Using Numerical Data in Action Research

Most of you are collecting some type of numerical data (test scores, homework scores (possibly using a rubric), surveys (counting choices as 1-5), etc.). Now that you have all collected some of this data and are trying to use this data to support some of your assertions, we wanted to give some further guidelines on using numerical data.

First of all, know that while you are collecting numerical data, you will mainly be reporting it qualitatively. If that last sentence didn’t quite make sense, don’t worry, just keep reading. In the field of statistics, there are lots and lots of formulas and procedures for analyzing numerical data. Nearly all of these formulas and procedures are for “large n” studies—typically defined as groups of at least 30. So, unless you have at least 30 students who have consented to participate in your research, you will not be able to analyze your numerical data statistically. Another technical term in statistics is “statistically significant.” Although your numbers may increase (or decrease) across the time span of your data collection, an important point to a statistician is whether or not such a change is “significant.” While you may have students score higher on the post test of vocabulary than on the pretest, if student scores increased by an average of 3 points, is that significant? None of you have enough data to establish changes as “significant” so you will not be able to use your numerical data in this way. Also, in education, there are numerous other variables than can explain changes, in addition to what you did with your action research.

What you can do: it often makes sense to report means (averages) of your numerical data. When doing so in a formal paper, a mean always must be accompanied by a standard deviation and the number of whatever the mean represents. Your TI-84 as well as Excel and some web-based applications can all calculate means and standard deviations after you enter your data. For example, if I am reporting quiz scores, I could report that for n=17 (the number of students in my class) who took 6 quizzes during February and March, 2009, the mean score was 12.2 out of 15 points, with a standard deviation of 1.7 points. Things such as mean, standard deviation, and median are “descriptive statistics”; in the way that elementary addition is only one small component of calculus, descriptive statistics are only one small, elementary component of the field of statistics.

Another thing to do: make tables of your data. People frequently find that collecting numerical data in a table is a nice way to summarize it. For instance, if you scored something with a rubric weekly, you might make a table with the weeks going down the left side, and the n, mean, and standard deviation as the columns of the table. The same goes for surveys. Put the survey questions down the side, then the mean and standard deviation. Sometimes it makes sense on a survey to report median responses (even sometimes reporting the modes). You may look at it both ways and decide which way better represents your data. Either way, explain why you chose the way you did.

Closely related to tables: make graphs of your data. Especially when you are looking at scores over time (using a rubric, or considering homework or quiz scores), you may want to create some
type of graph. Make sure you do not use a continuous function (such as a line) to represent
discrete data (such as scores collected once a week). For scores over time (such as weekly
homework presentations), you may decide to use a bar graph. For something like homework
completion rate, you may just create a scatter plot to show completion rate over time.

While tables and graphs can nicely summarize your data, what is more important is your
interpretation of what it all means. You will not be able to make claims that your numbers
“prove” anything. Just as “proof” in mathematics is a technical term that does not mean show a
few examples to support something, showing that one thing caused another—“effect”—is a
technical term in educational research. You do not have enough data to prove “effect.” Some of
you will recall that Wendy steered you away from using the word “effect” in your research
questions. Now, we will steer you away from trying to use numerical data to establish “effects.”

For instance, if student test scores went up over the course of this semester, this does not prove
that your action research project caused the increase. Think of all the other variables involved:
did the chapters get easier this semester? Did you ask easier questions on some tests? Did
students get more used to how you write test questions, and so do better? Did the reality of the
approaching end of the school year cause some students to finally kick it into gear (I know, not
likely)?

I think that as math people, we tend to gravitate toward numbers and numerical data as “better”
than qualitative data such as interviews and journals. However, from a research perspective,
when you are conducting action research, the qualitative data is typically more informative than
the quantitative data you collect. In order for numerical data to be convincing to a researcher,
you have to run statistical tests on it (think of articles you have read with t-tests, ANOVA,
confidence intervals, etc.). However, almost all of you are in the position that you don’t have
enough data to use any of these types of statistical tests. Thus, you can represent your numerical
data with charts and graphs, but the focus is more on you describing what you think this data
means, and not on having your numbers prove that your project worked. Certainly you can use
your numerical data to triangulate your assertions—as one of your three forms of evidence.
However, we suggest you consider your own journal and your student interviews as primary
sources for creating assertions, with your numerical data in a supporting role. While this is not an
always/never kind of rule (there are situations in which it is appropriate to make assertions
primarily based on your numerical data), as a mindset, we want you to try to get comfortable
moving away from numbers and toward qualitative themes (remember—lumpy data) and
descriptions.