data for the past nine years, available on the College Board website for AP Statistics, shows that students have scored lower on questions involving concepts of statistical inference than they have on other types of questions within each given year. There are also lower scores on data pattern analysis (3 questions above the annual mean score vs. 10 questions below) and higher scores of data exploration (10 above vs. 2 below). I originally intended to delve into studying possible causes of this phenomenon with two concepts because they are closely related. However, I believe it is more valuable to study the reasons for “lower than the mean” performance than it is to study “above the mean performance,” given that my intention is to discover ways to help our students improve their performance. That said, I revisited the statistics at College Board and confirmed that questions involving the concepts of statistical inference had the biggest range between the number of questions which had mean scores below the annual mean and questions which had mean scores above the annual mean (4 above vs. 16 below). Because I have decided against trying to simultaneously study two closely related topics and will instead be focusing on only one conceptual area, it is prudent to choose the conceptual area in which the most striking differences exist.

My intention is to devise a pilot study in which my data collection will rely mainly on AP Statistics teachers. I want to know if and how the teachers’ depth of understanding of statistical inference is a contributing factor to the student performance on the annual AP Statistics exam. I intend to conduct interviews with numerous AP Statistics teachers in Northern Virginia, approaching them for their expertise in helping me to study this issue. Sounds good; but, how am I going to make this happen? So, I starting really thinking about this and the logistic limitations I faced. It was more than a

little daunting; and, I will admit to some paranoia. I know I will make mistakes and happily learn from them. But, I do have a dread of totally messing up things. I'm not a big fan of wasted time and mistakes which could have been avoided. That is the main reason I want to start with a decent pilot study, so that I can make my mistakes on the small scale.

When I started to construct my matrix, I experienced a mercurial ride through information overload, leaking memory, joy, panic, clarity, confusion, confidence, and doubt, in other words, ... reality. My notional thoughts of "I'll do this and I'll do that" need to evolve into concrete, specific statements of, first, what I wanted to accomplish; how I was going to accomplish it; who and what would give me the data which I needed; what foreseeable problems existed and my ideas for staving them off before they could materialize; and, the piece de resistance, how was I going to analyze all this data and draw some reasonable, defensible conclusions. So, instead of just pondering, I started making a plan. After days of moving things around in my matrix, taking things out, putting things in, and changing "glad" to "happy," I acknowledged that I needed some guidance. My consultation gave me some valuable insights and helped me to be more assured about the wisdom of some of my decisions.

Who to interview and/or observe?:

As a matter of practicality, it makes the most sense for me to interview AP Statistics teachers at independent schools. The Virginia Association of Independent Schools (VAIS) is the network of which my school is a part. I can contact teachers through this network and I expect that they would be interested in being involved. Because they are not

public school employees, headmaster permission is all that is needed, not the voluminous paperwork which is required by Fairfax County public schools.

Even though access to students at independent schools would be easier to obtain than access to public school students, I weighed the value of involving the students at this juncture. I am interested in (1) teacher perceptions of their own content knowledge, (2) assessing their actual content knowledge, (3) understanding the breadth and frequency of incorporation of statistical concepts into their daily lessons; and, (4) if their conceptual knowledge and curricular strategies impact the students AP exam scores. I really do not input from the students to get this information. Granted, student commentary may well add some illumination; but, the cost does not justify the gain, in my opinion. After I start the pilot study, I may change my mind. I hope not; but, I know that is a possibility.

I had considered classroom observations, admittedly almost as a rote response and not because of any reason germane to the research questions. This realization has made me stop dead in my tracks and vow to never fall prey to that thinking again. Actually, it is not thinking; I view it as the research equivalent of just plugging numbers into a formula and not having any idea what it means (as some lethargic math students like to do). Doing a high school research study? Well, then, go observe the class. Not so fast. I am now convinced that classroom observations will not provide me with the information I seek.

What to ask:

With the teachers, I want to start a discussion of what they feel are the areas in which AP Statistics students most need more understanding (student need, not teacher shortcoming). Then, I would like to move on to what the teacher thinks he/she could do to address the problem if they had the resources (lack of resources, not teacher fault). I need to ensure that these teachers know I see them as insightful professionals whose experience and perceptiveness will provide me with the data I need to help all of our students and improve our teaching practice. I will be stunned if most of the teachers do not cite statistical inference as their main area of concern. However, even if they do not, I want to get them talking about it. Asking about their students AP scores may be a touchy subject. However, I intend to approach this by asking the teachers how the students thought they did on the exam, as reported to the teacher in the days immediately following the exam. I know that my own students vividly remembered what type of problems gave them difficulties.

After I have done a number of interviews, I want to hold focus groups. People are more likely to talk when there is more give and take communication and they have a common interest. I will use the common themes which I derive from the interviews to frame my focus group questions. I can also look on an AP Statistics teachers' listserve for "hot topics" of discussion.

I want to keep the interviews and focus groups centered on experiences, opinions, perceptions, and attitudes. I intend to keep it free flowing with no element of assessment. But, I also need some measure of the teachers' actual content knowledge. I am aware of two different instruments which were used to assess teacher statistical content knowledge. I plan to adapt these to specifically address statistical inference. These also collect data on number of years

in teaching, levels of math taught, undergraduate and graduate degrees, sex, age, number of students in the AP Statistics classes, age range and grade levels of students, etc.

What does it all mean?

At the end of the pilot study, I should have a small mountain of transcriptions from audiotapes, memos from interviews and focus groups, and more data from the content knowledge assessment instrument. How will it mesh together? Bryman (2007, p. 20) proposes that, “in the eyes of mixed methods researchers, a significant difficulty is that of merging analyses of quantitative and qualitative data to provide an integrated analysis. One consideration that may aid the linking of analyses is not to lose sight of the rationale for conducting mixed methods research in the first place.” This is an especially poignant thought for me. I entered the class thinking that mixed methods was a sophisticated collection of “pick one from column A and one from column B” approaches. I believe that the quantitative and qualitative chunks of my proposed pilot study are inextricably intertwined. No column A and column B. One makes much more sense with the other, which is the whole idea. One illuminates the other. I get that now. I don’t everything yet; but, I get that.

Reference

Bryman, A. (2007). Barriers to Integrating Quantitative and Qualitative Research. *Journal of Mixed Methods Research*, 1(1), 8-22.