INTERVIEWS WITH STATISTICS EDUCATORS

Interview With Gail Burrill

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Beginnings

AR: Thanks very much, Gail, for agreeing to be interviewed for the Journal of Statistics Education. Which came first—your interest in statistics, or your interest in education?

GB: Thanks, Allan.

I had been teaching high school mathematics for four or five years in the late 1960s when I taught a group of students who had several study halls each day and were bored. I thought it might be fun to do a statistics class with them so they could do something intellectual instead. (I always liked data and working with graphs, even though I never took a statistics course as part of my undergraduate mathematics major.) So I created a semester course—we used the book Probability and Statistics by Stephen Willoughby and just kind of meandered our way through, doing whatever seemed to be fun and that the students enjoyed. And from then on we had anywhere from one to four statistics courses per year, with the only prerequisite being first year algebra. The focus was on hands-on activities. For example: (1) Several Milwaukee companies tried different marketing strategies for different areas around the city, and we had access to some of that work. (2) We tried to figure out what kind of statistics the Green Bay Packers made use of (a long time ago when the data were mostly collected in big books). (3) The students learned what went into creating a survey, including some sent out by members of Congress, and examined political campaigns from different parts of the U.S. The course evolved over the years as society and the students changed, but it was all fun to teach.

AR: Please describe the evolution of that course.

GB: The course initially had quite a bit of probability with lots of problems involving combinations and permutations—making connections between binomial distributions and Pascal’s triangle—as well as an emphasis on real data and calculating summary measures of center and variability. In the early 1980s I met an avid statistics teacher from Canada, Jim Swift, at an NCTM meeting and was introduced to the NCTM/ASA Joint Committee on Statistics and Probability. This committee was in the process of developing the Quantitative Literacy materials, and as a member of the Joint Committee and with the guidance of other members such as Jim Landwehr, Dick Schaeffer, and Ann Watkins, I learned about exploratory data analysis, which transformed what I did in my statistics classes. Jim Swift’s approach to sampling and margin of error, written up in Exploring Surveys: Information from Samples, changed my whole thinking about inference (and I was excited to see the same approach advocated in the Statistics Progressions document for the Common Core State Standards). In 1984 I was fortunate to be selected to attend the first Woodrow Wilson Teacher Institute, focused on statistics, at Princeton University. With 48 other high school teachers from across the U.S (probably the only ones who were teaching a high school statistics course at the time), I met John Tukey and for three weeks talked day and night about statistics. The following year I was fortunate to be part of a small group of teachers taking a workshop from W. Edwards Deming at Ford Motor Company, and then new ideas about sampling and quality control became part of my course.

As part of the Quantitative Literacy materials, the Joint Committee produced a computer program that allowed us...
to generate random numbers and simulate random samples. My statistics classes moved to a computer lab, and simulation became a core tool for developing an understanding of sampling distributions. The advent of graphing calculators in the mid-1980s allowed us to gradually move from filling in pieces of formulas (e.g., $\sum \frac{x_i^2}{\sigma^2}$) for statistical measures such as standard deviation and correlation to punching a key to get the whole value. The advances in technology pushed me more and more towards simulation as a way to build understanding of core statistical ideas. The programmable devices even let us do some resampling and bootstrapping. When I left high school teaching in the mid-1990s, I was really ready to let go of random number tables.

**AR: Considering that Tukey and Deming are among a handful of the most famous and influential statisticians ever, I have to ask: What were they like, and how was it to be taught by them?**

**GB:** We were not actually taught by Tukey during the Woodrow Wilson program at Princeton, but he was there and talked to us and responded to our questions. From what I remember, he seemed a bit scary (we knew he was important and influential) but was patient with us. The biggest thing that stands out in my memory is the care he took with giving responses to questions and shaping what he was going to say; he thought first before he spoke, leaning back in a chair with his eyes shut if I remember correctly after these many years—we just kind of watched him think.

