

Support for mathematicians' teaching reform in an online working group for inquiry oriented differential equations

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There is more need for research on how mathematicians can alter their teaching style to a reform approach (Speer, Smith, & Horvath, 2010), especially if they have always been teaching the same way (Speer & Wagner, 2009; Wagner, Speer, & Rossa, 2007). One particular area that needs more work is investigations of support structures for mathematicians hoping to reform their teaching practice. This poster focuses on supports designed to aid in the reform of teaching practice and specifically discusses the Teaching Inquiry-oriented Mathematics: Establishing Supports (TIMES) project and one online working group (OWG) used as a mode of support in the project. Results indicate that facets of the OWG are successful support structures for mathematicians who desire to align their practice to an inquiry oriented (IO) approach to undergraduate differential equations (Rasmussen & Kwon, 2007; Rasmussen, 2003).

Key words: inquiry oriented, differential equations, support, instructional reform

There is clear evidence of the effectiveness of the inquiry oriented differential equations (IODE) curriculum and materials (Kwon, Rasmussen, & Allen, 2005; Rasmussen, Kwon, Allen, Marrongelle, & Burtch, 2006) and a plethora of research on the enactment of that curricula (e.g., Keene, Lee, & Lee, 2011; Rasmussen & Marrongelle, 2006; Rasmussen, Stephan, & Allen, 2004; Stephan & Rasmussen, 2002). However, just because reform curricula have been proven to be effective in certain contexts does not mean that mathematics instructors will be able to effectively implement the reform curricula unless they have support to do so (Speer et al., 2010; Speer & Wagner, 2009; Wagner et al., 2007).

The TIMES project is currently supporting the development and refinement of a set of instructional supports to aid university mathematics faculty in shifting towards an inquiry-oriented (IO) practice. Important to the project is not just that the mathematics instructors use the IO materials, but that they receive multiple forms of contact with the lead researchers to aid in that desired shift of practice. The form of contact which this poster focuses on, is a weekly online working group (OWG) which uses lesson study (Lewis, Perry, & Hurd, 2009) that are composed of four week-long segments. In two of those weeks, instructors seek help from their fellow instructors and from the facilitators to improve their teaching practices, and they use video clips from their own classrooms to facilitate that discussion. I observed one OWG in which the instructors were sharing videos of themselves, and particular attention was paid to the types of questions that the instructors asked their fellow instructors. Specifically, this report addresses the following research question: *What types of questions do mathematicians ask in an online working group for inquiry oriented differential equations and how do these questions relate to their perception of support from the online working group?*

Methodology

This report focuses on three of the participants currently in the IODE OWG. All three come from small liberal arts colleges/universities across the country and are all teaching IODE for the first time. One form of data came from interviews with the three participants (audio-recorded and

self-transcribed). Additionally, I observed and took live field notes of one OWG where the instructors were sharing videos of their teaching of the systems of differential equations unit. To analyze the interview data, I began with an initial set of codes (i.e., content, pedagogical, logistical, and advice questions) that would be useful in answering the research question. Then I open coded transcripts to discover emergent themes. Lastly, I compared the field notes from the OWG observation to the interview transcripts to confirm instructors' claims of their dominant question type in the OWG.

Preliminary Findings and Conclusions

Results from the analysis highlighted several components of support afforded by the OWG. That support is directly correlated to the types of questions that instructors asked in the OWG. Because all three instructors are from small colleges/universities, being part of a collaboration with fellow instructors is unique for these participants. They can collaborate about innovate approaches to their teaching without being tied down by departmental regulations. Participant A remarked about the importance of honest feedback from her fellow instructors,

I think that the fellow instructors tend to give honest feedback. And so since I am in such a small department here, it is really helpful to have honest feedback from people who are not involved in any departmental politics.

Furthermore, the instructors typically are not afforded opportunities to reflect on their teaching practice in their work environment simply because there are no support structures that exist within these participants' departments specifically focused on allowing them to reflect on their teaching practice. Participant B noted,

And so where I think I can get the most benefit out of this of this kind of experience is when I can reflect with others on how that went so that I can see where I need to be anticipating or what I need to be thinking about more in that chaotic moment when I am processing the whole class.

Similarly, Participant C stated how he receives, "an on the spot, real time, type of feedback" from the OWG. Further, Participant B mentioned he does not observe other teachers teach in their classroom and has no one observe him in his classroom. This, however, does happen in the OWG when they all watch videos of their fellow instructors teaching in the lesson study.

