PURDUE UNIVERSITY

SCHOOL OF ENGINEERING EDUCATION

POST-DOCTORAL FELLOW POSITION

The Mathematical Modeling Research Group at Purdue University has a position available immediately for a post-doctoral fellow. The work of this research group is described on the next pages.

This position is funded to analyze data and disseminate findings around student work on Model-Eliciting Activities, with particular emphasis on the impact of peer and teaching assistant feedback on student work.

During this one-year position, the postdoctoral fellow would participate in data analysis, supervise the work of graduate research assistants, train graduate and undergraduate teaching assistants, publish research papers, contribute to grant writing, and help shape the overall scope and direction of the research. This is an opportunity to learn about design research methods and research-to-practice from a group with a 10-year history of conducting research on open-ended problem solving in a first-year engineering setting. Continuation of the position for a second year is contingent upon available funding and first year performance.

A successful candidate for this position needs strong qualitative and quantitative research skills, and good communication skills (particularly written). Prior knowledge of/interest in problem solving, mathematical modeling, or design education would be helpful.

This position is being offered from within the vibrant community of scholars at Purdue University's School of Engineering Education. ENE has 22 faculty, 10 postdoctoral fellows, and more than 50 PhD students in engineering education. Approximately 1700 students enter our First-Year Engineering Program each year, and there are 75 students in the Interdisciplinary Engineering Program. ENE is home of the first PhD program in engineering education and of INSPIRE, the Institute for P-12 Engineering Research and Learning. This position offers opportunities to participate in this wider ENE community. Applicants with a career trajectory leading to a faculty position may be considered for a mentored teaching experience as a Future Faculty Fellow.

If you are interested in this position, please send your CV, cover letter, and contact information for three references (or reference letters that also include contact information) to Heidi Diefes-Dux, Associate Professor of Engineering Education (hdiefes@purdue.edu) or Monica Cardella, Assistant Professor of Engineering Education (mcardell@purdue.edu). This position will remain open until filled.

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Mathematical Modeling Research Group

Our research is about designing, implementing, and assessing student work on open-ended engineering problem, and it is highly tied to actual classroom implementation. Data is collected *in situ* with all the complications that entails. As a result, our team employs a design-based research methodology, wherein particular research questions are pursued but we learn from the system as a whole too. What is learned in one implementation cycle is fed directly into the next for continuous and documented improvement.

This work is about recasting the models and modeling theoretical perspective, which originated in mathematics education, for engineering education. It about developing and successfully implementing authentic open-ended, team-oriented problems set in engineering contexts that require, in our case, first-year student teams to create generalizable mathematical models for direct users. It is also about developing and successfully implementing authentic and impactful feedback and assessment strategies that improve the quality of student work and increase student learning.

Two to four Model-Eliciting Activities have been implemented and studied each Fall and Spring semester since Fall 2002 in a first-year engineering course with enrollments up to 1600 students. We are constantly (re)designing MEA instruction, training instructors, implementing MEAs, collecting and analyzing data around the implementation, and disseminating results.

Our current research falls into three main categories:

Problem Formulation:
- How do students individually formulate the problem presented in an MEA?
- How are individual ideas translated into a team problem formulation?
- How do TAs assess students' problem formulations?
- How do students' ability to formulate problems change across multiple MEAs implemented in the same semester?
- What is the impact of new instructional strategies around problem formulation?

Students' Mathematical Model Development:
- What is the quality of student team solutions in terms of mathematical model and generalizability?
- How do student models change across drafts?
- How do changes in MEA design or implementation impact student team solutions?

Feedback and Assessment:
Teaching Assistants (TAs)
- How do TAs perceive their ability to give feedback and assess student work?
- How reliably do TAs apply MEA rubrics?
- What is the nature of TAs' written feedback on student teams' solutions to MEAs?

Peers
- How do peers perceive their ability to give feedback and assess peer work?
- How reliably do peers apply MEA rubrics during peer review?
- What is the nature of peer written feedback on student teams' solutions to MEAs?

Students' Use of Feedback
- How do students perceive their ability to respond to feedback?
- How do student teams interpret feedback?
- What is the impact of TA and peer feedback on student team solutions?

Heidi Diefes-Dux, Associate Professor & Monica Cardella, Assistant Professor
School of Engineering Education, Purdue University

Book

1. Zawojewski, J. S., Diefes-Dux, H., & Bowman, K. (Eds.) (2008). *Models and modeling in Engineering Education: Designing experiences for all students.* Rotterdam, the Netherlands: Sense Publishers.
   - Diefes-Dux. H.A, Hjalmarson, M., Miller, T., and Lesh, R. (2008). Chapter 2: Model-Eliciting Activities for Engineering Education
   - Moore, T., Hjalmarson, M., and Diefes-Dux, H.A. (2008). Chapter 3: Designing Modeling Activities for Engineering
   - Diefes-Dux, H.A. and Imbrie, P.K. (2008). Chapter 4: Modeling Activities in a First-Year Engineering Course
   - Diefes-Dux, H.A., Osburn, K., Capobianco, B., and Wood, T. (2008). "Chapter 12: On the Front Line – Learning from the Teaching Assistants
   - Diefes-Dux, H.A. and Capobianco, B. (2008). Chapter 13: Learning from a Faculty Self-Study