I was privileged to ride with Deming enroute to Ford and to talk with him before and after the workshop he led, where we did his famous red bead and funnel experiments. He was crisp, had a sense of humor that could be a bit biting at times, and basically seemed like he did not tolerate much nonsense. He was passionate about making sure we understood the role of variation in the output from a process, the notion of tracking whether variability was due to a special cause or a common cause, and the consequences of ignoring this variability in trying to improve a system.

The experiences from the workshop had a profound effect on the way I thought about our efforts in the U.S. to improve mathematics education in our schools. The messages from his work have typically been ignored by “management” types, including politicians, who do not seem to even consider that problems might be due to common cause (like why so many students do poorly with fractions), nor examine the entire process and make fundamental changes to prevent the problem from occurring again. Instead, based on limited information, some schools and teachers get high praise for raising scores only to have things change in a few years, and nearly everyone is involved in making knee jerk reactions adopting the latest new mantra that will make the problems go away. It is quite revealing to see how these continuing efforts to “improve” math education line up with Deming’s list of what not to do.

Meeting these two giants in the statistical world in my own journey through statistics education was awesome. But also awesome was the help and support of Dick Scheaffer, Jim Landwehr, and Jeff Witmer, who spent countless hours over the years helping us as teachers translate statistics into language that made sense to us and to understand in a deep way what statistics was about. One example is realizing that if you wanted to use the dependent variable to ask something about the independent variable, you should have done your regression that way in the first place.

**K-12 Statistics Curriculum**

**AR:** You mentioned the ASA/NCTM Joint Committee earlier. How did you become involved with that group?

**GB:** As I mentioned earlier, I met Jim Swift, who was staffing the ASA/NCTM Joint Committee booth an NCTM meeting. His excitement about statistics was awesome, and we became friends. The committee was engaged in finishing and promoting the four Quantitative Literacy (QL) books (Exploring Data, The Art and Techniques of Simulation, Exploring Probability, and Exploring Surveys: Information from Samples). I reviewed and piloted the materials and eventually was appointed as the NCTM representative to the committee. We received an NSF grant to do professional development around the U.S. with the QL materials, which was an important part of getting the message into the field (and the materials are still a valuable resource today). I served several terms, both as an ASA representative and as an NCTM representative, and became chair of the committee.

One of the very good things that happened during this time was the creation of the first NCTM Standards, the *Curriculum and Evaluation Standards for School Mathematics.* I happened to know Tom Romberg, who was heading up the work, and he sent me the draft of the statistics and probability section for comments. The draft was pretty underwhelming when we got it, but Tom listened to what the Committee wanted, and the result established a path for getting statistics into the mainstream mathematics curriculum. We’ve moved ahead along this path (and maybe a bit behind by leaving statistics out of K-5 in the Common Core) ever since. I am very encouraged by the latest NCTM curriculum document, *Catalyzing Change in High School Mathematics,* that pushes for both quantitative literacy and core statistical concepts related to data analysis and inference as essential for all high school graduates. The Joint Committee really laid the groundwork for where we are today.

**AR:** I’m tempted to simply ask where we are today, but I’ll ask it like this: With regard to the teaching and learning of statistics in K-12 in the U.S., what aspect are you most satisfied with and what aspect are you least satisfied with?

**GB:** While we are in a better place today, we have a long way to go. So, what am I least satisfied with? Preparing future teachers to teach statistics should be as fundamental as preparing future secondary teachers to teach algebra and geometry, but teacher preparation programs and university statistics programs are not really all onboard. Neither are many high-stakes assessments. Until we get introductory statistics courses at the university level that focus on building understanding of key statistical concepts, not just pushing formulas, that help students make sense of data, and prepare them to recognize valid statistical reasoning as well as being able to reason statistically themselves, we will always be a in a “catch-up” position. This means that those who deliver statistics courses and who write curricula and create standards
and design assessments all have to be on board—and we are far from there at this point in time. Statistics is not mathematics, and that is not yet well understood.

