

Contributing to the Development of Grand Challenges in Maths Education

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The goals of this workshop are to

- Introduce a global community of educators and researchers to the concept of Grand Challenges based on the Research Committee Research Commentary published in JRME (Stephan et al., 2015);
- Develop a collective understanding of what are seen as Grand Challenges in various countries;
- Provide a mechanism for ongoing virtual discussion and feedback to support the development of Grand Challenges in Maths Education.

What are Grand Challenges?

In 1900, a mathematician named David Hilbert presented a set of challenging problems before the International Conference of Mathematics and argued that mathematics was at a crossroads and a sense of direction was necessary to guide the field forward in the next century. He submitted a list of mathematics problems that had yet been solved and some questions that had not even been asked. He expected that these problems would spark creativity and discovery, yet acknowledged that it was difficult to know how important a problem would be in advance. A good problem is one that is easy to understand yet “difficult ... to entice” mathematicians to explore it (Hilbert, 1902, p. 438). He also understood the importance of a community of scholars being able to determine when a problem is solved, the need to develop new representations to express a problem, and the ability to explain its solution.

Hilbert probably did not anticipate that his list of problems would prove so inspirational to other fields that, based upon his idea, began to create lists of Grand Challenges for their disciplines. The goal of Grand Challenges is to prioritize the most pressing problems that research should address. In the U.S., the National Academy of Engineering recently released a list of 14 Grand Challenges that, if solved, could significantly change the lives of millions of citizens around the world (National Academy of Engineering of the National Academies, 2008). The list includes challenges such as making solar energy economical, engineering better medicines, and preventing nuclear terror.

According to Gould (2010), Grand Challenges:

1. Represent complex and extremely difficult questions that are solvable (potentially within 10–20 years);
2. Improve the quality of life through positive educational, social, and economic outcomes potentially affecting millions of people;
3. Involve multiple research projects across many sub-disciplines to be satisfactorily addressed;

4. Require measureable outcomes so that progress and completion can be identified; and
5. Compel popular support by encouraging the public to relate to, understand, and appreciate the outcomes of the effort.

While there are significant differences in the local and national challenges when you consider maths education globally, there are also likely to be significant overlap. The endeavor of ICME is founded on the desire “promote the collaboration, exchange and dissemination of ideas and information on all aspects of the theory and practice of contemporary mathematical education.” (ICMI Homepage.) The voluntary participation in and adoption of a common set of Grand Challenges in Maths Education work to support the international collaboration toward common challenges.

1. Key questions and issues for the Discussion Group or the Workshop to consider.

The following are key questions the workshop group will consider with respect to Grand Challenges:

- What are characteristics of question/research question that qualify it as a grand challenge?
- As you consider the state of maths education in your community/country what would you see as research questions that could qualify as grand challenges?
- Which of a preliminary set of additional questions would be of interest to the maths education and research community for your country? What are the benefits and what are the risks?
- Are there opportunities to engage educators, researchers and policy makers in the development of Grand Challenges in Maths Education and collaborative efforts to solve these problems?

References

- Gould, M. (2010). GIScience grand challenges: How can research and technology in this field address big-picture problems? *ArcUser*, 13(4), 64–65. Retrieved from <http://www.esri.com/news/arcuser/1010/files/geochallenges.pdf>
- Hilbert, D. (1902). Mathematical problems. *Bulletin of the American Mathematical Society*, 8(10), 437–479. doi:10.1090/S0002-9904-1902-00923-3
- National Academy of Engineering of the National Academies. (2008). Grand challenges for engineering. Retrieved from <http://www.engineeringchallenges.org/cms/8996.aspx>
- Stephan, M.L., Chval, K. B., Wanko, J. J., Civil, M., Fish, M., Herbel-Eisenmann, B., Konold, C., & Wilkerson, T.L. (2015). Grand Challenges and Opportunities in Mathematics Education Research. *Journal for Research in Mathematics Education*, 46(2), 134–146. Retrieved from <http://bit.ly/1Yd4q2V>.