

Know Thyself: Is This Possible?

Norman G. Lederman¹ · Judith S. Lederman¹

Published online: 2 May 2016

© The Association for Science Teacher Education, USA 2016

As researchers in science teacher education, and science education research in general, we often consider the sample size of our studies and the studies of others. The ultimate concern is how much we can believe or generalize the results of a study with a small sample size. What constitutes an adequate sample size is a perennial argument and how much a small sample size can establish “believability” has just as long a history (Edgar & Billingsley, 1974; Krathwohl, 2009). Consider two common situations relative to this debate. There are 300 people in the audience of a magic show and the magician appears to pull a rabbit out of a hat that was previously empty. All 300 people have no problems testifying that the rabbit suddenly appeared. They can provide no explanation, but they have no problems agreeing on what they have seen. Alternatively, a woman makes visits her doctor because she is feeling a consistent pain in her abdomen. It is especially acute after eating a meal. The doctor checks for ulcers and runs a series of other diagnostic tests, but can find no physiological or anatomical evidence for the pain. The doctor tells his patient that nothing is wrong, but she insists she feels the pain. Should we believe the 300 people in the magician’s audience more than the single woman, just based on sheer numbers of observations? In addition, the woman is observing something about herself, as opposed to what others have agreed they have seen external to themselves. This immediately raises questions about potential bias. Returning to science education research and research in science teacher education, small sample sizes and research on oneself raise concerns that clearly exceed what

✉ Norman G. Lederman
JSTE@iit.edu

✉ Judith S. Lederman
JSTE@iit.edu

¹ Illinois Institute of Technology, Chicago, IL, USA

is seen in “typical” and “rigorous” traditional research designs. In some ways this harkens back to the contentious debates about the value of qualitative research (Jacob, 1987; Peshkin, 1993; Rist, 1977).

The quality of the K-16 science curriculum and the level of students’ science achievement remain critical global concerns. Science education has always chased the ever elusive goal of scientific literacy and dissatisfaction with students’ knowledge and ability typically leads to concerns about the science curriculum and science teachers. Eventually, stakeholders and policymakers focus on teacher education programs (i.e., graduate degree programs, preservice programs, and professional development programs) and those directly involved with the education of teachers. Of course the “blame game” focuses on many factors, but science teacher education is believed, by many, to be the root cause of many of the problems related to the quality of science teaching and students’ learning of science.

We have the privilege of editing the *Journal of Science Teacher Education*, the flagship journal of the Association of Science Teacher Educators. It is the only peer reviewed research journal that focuses solely on science teacher education at all levels. The manuscripts we receive focus almost exclusively on systematic research on the impact of various forms of preservice and inservice teacher experiences with the typical outcomes being teacher knowledge and practice. The general design of the studies submitted to *JSTE* for potential publication is usually one or more researchers studying the development and/or change in science teachers’ knowledge and/or practice. Rarely do we receive manuscripts that involve a science teacher educator turning a reflective eye on her/him self. We strongly believe that there is much to be gained from studies that generally adhere to an increasingly popular genre of research known as “self study.” Research characterized as self study has been popularized by Bullough and Pinnegar (2001), LaBoskey (2004), and Loughran (2014), among others. These are studies in which the science teacher educator/researcher looks in the mirror and is transformed into the unit of analysis. It is true that self studies often involve “critical friends” who are colleagues of the researcher and serve as a source of data, but in the end the researcher in a self study becomes the research sample. Yes, the sample size is often one, as in the case of the woman having abdominal distress (nothing is intentionally implied by the parallel example). Given that self study investigations have small sample sizes and involve the researcher ultimately studying her/him self, it is a research approach that often falls under criticism as being of less value and rigor than “traditional” empirical research. Our purpose here is to discuss the implications of self study research for science teacher education, from our perspective as editors of *JSTE*.

Before continuing the discussion of the implications of self study for research on science teacher education, it should be of some value for us to discuss the criteria used for making editorial decisions about the publication of research manuscripts submitted to *JSTE*. In general, Editorial Review Board Members, Associate Editors, and the Editors-in-Chief consistently ask the following questions with respect to each submitted manuscript:

1. Are the purpose and research questions clearly stated?
2. Does the literature review provide a rationale and theoretical/conceptual framework for the proposed study?
3. Is the research methodology clearly described in detail?
4. Do assessment instruments have appropriate validity and reliability?
5. Is the data analysis appropriate and clearly described?
6. Are the conclusions supported by the evidence?
7. Do the findings add to the literature on a question of importance to science teacher education and have practical applications for the practice of science teacher education?