One thing that I am most satisfied with is the growing acceptance of simulation-based inference, because I think it has the potential to help people get a much better understanding of statistical reasoning. Another is that research related to teaching and learning statistics seems to be moving from identifying things learners cannot do (e.g., the vast number of studies related to not understanding the mean or measures of variability) to looking at interventions that can help us address the challenges and misconceptions. I am also excited about the possibilities that interactive dynamic technology brings to the learning of statistics and the expanding role of visualization in supporting the development of core statistical concepts. We clearly are in a better place than we were 20 years ago, with lots of opportunities to continue to grow as a field, which makes it a fun place to be.

AR: Thanks for these very interesting points on both lists. I have many follow-up questions in mind. First, what’s your sense for how much statistics is typically taken by prospective math teachers? Do you think it’s common for such students to take multiple courses in statistics? Do you think it’s common to take at least one statistics course? Do you know of any good data on these questions?

GB: According to the 2010 national survey conducted by the Conference Board of the Mathematical Sciences, 56% of colleges and universities with a K-8 teacher certification program offer a specially designed statistics course; 90% of the universities with a secondary certification program require a statistics course, but only 6% of these courses are designed for teachers. The data do not indicate whether the courses are traditional mathematics-based courses with an emphasis on formulas and probability or data-based courses that emphasize statistical reasoning and the investigative process. It would seem to be rare that preservice teachers would take more than one statistics course, despite the recommendations of reports such as Mathematical Education of Teachers (MET) II and ASAS GAISE framework. Research studies involving practicing teachers (e.g., see the book that Carmen Batanero, Chris Reading and I edited for a Joint ICMI/IASE study on teaching statistics) typically indicate that teachers’ statistical knowledge is fragile at best, and they often struggle to teach the kind of statistics that is called for in the GAISE report.

AR: You mentioned that high-stakes assessments also need to do better with emphasizing statistical reasoning. Do you think any progress has been made on this front? How can statistics educators help with this?

GB: Statistics educators have a huge role in assessment. Dick Scheaffer gave a great talk many years ago showing examples of the items in some state and national assessments labeled as statistics that were not actually assessing anything statistical but rather the ability to do numerical computations (e.g., given these five test scores, what grade is necessary on the next test to have an overall average of some given number). We have made some progress since then with items from univariate data analysis—interpreting boxplots or bar graphs or reasoning about probabilities from data in a table—showing up on some tests but not as much as we need. The one domain that seems to have become usual is giving students a scatterplot of data and asking which of the following is the “line of best fit,” with choices in the slope-intercept form of a line varying the slope and y-intercept. (I gave up trying to get the general world to stop saying “best” and instead use least squares regression line—I am pretty sure that many do not have a clue why the line the technology produces is “best.”) I can say from my own work that some test designers such as the College Board are committed to trying to do better—but still items like “A random sample of 800 students found that 200 of them liked brand x. If there were 2000 students in the population from which the sample was chosen, how many will like brand x?” where the correct answer choice is 500 keep popping up as statistics questions. People like Roxy Peck have helped some assessment teams find ways to deal with questions related to making inferences from a sample (e.g., “A random sample of 700 students found that 120 liked brand x. If there were 2000 students in the population from which the sample was chosen, which of the following would you find surprising?”) Some assessments are asking questions about which strategy for selecting a sample would be random and questions about how bias might be avoided in the design of a survey or experiment, but these are not yet common. One reason is probably that it is difficult to reduce the nuances that are so important in statistical reasoning to a multiple choice or short answer question. But, I would encourage every statistician and AP statistics teacher to reach out and volunteer to at least review the items test designers are using as well as the specifications they have drawn up for the items they call statistics—doing so in a positive way to support their work not to denigrate it. (It is important to remember that most folks outside of our community have a pretty fragile knowledge of statistics.) And for those interested, LOCUS (https://locus.statisticseducation.org) is a great place to send folks to look at models of good statistics questions.

High School Teaching Career

AR: Let me shift gears and ask about your career path. You mentioned at the outset of this interview that you began as a high school math teacher, and you eventually became a faculty member at Michigan State. For how long were you a high school teacher? What did you enjoy most and least about that part of your career?