Every instructor noted how the OWG allows them to ask questions to their fellow instructors about their teaching practice, past or future. Thus, questions that emerge in the OWG are used by the instructors to address the concerns that they have about teaching practice, which are not addressed by colleagues at their own colleges/universities. However, at the root of all instructors' questions type choices are notions of structures that are missing from their practice, yet are inherent components of the OWG. Ultimately in answer to the research question,

The OWG allows instructors to reflect on their teaching practice because they can ask for advice and feedback from the fellow instructors in a safe and collaborative environment to improve their implementation of the IODE material and their holistic teaching practice, which does not happen in their normal work atmospheres.

These results are from an early investigation of support structures for mathematicians hoping to reform their teaching practice. They show promise for additional and exciting research on support structures for mathematician's instructional reform. The implications from this work add knowledge to the field of undergraduate mathematics education and instructor professional development and highlight the power of OWGs in mathematicians' instructional reform.

References

- Keene, K. A., Lee, J. T., & Lee, H. S. (2011). Linking instructor moves to classroom discourse and student learning in differential equations classrooms. In *Proceedings of the 14th Annual Conference on Research in Undergraduate Mathematics Education* (pp. 111–115).
- Kwon, O. N., Rasmussen, C. L., & Allen, K. (2005). Students' retention of mathematical knowledge and skills in differential equations. *School Science and Mathematics*, *105*(5), 227–240. <http://doi.org/10.1111/j.1949-8594.2005.tb18163.x>
- Lewis, C. C., Perry, R. R., & Hurd, J. (2009). Improving mathematics instruction through lesson study: A theoretical model and North American case. *Journal of Mathematics Teacher Education*, *12*(4), 285–304. <http://doi.org/10.1007/s10857-009-9102-7>
- Rasmussen, C. L. (2003). *Inquiry-oriented differential equations instructional materials*. Unpublished materials.
- Rasmussen, C. L., & Kwon, O. N. (2007). An inquiry-oriented approach to undergraduate mathematics. *Journal of Mathematical Behavior*, *26*(3), 189–194. <http://doi.org/10.1016/j.jmathb.2007.10.001>
- Rasmussen, C. L., Kwon, O. N., Allen, K., Marrongelle, K., & Burtch, M. (2006). Capitalizing on advances in mathematics and K-12 mathematics education in undergraduate mathematics: An inquiry-oriented approach to differential equations. *Asia Pacific Education Review*, *7*(1), 85–93. <http://doi.org/10.1007/BF03036787>
- Rasmussen, C. L., & Marrongelle, K. (2006). Pedagogical content tools: Integrating student reasoning and mathematics in instruction. *Journal for Research in Mathematics Education*, *37*(5), 388–420. Retrieved from http://web.stevens.edu/golem/llevine/CIESE/student_reason_math_instruction.pdf
- Rasmussen, C. L., Stephan, M., & Allen, K. (2004). Classroom mathematical practices and gesturing. *Journal of Mathematical Behavior*, *23*, 301–323. <http://doi.org/10.1016/j.jmathb.2004.06.003>
- Speer, N. M., Smith, J. P., & Horvath, A. (2010). Collegiate mathematics teaching: An unexamined practice. *Journal of Mathematical Behavior*, *29*, 99–114. <http://doi.org/10.1016/j.jmathb.2010.02.001>
- Speer, N. M., & Wagner, J. F. (2009). Knowledge needed by a teacher to provide analytic scaffolding during undergraduate mathematics classroom discussions. *Journal for Research in Mathematics Education*, *40*(5), 530–562. <http://doi.org/10.2307/40539355>
- Stephan, M., & Rasmussen, C. L. (2002). Classroom mathematical practices in differential equations. *Journal of Mathematical Behavior*, *21*(4), 459–490. [http://doi.org/10.1016/S0732-3123\(02\)00145-1](http://doi.org/10.1016/S0732-3123(02)00145-1)
- Wagner, J. F., Speer, N. M., & Rossa, B. (2007). Beyond mathematical content knowledge: A mathematician's knowledge needed for teaching an inquiry-oriented differential equations course. *Journal of Mathematical Behavior*, *26*(3), 247–266. <http://doi.org/10.1016/j.jmathb.2007.09.002>