Question #2 is the criterion that is the primary reason for manuscripts being rejected for publication and it was the focus of our November, 2015 editorial. Our June editorial each year provides detailed information about which problems eventually lead to manuscripts not being accepted for publication in *JSTE*.

Question #7 is of critical importance and deserves some further elaboration, especially with respect to the implications of self study research for research in science teacher education. On occasion, manuscripts are received that replicate findings that are already well known with numerous supporting articles. For example, it is well-known that with respect to professional development, “one size does not fit all.” Best professional development must be customized to teachers’ needs and take into account where teachers are in terms of their knowledge and skills (Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003). A new study in a different location that just reiterates what is now common knowledge is not adding to the empirical literature.

Just as science teacher educators find themselves in various contexts and roles, self study research in science teacher education is quite varied. The three most common categories are studies in methods courses, studies in subject matter courses, and studies of the development of one’s personal identity as a science teacher educator and/or making the transition from classroom teacher to science teacher educator. As you might expect, self study investigations are typically qualitative with multiple data sources. In some sense these investigations are quite similar to case studies, notwithstanding the clearly introspective preference. The focus of reflection on one’s practice is not a new idea, but it has typically been applied to self-reflection by teachers (Schon, 1991). The multiple data sources provide a strong argument for the validity and verisimilitude of the research findings. This is critically important because most individuals are a bit skeptical of researchers collecting and analyzing data they have collected about themselves. These multiple data sources are wide ranging and may include; observations of teaching by others, interviews with colleagues and students, written and oral feedback from students about their perceptions of the researcher’s teaching practices, and personal journals written by the researcher, instructional and artifacts such as lesson plans and assessments. The diverse and multiple data sources used in self study coincides nicely to questions #4 (Do assessment instruments have appropriate validity and reliability?) and #5 (Is the data analysis appropriate and clearly described?) in the list of *JSTE* review criteria. Although self study

investigations are different than what is typically found in the literature, their collection and analysis of data to answer the research questions align well with what is found in the more “traditional” empirical literature.

As mentioned previously, we are strong believers that quality research in science education should impact and/or change classroom practice and learning, whether it is in K-12 settings or preservice/in-service contexts. Given the importance of effecting positive change, it seems to us that self-study provides a more direct connection to change than researchers studying other individuals. After all, when one collects data on her/himself the data are not abstract or distant. The data are about ourselves. When we all read research about people we do not know or even when we directly complete research on others, it seems one step removed from having an effect. Instead of having to just convince yourself to change your practice; you have to convince others to change their practice from the findings of research conducted with others. It is also clear that one of the most important outcomes of self-study is the necessary heightened attention to students by the researcher (i.e., teacher educator). This seems like an odd comment because we all know good teachers pay close attention to the needs of their students. But the critical issue here is that the self-study methodology, through its data sources, really facilitates and necessitates attention to students through systematic collection of data from students about one’s teaching.

Studies of the development of one’s transition from classroom teacher to science teacher educator are enlightening because the perspective is on the teacher educator rather than students or preservice/in-service teachers. Often, in our field, it is not recognized that being an excellent science teacher involves a very different skill set than being a science teacher educator. All too often, we are quick to hire classroom teachers as adjuncts to teach a science methods course. But the content of a methods course is different than the content of a science classroom. The content of a methods course has its own pedagogical demands with which even the best of classroom teachers may not be familiar as new science teacher educators. This is in line with what we have learned from the research on pedagogical content knowledge. There is a parallel between such studies and studies of preservice teaching. In each case the individual is learning how to do something she/he has not done before. There are differences of course, but there are just as many similarities.

As Editors of *JSTE*, we are convinced that self-study investigations in science teacher education can have an important and productive impact. We feel such research, if carefully completed, is just as rigorous and as valuable as more traditional research designs. Studies that focus on the researcher reflecting upon his/her practice and thinking provide a unique perspective. Naturally, there are particular areas of research that are in need of attention and we feel would have the potential to improve science teacher education research and practice. Following are just a few examples.