GB: I was a high school teacher for over 28 years and really loved teaching high school students. The students we had were from an upper working class suburb; they were game to try almost anything, were honest with you about what they were thinking and what they knew and didn’t know, and most of them really wanted to learn. I taught first-year algebra nearly every year, along with statistics and calculus, with some pre-algebra, practical math (not really effective courses as we found out), and second-year algebra. Trying to help students understand the content was always interesting because they thought about it in so many different ways—mostly foreign to the way I thought. I always thought if I was bored, then so were the students, and so we tried something different (like writing the units we were studying or designing their own tests). We were free to do what we knew from the data we had was best for the students, with
no one telling us what to teach or what to assess and how, and it worked: over 90% of the students took four years of high school math. We had a small but great mathematics department and worked together to design a common curriculum with common tests and regular meetings to see how things were working. We took on all sorts of challenges, such as writing a problem-solving unit, introducing statistics into all algebra courses, using materials created by the math educators from the Freudenthal Institute in the Netherlands to see if they could work in the U.S. (they did, and we learned a lot from the Dutch), and building all of the table decorations for the state math conference. The entire school faculty was close and stable; we played together as well as worked together.

What I enjoyed the least was the shift every new administrator brought to the district. We took part in every educational fad that came along—mastery learning, competency-based education, back-to-the-basics, behavioral objectives and Madeline Hunter, learning styles, outcome-based teaching. ... We came from way too many faculty meetings saying “this too shall pass,” and it did. We learned to figure out what might be good for kids in the newest fad, decide how to integrate that into what we did, and ignore the rest.

AR: It sounds like your students were a delight to work with. Did you find that their attitudes about learning, or about interacting with their peers or teachers, changed at all over the years and generations?

GB: Thinking back I can't really tell because I was with kids for a long time, so I probably changed along with them. I taught in a school with a fairly stable community, which meant that I had many brothers and sisters over the years. They typically knew what to expect in my classes coming in (e.g., the algebra students had to draw a picture of algebra, the statistics students had to do a survey project, the calculus students could paint a math or statistics picture on a block on the wall in my room). When new groups of students came, the others clued them in. We also had a very stable core mathematics department and so were very consistent in our expectations across all of the classes; the kids knew that as well and pretty much behaved accordingly. The books they read changed (one group read Soul on Ice and Black Like Me), sometimes their sense of identity changed (we had a very sad number of suicides for a few years), the songs changed, their heroes changed, but they mostly seemed to like being challenged, going to the board to do work, and trying new things.

NCTM, NRC, and IASE

AR: That sounds terrific. What prompted you to leave the classroom for other pursuits?

GB: I was asked to run for president of NCTM, and my superintendent did not want me to do that, even though NCTM would have paid my salary for two full years and half-time for two more years. He thought I belonged in the classroom. I also had a very, very bad principal. (We had a lot of them over the years, and this one was just not functional—e.g., scheduling all of the AP courses in the same time period. When the staff pointed out this was not a good thing, the response was that the kids would just have to choose. The students actually came to me and asked what we could do because the school was literally falling apart from their perspective, with a myriad of problems not just the scheduling.) There were no indications that anyone in an authority position cared, which was dispiriting. The combination of the two was enough to convince both my husband (who taught math in the same department—we met there) and me to “retire” from the district. We felt vindicated when the administration was changed the next year.

AR: Did you move immediately to Michigan State, or did something else come along first?

GB: My husband and I had been working with Tom Romberg and a team from the Wisconsin Center for Educational Research (WCER) at the University of Wisconsin—Madison and from the Freudenthal Institute in the Netherlands on a middle school curriculum project, building on what we had done at Whitnall using Dutch materials in our algebra courses. When we left Whitnall, Tom offered us jobs at the WCER while I was President-Elect of NCTM. I was full-time as NCTM President for two years. While I was immediate Past President, one of the people I had worked with at NCTM, Joan Ferrini-Mundy, the chair of the group responsible for the 2000 Principles and Standards for School Mathematics, brought me to the National Research Council (NRC) as assistant director for the Mathematical Sciences Education Board and then as the Director when she left for Michigan State. The NRC was where I really learned about research and how to write NRC reports that stood up to the harshest scrutiny; it was a new and fascinating experience and stood me well in the years to come, but I did miss the “real world” of teaching. After three and a half years, I followed Joan to MSU.

