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My research focus is physics education research (PER), or the research in the teaching and learning of physics. I conduct in-depth investigations of student thinking in the solution to both qualitative and quantitative physics problems. One particular focus in my independent research is student learning in advanced courses like upper-level mechanics and quantum physics. When students have difficulty in such courses, to what extent are their difficulties rooted in basic concepts, and to what extent are they instead intrinsic to the material they encounter in these advanced courses? (Are the students’ difficulties tied more closely to the more sophisticated physical concepts, or the more sophisticated mathematics, or possibly both?) I also am engaged in research projects, particularly with physics majors who are working on secondary certification, that focus on learners in our introductory courses. (See examples of past projects below.)

One overall objective of PER is to learn more about the structure and evolution of student thinking in physics—how students construct their knowledge, how solidly or loosely connected their ideas seem to be within their conceptual framework, and how to effect meaningful conceptual change. Results from this research and other PER studies can be incorporated to develop of innovative teaching strategies or to guide the adaptation and implementation of existing PER-based curricula. The same methods used to probe student thinking are then used to assess the effectiveness of the modified instructional methodology. Like other physicists, we are keenly interested in understanding the physical world and “knowing how we know” what we know; as physics education researchers we also endeavor to understand how students make sense of the physical world and to be more effective in helping our students do so.

Recent PER projects conducted with GVSU physics students:

K. Barber: *Student learning of wave mechanics through an inquiry-based approach,* 2011.

E. Michel: *Effectiveness of structured learning assistance instruction in rotational kinematics,* 2010.

B. Farlow: *Making connections: Investigating the effectiveness of laboratory instruction techniques on student conceptual understanding of DC resistive circuits,* 2009.

T. Major: *An exploration of student understanding of equations using work and the law of conservation of energy,* 2008.

K. Pachla: *An analysis of two non-traditional instructional methods,* 2008.