The Professional Development of Science Teacher Educators

It is not at all common to see studies of the professional development of science teacher educators after they have officially received their rights of passage in the community (i.e., a Ph.D. in science education and procurement of a university position

that involves teacher education at some level). It seems that the field can be enlightened and move forward significantly if a culture of continued professional development was in place within the community. Science teacher educators would quickly point to their attendance and presentations at the meetings of professional organizations as professional development. And, of course, they certainly are. However, “how does the attendance at such professional meetings change one” practice? How do science teacher educators use such experiences to reflect on their own practice? The field needs self study research in which science teacher educators study their participation and reactions to professional development activities (self-designed or the usual types). Hopefully, we all get better at what we do over the years, but there is no systematic documentation of our personal and professional development and which types of activities seem to have the most impact on our practice.

The Process of Developing Preservice and Inservice Teacher Education Programs

As science teacher educators most, if not all, of us have been involved in revising preservice and inservice program requirements or even creating totally new programs. How to we decide on what changes need to be made? What sources of information do we use to make such changes? How do we arrive at consensus with our colleagues? How do we personally feel about the changes that are made and how does this impact our commitment and enthusiasm for the enactment of the program changes? How do we each personally perceive the enactment of the changes and their effectiveness? How committed are we to simply making our programs look like the ones we each graduated from? Many of these topics are discussed “off line” at social gatherings and informal conversations with colleagues at other institutions. However, there is no large volume of research in the empirical literature. It is an important topic and could be significantly addresses through self-study research.

Development of new programs and revisions of existing programs is a reality of the teacher educator” life. The decisions that are made can be both painful and joyous. Regardless, there is always a level of deep personal concern. Whether we like to admit it or not, we all have are own personal biases or, to be more positive, professional convictions. Some of us are only marking territory and some of us are looking out only for the needs of our students. Regardless of how you want to look at it, we can all be helped by having systematic self-study research documenting how others have confronted such situations. We all can benefit from being more reflective on our own reactions to these situations of change.

Studies of Personal and Professional Development of Teacher Educators With and Without Teaching Experience

There is a perennial discussion concerning the importance of having teaching experience before embarking on the path of becoming a science teacher educator through graduate education. On the one hand, there are those who will say that it is

doubtful one can offer credible advice to a preservice or inservice teacher if he/she has never taught. The same could be said about doing research on teacher education. After all, we often say that “you can” teach what you have never done.” On the other hand, there are countless examples of individuals who have been successful teacher educators (and teachers) without ever having taught or completing a teacher education program. In North America some states require that all university teacher educators have previously been certified to teach or are currently certified to teach. Again, this is only legally mandated in some states, but not all. Outside of North America it is very common for individuals to teach in schools without going through a teacher education program or become university teacher educators without ever having taught. Most of the discussions around this topic are usually theoretical; there is scant empirical research that supports one side or the other.

It seems intuitive that the thought processes and professional development of individuals who have taught and those who have not would be very different as they travel the path to becoming a science teacher educator and/or science teacher education researcher. Having some introspective data on what these individuals are thinking and how they are perceiving and reacting to the courses they take would be significant and it would have the potential to transform the nature of our graduate programs. Should there be different curriculum tracts? Are there certain experiences that are essential for all, or does it make no difference? In any case, it appears that self study investigations that establish single case studies or compare multiple case studies would be quite illuminating and significant to the field.

Personal and Professional Development of a Person with Secondary Education Experience Becoming an Elementary Science Teacher Educator

The structure and nature of Ph.D. programs in science education around the world requires graduate work in a science area that ranges from “some” graduate work in a science area to either a Masters degree or the equivalent. Most people who have worked in elementary schools who choose to move to university positions do not have the science backgrounds to complete graduate work in the sciences. Hence, they usually enter Ph.D. programs in curriculum and instruction or elementary education. Preservice elementary education programs are quite abundant, but it is difficult to find university science teacher educators with experience teaching in the elementary grades. Consequently, those individuals working as elementary science teacher educators are all too often secondary science teacher educators that have a desire to be involved with elementary teacher education or whose positions require that they do some work with elementary teachers. In either case, there is clear recognition of the situation that many elementary science teacher educators are really individuals whose previous focus was on secondary level teaching. Once again this is a PCK issue. There is considerable literature on the different focus of attention that exists between elementary and secondary teachers.

