RADFORD UNIVERSITY

Artis College of Science and Technology

REALISE

Realising Inclusive Science Excellence

Spring Break... ahhhh, that was nice! Now recharged, check out these updates and opportunities:

- Peer role modeling program launches
- The value of diversity for solving problems
- Reading group and project-based learning community resumes after break

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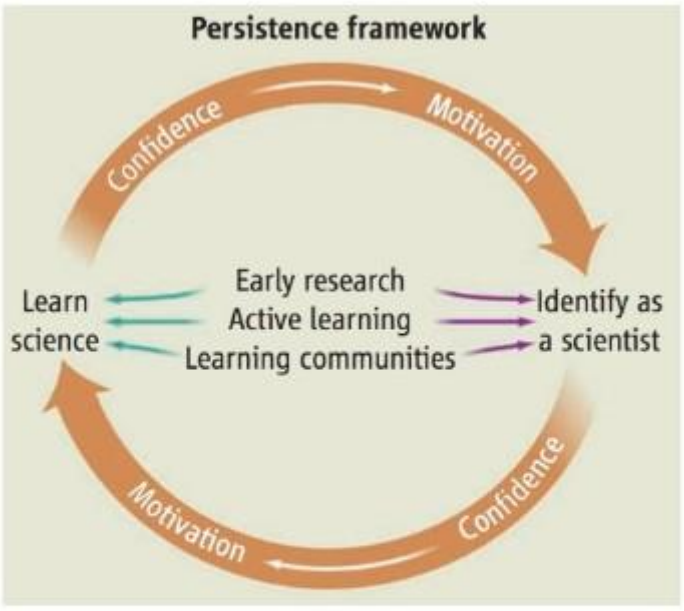
Peer role modeling program launches

Nationally, less than half of students entering college as STEM majors persist to graduate with a STEM degree. Graham et al. (2013) synthesized evidence-based approaches that increase student success, and perhaps surprisingly, found student attitude rather than aptitude was key (See figure below). Persistence was most strongly improved by providing engaging, relevant, active experiences for students that helped build their confidence, motivation and identity as a scientists. Waiting until the junior or senior year for our highest impact practices (e.g., undergraduate research, study abroad, open inquiry coursework) is too late for many students, particularly first-generation, minority, and female students.



The Persistence Framework. Confidence is belief in one's own ability; motivation is intention to take action in pursuit of goals; learning is acquiring knowledge and skills; and professional identification is feeling like a scientist.

From Graham MJ et al. 2013. Increasing persistence of college students in STEM. Science 341:1455-6.

Not coincidentally, REALISE is supporting curricular and instructional reforms across Biology, Chemistry, and Physics to include more authentic research and active learning in first- and second-year courses, consistent with Graham et al.'s framework. *The REALISE peer role-modeling program is meant to provide students that last critical piece - membership in a community of learners and a sense of identity as scientists.*

Peer role models have now started reaching out to all of our students through a number of mechanisms. Signs asking students about their "why" - why they chose science and why they chose Radford were posted around the Center for the Sciences. The role model team hosted a speed-gaming night, providing a welcoming social space for students to connect with each other across disciplines. Much more is on tap - a growing cohort of role models will be