AR: Before I ask about your work at NRC, I have to ask about your time as NCTM president. I didn't realize that this is a full-time position. Can you shed some light on the day-to-day activities involved?

GB: When I started as President, I had a half-finished curriculum unit for Math in Context, the middle school program we were working on, and thought I could easily finish it in the next few months. Wrong! At the time there were more than 20,000 NCTM members, with a lot going on and a lot of people involved (we organized, wrote and had reviews of the Principles and Standards for School Mathematics during my term, and the document was published in 2000). I had very little free time. My weekends (typically Thursday to Sunday) were taken up by going to NCTM regional conferences, state conferences, committee meetings (the plan was that the President would be present for at least one meeting per year for each of the committees—and there were more than ten committees and task forces), annual meetings of organizations such as MAA, NCTM Board meetings, and meetings of groups such as the Conference Board of the Mathematical Sciences (CBMS). Monday to Wednesday was spent writing monthly columns for the NCTM newsletter, articles for the NCTM journals, preparing talks for the weekend meetings, being interviewed by the media, finding and inviting people to be on committees and task forces, and
putting out fires, many related to the “math wars” that were going on during my tenure. I was involved in an active outreach campaign to counter accusations that were raging during the math wars about the original 1989 *Curriculum and Evaluation Standards*; critics claimed that it was “rainbow” mathematics that relied on pictures instead of mathematical reasoning and was “dumbing down” the curriculum.

One of my favorite stories was when I was asked to explain what NCTM believed about mathematics on the *Today* show with Katie Couric and Matt Lauer. It was fascinating getting prepped to be on the show, actually trying to help Matt and Katie do a sixth-grade math problem that involved reasoning about pictures that represented systems of equations intended to lay the foundation for the more typical abstract approach that would come later. (Over break Matt and Katie continued the conversation between themselves about how the math worked—which was fun to hear.)

**AR:** Wow, that does sound fascinating! What kind of questions did Matt and Katie ask you?

**GB:** Basically what were the “math wars” about—why all the fuss. I explained that many people had misconstrued some of the statements in the 1989 *Curriculum and Evaluation Standards for School Mathematics*—for example, the notion that drill-and-practice should be deemphasized and more focus on conceptual understanding was taken to mean eliminate drill-and-practice or that students should be constructing learning to mean that students were supposed to recreate for themselves the ideas involved from the ground up. Our language has evolved a bit since then and we talk more about engaging students in the mathematics, active learning with a focus on student thinking, and how we can use their ideas to shape the discussions. We often seem to get caught up in a detail and make it the “magic bullet” that either will destroy mathematics or increase student understanding (depending on your perspective), instead of thinking about new ideas in a balanced way. Katie and Matt were very interested in how NCTM was thinking about mathematics teaching and learning and seemed to enjoy doing the problem. It was a fun experience.

**AR:** Back to your work at NRC: What does the Mathematical Sciences Education Board do?

**GB:** The Mathematical Sciences Education Board (MSEB) was founded in 1985 at the National Research Council to provide leadership in mathematics education in the United States, advice to federal, state and local agencies related to mathematics education, increase public understanding of the mission and nature of the mathematical sciences, recommendations to strengthen the infrastructure of mathematics education, and assistance in determining curricular goals, higher standards for all students and improve teacher preparation. It was a coalition of educators, mathematicians, parents and representatives from government, business and industry. To that end, they designed projects focused on efforts such as ways to increase access, promote curricular standards, shape thinking around assessment. The work reached into states, out to families, and joined with other associations such as NCTM through MSEB workshops, conferences, and study groups. They produced many reports and publications, including *Everybody Counts* in 1989 and *On the Shoulders of Giants* in 1990. I was a member as a high school teacher where I was fortunate to be able to meet and work with mathematicians such as Hy Bass and Roger Howe, people who gave me real insight into mathematics and what it means to be a mathematician. When I returned many years later as staff, MSEB was more focused on ways in which research could support improvement in mathematics education, and one major effort was a U.S.—Japan Workshop, held after ICME10 in Japan, which helped us in the U.S. understand the nature of Japanese lesson study and paved the way for much of the work in that area that is going on today. MSEB ceased to exist in 2007, primarily for funding reasons as well as a shift in the direction of the MSEB oversight Board. Given the many challenges that mathematics and statistics education face today, it seems like reviving MSEB or creating a similar entity might help the nation move forward.