Journal Publications

1. Verleger, M., Diefes-Dux, H., Ohland, M.W., Besterfield-Sacre, M., and Brophy, S. (2010). Challenges to Informed Peer Review Matching Algorithms, *Journal of Engineering Education*. *99*(4): 397-408.
2. Diefes-Dux, H.A., Zawojewski, J.S., and Hjalmarson, M.A. (2010). Using Educational Research in the Design of Evaluation Tools for Open-Ended Problems, *International Journal of Engineering Education*. Special Edition. *26*(4):807-819.
3. Diefes-Dux, H.A., Hjalmarson, M., Zawojewski, J., and Bowman, K. (2006). Quantifying Aluminum Crystal Size Part 1: The Model-Eliciting Activity, *Journal of STEM Education: Innovations and Research*, 7(1&2):51-63.
4. Hjalmarson, M., Diefes-Dux, H.A., Bowman, K., and Zawojewski, J. (2006). Quantifying Aluminum Crystal Size Part 2: The Model-Development Sequence, *Journal of STEM Education: Innovations and Research*, 7(1&2):64-73.

Conference Proceedings

1. Carnes, M.T., Diefes-Dux, H.A. & Cardella, M.E. (2011). Evaluating Student Responses in Open-Ended Problems Involving Iterative Solution Development in Model Eliciting Activities (MEAs), 2011 ASEE National Conference Proceedings, Vancouver, CAN.
2. Fry, A., Cardella, M.E. & Diefes-Dux, H.A. (2011). Student Responses to and Perceptions of Feedback Received on a Series of Model-Eliciting Activities: A Case Study, 2011 ASEE National Conference Proceedings, Vancouver, CAN.
3. Merugureddy, R., Salim, A., Diefes-Dux, H.A. & Cardella, M.E. (2011). Feedback and Assessment of Student Work on Model-Eliciting Activities: Undergraduate Teaching Assistants' Perceptions and Strategies, 2011 ASEE National Conference Proceedings, Vancouver, CAN.
4. Salim, A. & Diefes-Dux, H.A. (2011). Model-Eliciting-Activities (MEAs) as Sites for Postdoctoral Researcher Training in Course Instruction and Development, 2011 ASEE National Conference Proceedings, Vancouver, CAN.
5. Carnes, M.T., Cardella, M.E., and Diefes-Dux, H.A. (2010). Progression of student solutions over the course of a Model-Eliciting Activity (MEA), Frontiers in Education Conference, October 2010, Washington, DC.
6. Verleger, M.A. and Diefes-Dux, H.A. (2010).Facilitating Teaching and Research on Open-Ended Problem Solving through the Development of a Dynamic Computer Tool, 2010 ASEE National Conference Proceedings, Louisville, KY.
7. Salim, A. and Diefes-Dux, H.A. (2010).Graduate teaching assistants' assessment of students' problem formulation within Model-Eliciting Activities, 2010 ASEE National Conference Proceedings, Louisville, KY.
8. Diefes-Dux, H.A. and Verleger, M.A. (2009) Student Reflections on Peer Reviewing Solutions to Model-Eliciting Activities. Frontiers in Education Conference, San Antonio, TX.
9. Salim, A. and Diefes-Dux, H.A. (2009). Problem Identification during Model-Eliciting Activities: Characterization of First-Year Students' Responses, Proceedings of the Research in Engineering Education Symposium (REES), Palm Cove, QLD.
10. Cardella, M.E., Diefes-Dux, H.A., Verleger, M.A., Oliver, A. (2009). Insights into the Process of Providing Feedback to Students on Open-Ended Problems. 2009 ASEE National Conference Proceedings, Austin, TX.
11. Diefes-Dux, H.A., Verleger, M.A., Zawojewski, J.S., and Hjalmarson, M.A. (2009). Multi-Dimensional Tool for Assessing Student Team Solutions to Model-Eliciting Activities. 2009 ASEE National Conference Proceedings, Austin, TX.
12. Verleger, .M.V. and Diefes-Dux, H.A. (2008). Impact of Feedback and Revision on Student Team Solutions to Model-Eliciting Activities. 2008 ASEE National Conference Proceedings, Pittsburg, PA.
13. Moore, T., Diefes-Dux, H.A., and Imbrie, P.K. (2007). How Team Effectiveness Impacts the Quality of Solutions to Open-Ended Problems, International Conference on Research in Engineering Education (ICREE), Honolulu, HI.
14. Moore, T., Diefes-Dux, H.A., and Imbrie, P.K. (2007). Spontaneous Groups Versus Long-Term Teams: An Investigation Using Complex Problem Solving in a First-Year Engineering Course, 2007 ASEE National Conference Proceedings, Honolulu, HI.
15. Moore, T., Diefes-Dux, H.A., and Imbrie, P.K. (2006). Assessment of Team Effectiveness during Complex Mathematical Modeling Tasks, Frontiers in Education Conference, San Diego, CA.