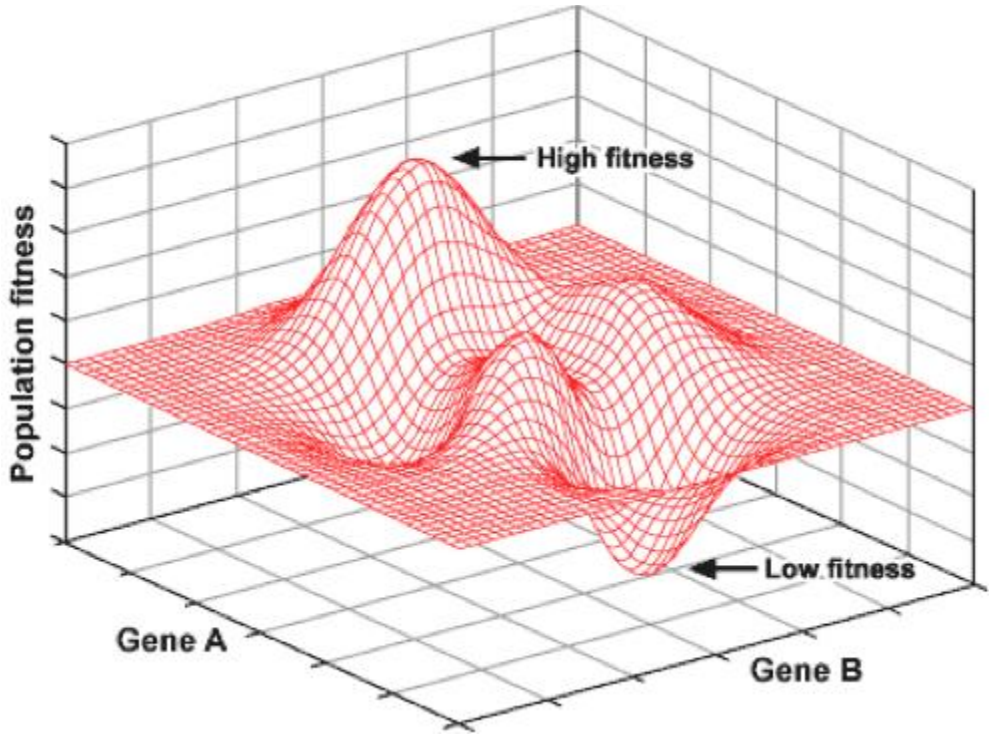
recruited for Fall 2018, and the frequency and diversity of outreach events will pick up.

Your good ideas about how to foster a culture of intellectual curiosity, rigor, and collaboration are most welcome. Involving a multidisciplinary community of students in your outreach event or community-based project could be a productive mutualism.

The Value of Diversity for Solving Problems

Sewall Wright proposed a powerful mental model for understanding evolution called the adaptive landscape. In Wright's landscape, the latitude and longitude corresponded to different combinations of trait values an organism could have, with each trait along one axis (more precisely, Wright described points as gene combinations). The height in the landscape represented the reproductive fitness of an organism with that set of traits (or genes). Natural selection would favor any change in traits that would move up the fitness landscape. Mutations and recombination of genes during sexual reproduction could produce organisms in new areas of the landscape, but most often

relatively near their parents in the landscape (and similar to their parents in terms of their traits). Those individuals with greater fitness will reproduce more, contributing more to the next generation, and over time, the population moves up the landscape toward an optimum set of traits. This mental model captures a lot of nuance in the process of evolution, including how organisms might get stuck on a local optimum in the landscape, without sufficient genetic diversity (new, divergent starting points in the landscape) to explore other, possibly better, trait combinations. Besides being a useful tool to understand evolution, the same mental model can be extended to many problem-solving situations.



https://evolution.berkeley.edu/evolibrary/images/evo/adaptivelandscape.gif

Scott Page from the University of Michigan studies complex adaptive systems in the context of economics, and often couches optimization problems in a similar landscape context. When used in this way, the ground plane corresponds to aspects of a particular solution, and the height represents a value function of that solution. For example, one could consider the subjective rating of ice cream flavor (z axis) as a function of the number of chunks (x axis) and the size

of chunks (y axis) embedded in the creamy matrix. Mmmmm.... chunks.

Page has provided rigorous mathematical theory on the value of diversity for finding optimal solutions to hard problems (for a digestible version, see *The Difference: How the power of diversity creates better groups, firms, schools, and societies*. 2007. Princeton University Press). But more colloquially, people with different experiences, histories, skillsets, and ideas will often define a problem differently. In Page's parlance, these are different perspectives, and represented as different landscapes. One person may see a problem as a single smooth hill, while another person sees the problem as having only one dimension, while a third may imagine a jagged, heterogeneous landscape.

To use a trivial but realistic example, if two companies are trying to make the best pasta, one might include taste and cost as the two important axes that define a landscape, while another might only optimize for taste. When problem solving, the person that includes a novel axis is often said to have been "thinking outside of the box", but perhaps more appropriately, they are looking at a different box. Now given their landscapes, each pasta maker will apply some algorithm or heuristic to explore the problem space. Gradient heuristics often try small variants from a starting point, and choose options that are improvements. This is analogous to natural selection driving trait values up the local landscape.

Even if our pasta manufacturers all use the same underlying heuristic for finding an optimal solution (gradient climbing, for example), they will arrive at different answers, because they essentially asked different questions. The pastafarian that optimized just on taste may have a delicious product that nobody buys because it is too expensive, while the two-dimensional perspective pastafarian might see their product flying off the shelf, despite it not tasting quite as good as their competitors.