**AR:** What are some of the most pressing challenges that you are referring to?

**GB:** This was a really difficult question to answer in a succinct way—forced me to reflect across the big picture and really think about my concerns. At least from my perspective, one big challenge is what has happened with assessment in schools, including the nature of the tests being given, the frequency of testing and its impact on time spent learning, the effect on teachers in terms of their jobs and salaries, and the impact on the curriculum that is actually taught (enacted curriculum). It is clearly the case that what is tested is what is taught—and in addition to the general issues related to these assessments, many of the high-stakes assessments do not test student understanding and ability to use statistical concepts, and as a consequence, statistics is the unit that is easy to omit from the curriculum. And, too often assessment items labeled as “statistics” are merely computational. Another challenge is having enough qualified teachers in all schools and grades; enrollment in many teacher preparation programs is declining and an equitable distribution of teachers in terms of expertise and experience as well as diversity is far from a reality in classrooms and schools across the United States. Many schools are making do with teachers with lesser qualifications out of necessity. This is particularly true for those teaching statistics, who often have a fragile knowledge of the content and struggle with the same concepts they are supposed to be teaching. And far too few teacher preparation programs include courses in statistics that are relevant to teaching in K-12.

Too many students do not have opportunities to take challenging mathematics and statistics taught by competent teachers, and the gaps are growing. For example, in many states NAEP achievement results show continued improvement in scores but at the same time an increase in the standard deviations of those scores. The system seems to thrive on educational fads, with each new administration finding their own “magic bullet” intended to solve all of the problems, which typically have little or no research foundation and create new hurdles for students and teachers to jump through. Schools try to be “data driven,” but many do not have a clue what to do with the data. For example, every student in Michigan receives an achievement report for their performance on the state test, which includes
working jointly to design texts and carry out professional development activities. This does not seem to be the case in many other countries, and I think a lot of credit goes to the American Statistical Association and its leaders for their commitment and support over the years for K-12 education.

**Pop Quiz**

**AR:** Let's proceed to what I call the "pop quiz" portion of the interview, where I will ask a series of unrelated questions and will request that you keep your responses brief. First, please tell us about your family.

**GB:** My husband Jack was also a mathematics teacher, and we taught at the same high school in Wisconsin for many years. He worked a bit at Michigan State and is now retired. We have two sons, John who is married to Janet Braisted and has two sons, Nate and Jacob, and lives in Redwood City, California; and Matthew who is married to Donelle Roberts, has a son Brady and a stepson, TJ, and lives in Oconomowoc, Wisconsin. Right now our lives as grandparents are pretty much consumed with sports!

**AR:** What are some of your hobbies?

**GB:** I read a lot, crossword puzzles, Sudoku, jogging, hiking, cross country skiing. We used to whitewater canoe and do a lot of biking but not so much in recent years.

**AR:** What are some recent books that you have read?

**GB:** I read a lot of murder mysteries/detective stories and not so much heavy lifting. One kind of fun series is the *Chronicles of St. Mary's* series by Jodi Taylor. I also read and enjoyed MAA's *Math Through the Ages* as background for teaching a class in the history of mathematics.

**AR:** Please name three favorite travel destinations, one that you visited for professional reasons, one that you visited for pleasure, and the top spot that still remains on your bucket list.

