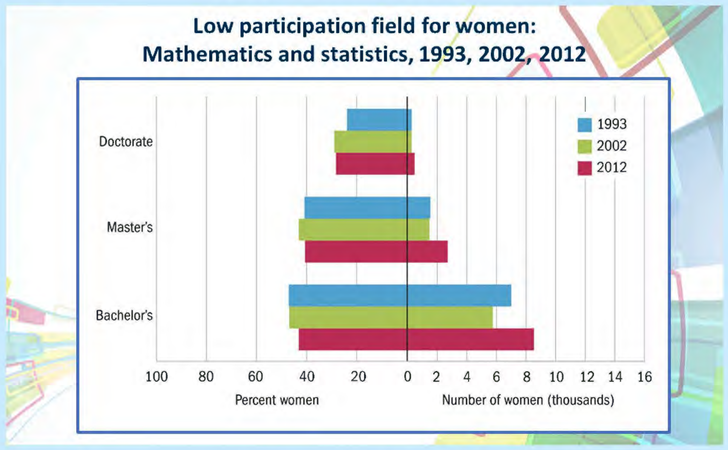
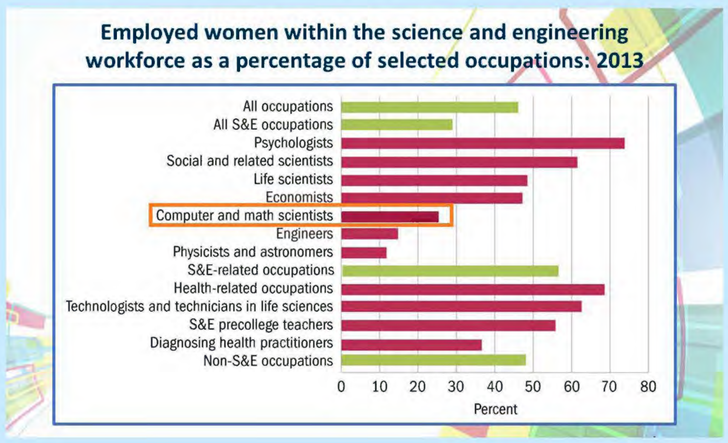
Undergraduate Research Fellowships: A Strategic Investment to Reduce Women Underrepresentation in the Mathematical Sciences

Janie L. Knell and Dr. Wilson González-Espada (mentor)
Department of Mathematics and Physics, Morehead State University

Women Underrepresentation in Mathematics





Undergraduate Research Fellowships: Investing for Women Success in Mathematics

* The MSU **Undergraduate Research Fellowship Program** (URF) is designed to provide talented undergraduate students with the opportunity to work with a faculty mentor on a research project associated with an academic discipline.

* Thanks to the **MSU URF** Program, I was able to present my research at professional meetings. By May 2016, I will have 16 poster or oral scholarly presentations and 2 publications. Meetings included Celebration of Student Scholarship (3), Kentucky Academy of Science (3), Kentucky Science Teachers Association (3), Kentucky Section of the Mathematical Association of America, (3), Kentucky Physics Teachers Association (2), and Posters at the Capitol (2).

* Using Item Response Theory to improve locally-constructed multiple choice tests: Measuring knowledge gains and curricular effectiveness. Electronic Journal of Science Education, 19 (7).

* Use of herbal supplements among college students in Eastern Kentucky: Impact factors. Journal of the Kentucky Academy of Science, 75 (1-2).

Study #1: 2013-2014
Use of CAM Therapies Among College Students in Eastern Kentucky: A Pilot Study

* Dietary supplements are pills, capsules, tablets, or liquid products that contain a vitamin, mineral, herb, botanical, or amino acid. These products are usually marketed using health claims that do not have to be approved or safety-tested by the US FDA. The literature on the use of dietary supplements has identified gaps in the knowledge associated with factors that influence their use, especially among young adults in rural Appalachia. This study (a) collected information regarding demographics, type of supplements and frequency of use, and (b) identified factors that are statistically related to an increased use of these alleged therapies. It was found that only two variables, amount of fruit and vegetables in the diet and number of physician visits per year, were related to increased dietary supplement use. Female participants who have a better perception of science as a discipline used dietary supplements more often, which is inconsistent with the fact that science does not support these products. It was noted that many participants could not differentiate dietary supplements from real medications. This information can be used to plan and implement targeted awareness campaigns that will educate college students about the lack of scientific evidence supporting the effectiveness of dietary supplements.

Study #2: 2014-2015
Using Item Response Theory to Improve Locally-Constructed Multiple Choice Tests: Measuring Knowledge Gains and Curricular Effectiveness

* Current science education reform efforts emphasize teaching K-12 science using hands-on, inquiry activities. For maximum learning and probability of implementation among inservice teachers, these strategies must be modeled in college science courses for preservice teachers. About a decade ago, Morehead State University revised their science content and science methods courses to follow an inquiry approach. As part of the courses' assessment, diagnostic pre- and post-testing was included and locally-made tests were prepared. The main purpose of this study is to use diagnostic assessment data to identify longitudinal science learning gains in a physical science (SCI 111) and a science methods (SCI 490) course. A related goal was to use Item Response Theory (IRT) to identify items that reduced overall test validity and reliability. It was found that SCI 111 students showed significantly higher scores and normalized gains in post-test scores compared with pre-test scores. Students who completed the curriculum "Physics and Everyday Thinking" showed higher gains than those that completed the curriculum "Interactions in Physical Science". In addition, SCI 490 students showed statistically similar pre- and pos-test scores and an average normalized gain of - 6%, suggesting that students are starting to forget some science topics. For each of the two diagnostic assessments, one for SCI 111 and one for SCI 490, between 6-8 items failed to meet IRT guidelines.

Study #3: 2015-2016
Mesoscale Meteorological Data Identifies Possible Effects of Climate Change in Western Kentucky

* The most recent consensus of the scientific community regarding global climate change is straightforward: "Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history." This study applied statistical approaches to daily data between 2007-2015 obtained from several WKU Kentucky Mesoscale Network stations, located in Western Kentucky, to test the predictions of global climate change at the mesoscale levels (between 1-150 miles in range). It was found that many Western KY counties showed evidence of statistically significant increases in climate parameters such as temperature, dew point, humidity, and solar radiation. Many Western KY counties showed evidence of a statistically significant decrease in average and maximum wind speed. Understanding mesoscale effects of climate change is important in order to plan ahead and make any necessary changes to minimize its economic and social impact.

Personal Thoughts on a Life-Changing Experience

* In the classroom, we are told that there are applications in the real world, but the URF Program showed me that problems in the real world can be solved using math methods from the classroom. I also learned about preparing and giving presentations. I'm a naturally nervous individual, and public speaking usually makes my nervousness even worse. Before, I had trouble explaining to people what something means, when it seems so obvious to me. By participating as a URF, I had to learn how to explain to others what was going on inside of my head about the project. The more presentations that I had to do, the more comfortable I got with giving them. Am I comfortable now? Not really, but I'm more comfortable than when I started.

* The fact that I have more presentations and publications than many other students at MSU feels surreal in a way. I know it gives me a step up in comparison to the other students, and I'm grateful at that. At the same time, however, I hope that other students can get similar opportunities. The URF was very beneficial to me, and I think it was/is/will be to others.

* I still sometimes just think of myself as a student that knows nothing about the real world. However, when I look back at the different URF experiences, I realize that I do know some things. I know that I have more to learn, but I've learned a lot by just being a part of the program.

Acknowledgements

* We would like to thank Morehead State University, the Department of Mathematics & Physics, and the Office of Research and Sponsored Programs for providing funding for these projects.