Groups members will bring different perspectives to a single problem, but in

order for groups to benefit from diversity, there need to be good mechanisms to recognize and choose among the perspectives. Page uses a simple mathematical example to hammer this point home – describing a rectangle is easy on a Cartesian coordinate system, but more difficult on a polar coordinate system, while describing an arc is easier with the latter coordinate system. Changing perspectives can transform a difficult problem into a simple one. But sticking with a single perspective because it has worked for another problem in the past can be painfully counterproductive.

Diversity can also improve problem solving because different people also often bring different heuristics to a common problem. Thus, even if a single landscape perspective (or, definition of the problem) is reached by consensus, different people may explore the problem space via different problem-solving strategies. Returning to the pasta problem, even if two groups both saw the problem as a compromise between taste and cost, one might try adjustments to the existing ingredients in the pasta (gradient climbing), while another might try adding a list of other tasty ingredients one at a time. The latter approach might be considered an error-allowing heuristic, one that tries really divergent solutions in an attempt to escape a local optimum. It might not always go well – Oreos are generally thought to be tasty, but Oreo-pasta probably is not. However, sun-dried tomato pasta might be a winner, and a winner that wouldn't be discovered by a gradient heuristic.

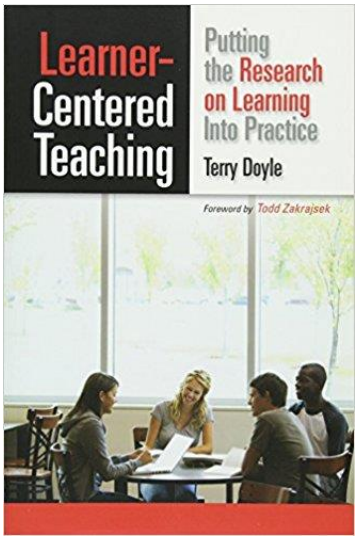
What does this have to do with REALISE, STEM education, or me?

We work in teams of faculty with departments and across the college. We hire new faculty. We select students to work with us on research. We teach groups of students, and often assign them work in teams. Post-graduation, our students will go on into graduate and professional schools and corporate settings where collaboration is paramount. In all of these situations, we are faced with problems, and have to make real decisions about how to work in teams, how to approach problems, and how to implement solutions. Real-life analogs of our trivial pasta example are not far from mind – as departments

reform their curricula, they often go through periods of small changes, trying to find a local optimum, and more periodically, attempt major restructuring, searching the landscape much more broadly for a better global optimum. Faculty view the curriculum through different lenses, almost certainly as very different landscapes with very different axes. Some reflection on the value of different perspectives, different problem-solving strategies, and especially how to generate, support and benefit from those differences is perhaps something for our departments to aspire to.

Spring STEMed Reading Group

We will continue to meet to discuss great teaching ideas and share our successes and failures in a supportive environment of peers.



Reading groups are open to any interested faculty member.

We will meet in CS 286, Fridays, at 1pm**.**

Date	Topic
2/2/18	*Doyle, Chapters 1-2* Follow the Research Getting Students to Do the Work *Project-based learning implementation community:* What assignments are you planning to implement, what help do you need from your peers?
2/9/18	
2/16/18	*Doyle, Chapter 3* The Power of Authentic Learning *Doyle, Chapter 4* From Lecturer to Facilitator
3/16/18	*Doyle, Chapter 7* How Teachers Can Facilitate Student Discussions by Not Talking

3/30/18	*Project-based learning implementation community:* Mid-course corrections. What structures were useful (rubrics, peer evaluation, managing team dynamics, etc.) and where do you still need help?
4/6/18	*Doyle, Chapter 6* Sharing Control and Giving Choices *Doyle, Chapters 8* Teaching to all the senses
4/13/18	The value of diversity for problem-solving *Project-based learning implementation community:* Lessons learned, new approaches for next time, faculty needs.

Center for Innovative Teaching and Learning

An invitation...

Whether you are interested, excited, nervous, or skeptical, we'd love to meet with you one-on-one for an informal chat about how we can:

- help you share your own expertise and experience with others that could benefit.
- use your concerns to improve the project as we go.
- help you find what you need to try something new in your course (e.g., materials, time, technical or instructional expertise).
- help you identify a part of the initiative that resonates with what you already do and value.
- plan for how you can get involved.
- define what the hell "Inclusive Excellence" is, anyways...

Contact Tara or Jeremy, and we can share some ideas over coffee.