**GB:** Most of my travel has been work-related and then sometimes we add on. A great conference site was Cairns, Australia (I got to go scuba diving). Both the north and south islands of New Zealand are fantastic places to visit with wonderful people. The top spot on my bucket list is a wine tour of France.

**AR:** And now a fanciful question: You can have dinner anywhere in the world (all expenses paid) with three companions, but the dinner conversation must revolve around teaching statistics. Who would you invite, and where would you eat?

**GB:** Intriguing question. I would invite Chris Wild, who has been thinking hard about statistics for a long time and really focuses on the nuances involved in understanding statistical ideas. I would also invite Hyman Bass, a world-class mathematician from University of Michigan and former president of ICMI, who has been thinking deeply about mathematical knowledge and teaching. Because of the differences in mathematics and statistics, I have found it very valuable to try to articulate how
statistics works to mathematicians who are sincerely interested and ask very good, probing questions. Finally, if I were in a fantasy world and could invite someone who is no longer living, I would invite David Freedman (1938–2008); *Statistics*, which he coauthored, was my go-to for trying to understand how to teach many, many statistical concepts. We would go to a restaurant on the beach in Katwijk aan Zee, Netherlands and have the sole. (If I have to invite a final guest who is still living, it would be Chris Franklin, because she has great ideas about how to construct activities that get at the meaning of core statistical concepts.)

AR: Another fanciful question: You can travel in time to observe what’s going on in the world for one day. What time would you travel to—in the past or the future—any why?

GB: I struggled with this. Despite really liking the history of math and finding it useful to what I do now, I am not sure if revisiting the past could better inform my work or whether it would be best to go forward. I will opt for a day in the future, maybe 50 years from now, where I could visit or note how mathematics and statistics were being taught (maybe classrooms will not be where this takes place then).

Conclusions

AR: Thanks again, very much, for all of the time and thought that you’ve invested in this interview. I have just two final questions. First, among all of your activities and accomplishments in statistics education, of which one are you most proud?

GB: Maybe two things. I was really flattered and honored to be the first high school teacher to become an ASA Fellow, basically in recognition of the work I did on the NCTM/ASA Joint Committee and to promote getting statistics into the school curriculum in all sorts of ways. The second would be my recent work with two colleagues, Tom Dick and Wade Ellis, designing applets to build understanding of core statistical concepts (*Building Concepts: Statistics and Probability*). The 22 interactive applets are designed to support teaching the statistics and probability concepts outlined in the Common Core State Standards but can be used in a variety of teaching and learning contexts. I have been doing research on their use with elementary preservice students, and the results are very promising. It took many hours of hard discussions to try to get to the core ideas in most cases and then figure out how to unpack these for students. It was hard but fun—and I am hoping some of the most productive work I have done.

AR: Finally, what advice do you offer to those who are just starting their careers in statistics education?

GB: I’m thinking about this in two ways. The first is about teaching statistics, where much of what I would say has already been said by others: use real data, begin with a graph (Tukey’s “interocular impact”), hands-on activities, informal investigations before definitions and formulas, take time to develop conceptual understanding (what is a deviation?) and revisit concepts in different situations, use simulation to introduce inference and to give students experience with random behavior. My work in professional development with teachers has maybe added a broader dimension to thinking about teaching in general. Just to offer a few thoughts, again said by others: Students don’t learn by telling; they learn by doing and reflecting on what they have done. Listen to what students are thinking rather than for correct answers, and use that thinking to shape your instruction; never say anything a student can say. Be open to new ideas or technological tools that can support better instruction for more students.

The second aspect for those just starting their careers in statistics education is to say yes to the challenges. Work with colleagues, find projects related to your work that can help you grow as a statistics educator, seek out conferences and attend sessions by leaders in the field, join ASA and IASE and take advantage of the opportunities they offer, seek out research articles in the *Statistics Education Research Journal (SERJ)* and the *Journal of Statistics Education (JSE)* that can inform your practice. Statistics is a great field, totally engaging and can be a wonderful and generative professional home.