Addressing the Need for an Undergraduate Statistics Teaching Observation Protocol

Caitlin Ireland
University of North Carolina at Charlotte

Keywords: introductory statistics, teacher practices, observation protocol, statistical knowledge for teaching

Historically, teacher knowledge has been categorized by the work of Shulman (1987): general pedagogical knowledge, knowledge of learners and their characteristics, knowledge of educational contexts, content knowledge, curriculum knowledge, and pedagogical content knowledge (Shulman, 1987). Ball, Thames, and Phelps (2008) expanded on these ideas by identifying mathematical tasks of teaching and tying them to Ball et al.'s (2008) adapted domains for mathematical knowledge for teaching (MKT).

The work of Gleason, Livers, and Zelkowski (2017) led to the Mathematical Classroom Observation Protocol for Practices ($MCOP^2$). The instrument "examines teaching mathematics for conceptual understanding through lenses examining teacher facilitation and student engagement" (p. 113). This research has served as the basis for continued observation protocol work, such as that conducted by the CoMInDS program (Lauren & Haberler, 2017). Another instrument that has been developed around the concept of observing teacher practices is the Mathematical Quality of Instruction (MQI) (Hill, Schilling, and Ball, 2004) which was used to measure Mathematical Knowledge for Teaching (Hill, Blunk, Charalambous, Lewis, Phelps, Sleep, & Ball, 2008).

However, there are few resources that pertain to observing practices in statistics education. Cobb and Moore (1997) argue that statistics' inherent focus on variability lends itself to a need for contextualization. They point out that "design, exploration, and interpretation [which] are core elements of statistical thinking" (p. 805) do not fall under traditional mathematical skills. Likewise, content in statistics differs from typical mathematics content. Thus, it is necessary to teach statistics differently than mathematics.

Groth's (2013) statistical knowledge for teaching (SKT) framework adds to Hill et al.'s (2004) domains with key developmental understandings (Simon, 2006, as cited in Groth, 2013), and pedagogically powerful ideas (Silverman and Thompson, 2008, as cited in Groth, 2013). Callingham and Watson (2011) published research on levels of SKT: aware, emerging, competent, and accomplished. In a hypothesized model of SKT, Batur (2021) embedded Callingham and Watson's (2011) levels with Groth's (2013) framework to develop a five domain framework that can be assessed at four levels, all with the aim of centralizing statistical literacy.

It is using this model that I believe I could create items for the development of a new instrument to observe a teachers' current abilities in statistical teaching, and potentially assess or evaluate their SKT. Therefore, my current questions for this study are 1) How are teachers currently enacting SKT in the classroom? And 2) How can we observe and evaluate SKT in the classroom? My plan to answer these questions would be to 1) observe for qualitative data collection what is currently happening in statistics classrooms, and 2) use the extant literature and my observations to find or write items for a new observation protocol. The target population for this instrument would be AP Statistics high school teachers or introductory statistics college course instructors. Further development of the instrument would require a validation study.

Acknowledgments

This material is based upon work supported by the National Science Foundation under DRK-12 Grant #2143816 and #2517085. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the view of the National Science Foundation.

References

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389-407. https://doi.org/10.1177/0022487108324554

Batur, A. (2021). Characterization of middle school mathematics teachers' statistical knowledge for teaching [Unpublished master thesis]. Trabzon University.

Callingham, R., & Watson, J. M. (2011). Measuring levels of statistical pedagogical content knowledge. In C. Batanero, G. Burrill, & C. Reading (Eds.), Teaching statistics in school mathematics–Challenges for teaching and teacher education: A joint ICMI/IASE study (pp. 283-293). Springer. https://doi.org/10.1007/978-94-007-1131-0_28

Cobb, G. & Moore, D. (1997). Mathematics, statistics, and teaching. *The American Mathematical Monthly, 104*(9), 801-823. https://doi.org/10.1080/00029890.1997.11990723

Gleason, J., Livers, S., & Zelkowski, J. (2017) Mathematics Classroom Observation Protocol for Practices (MCOP2): A validation study. *Investigations in Mathematics Learning, 9* (3), 111-129. DOI: 10.1080/19477503.2017.1308697

González, O. (2014). Secondary mathematics teachers' professional competencies for effective teaching of variability-related ideas: A Japanese case study. *Statistique et Enseignment, 5*(1), 31-51.

Groth, R. E. (2013). Characterizing key developmental understandings and pedagogically powerful ideas within a statistical knowledge for teaching framework. *Mathematical Thinking and Learning, 15,* 121-145. https://doi.org/10.1080/10986065.2013. 770718

Hill, H., Blunk, M., Charalambous, C., Lewis, J., Phelps, G., Sleep, L., & Loewenberg Ball, D. (2008). Mathematical Knowledge for Teaching and the Mathematical Quality of Instruction: An Exploratory Study, *Cognition and Instruction, 26*(4), 430-511. DOI: 10.1080/07370000802177235

Hill, H. C., Schilling, S. G., & Ball, D. L. (2004). Developing measures of teachers' mathematical knowledge for teaching. *Elementary School Journal, 105*, 11-30. https://doi.org/10.1086/428763

Laursen, S., & Haberler, Z. (2017). CoMInDS Program Profile: Bowling Green State University & University of South Carolina. In Program Profiles, College Mathematics Instructors Development Source (CoMInDS). Washington, DC: Mathematics Association of America. http://cominds.maa.org

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22. http://dx.doi.org/10.17763/haer.57.1.j463w79r56455411