Self study research on the thinking processes of a person who is transforming from a focus on secondary teaching to a focus on elementary teachers could be quite illuminating. It is also often the case that science teacher educators are assigned the task of providing science subject matter courses designed for elementary teachers. However, whether it is a science course or a methods course, how is the secondary teacher educator perceiving his/her audience? Is he/she working from a deficit model in a science course? Should he/she be doing so in a science course, or should he/she be teaching the same science that a secondary teacher would need? In terms of methods courses, does the teacher educator feel there may be a credibility problem? How is the potential credibility problem alleviated? What does the secondary teacher educator learn from elementary teachers? Again, all these questions are important and they are best answered through the self-reflection of the teacher educator. In addition to providing insight to others, the self study investigation should directly inform the practices of the secondary science teacher educator.

Summarizing Our Reflections on Self Study

We consider self-study as a legitimate form of research with the same rigor and value of more traditional approaches to empirical research. It is true that the sample size in self study research is one or close to one. However, the purpose is not to generalize from a single investigation (Wolcott, 1990). The purpose of a single investigation is to potentially effect change on the researcher and his/her practice. It is only after several similar studies yield similar results that considerations of generalizing to other situations and individuals may be pursued. In terms of any bias created by the researcher analyzing data collected on her/him self, this is a bit of a misconception. In self study investigations it is clear that there are typically multiple data sources, not just the reflections of the researcher. Consequently, there are more than enough opportunities to triangulate data and not simply rely on the data collected by the researcher about her/him self. In short, it is clear from the investigations in this text that the researcher's conclusions were reached from a combination of data collected from sources other than self reflections.

Self study is a powerful research approach that has the potential to significantly impact science teacher education and science teacher education research. It appears to be useful as an experience in a professional development program as well as a research endeavor for scholars in the field. At a minimum, it can effect change during the actual investigation in terms of immediate revisions to instructional practice, as opposed to being limited to impacts following the investigation. Most research may impact change, but only after completion and after reflection by the researchers and other researchers. More ambitiously, self-study can eventually serve to develop theory in the field as well as give rise to changes in policy related to science teacher education. As editors of *JSTE* we welcome submissions of self study investigations as equally as other forms of empirical research.

References

- Bullough, R. V. J., & Pinnegar, S. (2001). Guidelines for quality in autobiographical forms of self-study research. *Educational Researcher*, 30, 13–21.
- Edgar, E., & Billingsley, F. (1974). Believability when $n = 1$. *The Psychological Record*, 24, 147–160.
- Jacob, E. (1987). Qualitative research traditions: A review. *Review of Education Research*, 57(1), 1–50.
- Krathwohl, D. R. (2009). *Methods of educational and social science research*. Logrove, IL: Waveland Press, Inc.
- LaBoskey, V. K. (2004). The methodology of self-study and its theoretical underpinnings. In J. J. Loughran, M. L. Hamilton, V. K. LaBoskey, & T. Russell (Eds.), *International handbook of self-study of teaching and teacher education practices* (Vol. 2, pp. 817–869). Dordrecht: Kluwer.
- Loucks-Horsley, S., Love, N., Stiles, K., Mundry, S., & Hewson, P. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin Press.
- Loughran, J. J. (2014). Developing understandings of practice: Science teacher learning. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research in science education* (Vol. 2, pp. 811–829). New York, NY: Routledge.
- Peshkin, A. (1993). The goodness of qualitative research. *Educational Researcher*, 22, 24–30.
- Rist, R. C. (1977). On the relations among educational research paradigms: From disdain to detente. *Anthropology & Education Quarterly*, 8(2), 42–49.
- Schön, D. A. (Ed.). (1991). *The reflective turn: Case studies in and on educational practice*. New York, NY: Teachers College Press.
- Wolcott, H. F. (1990). On seeking, and rejecting, validity in qualitative research. In E. W. Eisner & A. Peshkin (Eds.), *Qualitative inquiry in education* (pp. 121–152). New York, NY: Teachers College Press.