

Mathematics Education Qualifying Exam
August 2013

The following five questions constitute the Mathematics Education Qualifying Exam for August of 2013. The questions are separated into two sections. You must answer both questions in Section I and two of the three questions in Section II. In Section II, make sure it is clear which questions you are answering and would like considered. You have four hours to complete this exam. Remember to save your work frequently.

Section I:

1. Consider the vignette provided, *Not Quite Right*. In this excerpt, the teacher is conducting a lesson on parallel and perpendicular lines. Using what you know from the research literature about the development of mathematical understanding and the use and evolution of symbol systems, explain how the teacher, Laura, could have approached the lesson differently so that deeper connections might have been made by the students. Pay particular attention to Sfard's (1991) construct of the interiorization-condensation-reification process and Kaput, Blanton, and Moreno's (2008) model for the development of symbolic meaning. You do not need to limit yourself to these two perspectives, but please include a treatment of both of them in your response.

2. In 2003, the Mathematical Association of America (MAA) released the, *Guidelines for Programs and Departments in Undergraduate Mathematical Sciences*. As part of these guidelines, the MAA gives a stance on the use of technology in undergraduate courses including advocating for the use of graphing technology and computer algebra systems (CAS). Now, ten years later, there are still many faculty who will not allow the use of such technology for the teaching and learning of mathematics. Using your knowledge of the research literature on the use of graphing technology and CAS, write a position paper to convince your colleagues that appropriate use of these technologies will lead to deeper understanding of mathematical concepts while still addressing their legitimate concern of a decrease in pencil-and-paper skill ability. Be sure to cite relevant research on both technology use as well as general theories of learning.

Section II:

1. The study by Dubinsky and Yiparaki (2000) uses what is known as “mixed methods”. This means that the study has both quantitative and qualitative components. Discuss the different methodology used for each component of the study. Then discuss in detail some of the things that these scholars learned from the quantitative portion of the study that could not have been discovered by the qualitative portion alone and some things that were discovered by the qualitative portion of the study that could not have been discovered by the quantitative portion alone.
2. Reliability and validity are important when conducting and critiquing mathematics education research. Begin by providing thorough definitions of both reliability and validity. Then discuss multiple techniques that Dubinsky and Yiparaki (2000) used to address reliability and validity within their study.
3. Many scholars have discussed the various purposes of proof (Hanna, 1990; Hersh, 1993; Segal, 2000; Weber, 2002, 2010). Begin by providing a thorough discussion of the different purposes of proof and use this to argue how a deep understanding of these different roles can be used to improve one’s teaching of advanced mathematics.