

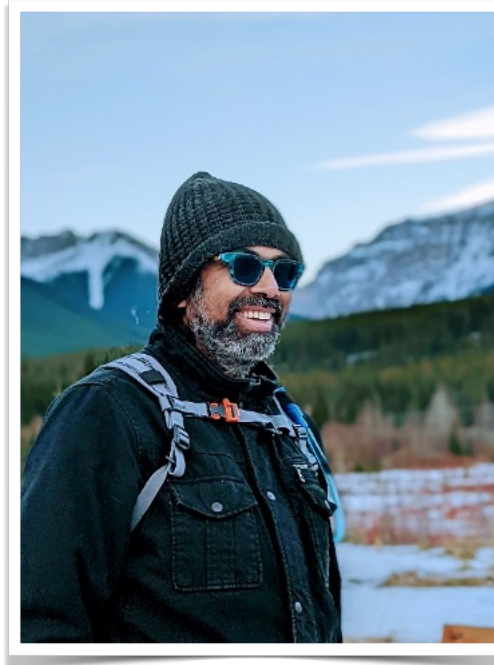
STEMester in Review

Kaput Center Newsletter

Welcome

After a hiatus during the 2020-2021 academic year, the Kaput Center reopened in Fall 2021 with Chandra Orrill reappointed as the Director. We resumed the colloquium series in Spring 2022. STEM4Girls will be back October 1 and we are starting to plan some new things for the coming year.

As always, you can email us at kaputcenter@umassd.edu or check us out at our website <http://kaputcenter.org>. We also have Facebook and Twitter accounts: <http://facebook.com/kaputcenter> and <https://twitter.com/kaputcenter>



Computational Science as a Complex, Ethical-Political Pivot in STEM Education

By Chandra Orrill, Kaput Center Director

Dr. Pratim Sengupta from the University of Calgary restarted the Kaput Center Colloquium series by offering our first colloquium since spring 2020. On March 2, he joined us via Zoom to talk about his trajectory of work across his career. In this fascinating talk, the audience was treated to a number of examples of students engaging with coding in ways that focused on the experiences of being human in the experience of working with code. Dr. Sengupta's work has focused on

aspects of playfulness, ethics, and emotions, among other constructs, as he has examined learning to code in a variety of settings. He characterizes his work as looking at the role of coding in centering stories from the margins, in supporting intergenerational interactions, and in helping learners learn to think critically about issues of discrimination. His presentation included short videos of people engaged in his research settings.

As a member of the audience, I particularly appreciated Dr. Sengupta's framing of his work in ways that allowed a wide variety of intersection points for the members of the audience. I found myself making connections to ideas in my own work and thinking about it in ways I had not previously.

To see Dr. Sengupta's presentation, visit this link: <https://www.youtube.com/watch?v=3A1IMF8ePFE>

E-Textiles in Schools

By Emmanuel Nti-Asante, STEM Education MS Student

In almost every academic semester, the Kaput center holds talks as part of its colloquium series.



This two-hour STEM speaker series provides the STEM Education community, including the Ph.D. students, opportunities to acquaint themselves with external researchers and leaders in the STEM education field. One expert who presented her research work and journey as a leader in STEM education for the 2022 Spring semester colloquium is Dr. Deborah Fields of Utah State University.

On March 25, 2022, Dr. Fields shared her research work and journey in the STEM world. In the first hour, she shared her multi-year development, implementation, and results of a ten-week curricular unit called Stitching the Loop. Stitching the Loop

integrates electronic textiles where students use conductive threads to connect sewable LEDs, microcontrollers, sensors, and other inputs and outputs onto fabric or similarly soft media. With the Stitching the Loop project, Dr. Fields described that her combination of traditionally classed and gendered activities such as engineering, crafting, and sewing disrupts students' and teachers' preconceptions about who can create with computing, engineering, and crafting.

Students and faculty engaged Dr. Fields in a question and answered session for the last hour of the session. Many questions asked Dr. Fields intriguing and insightful questions about the new pathways in her research trajectory.

Dr. Fields concluded her talk by highlighting her own thought-provoking and successful research journey and how the diverse research-oriented UMassD Ph.D. students could build their research along.

Dr. Fields' talk is available at <https://www.youtube.com/watch?v=b1Lz8WUQm6I>

Dr. Zandra de Araujo Challenges Our Deep-Seated Assumptions About Effective Teaching Practice

By: Karen Chang, Executive Board Member

On April 8th the Kaput Center hosted Dr. Zandra de Araujo, the Chief Equity Officer and Math Principal at the University of Florida's Lastinger Center for Learning. In her online presentation, (Re)Examining Assumptions, Dr. de Araujo challenges several ideas that are believed by many educators to be examples of effective teaching. She discusses findings from her past and present research projects in math education that have made her rethink these assumptions.

The first assumption Dr. de Araujo challenges is that textbook supports for English Language Learners (ELL) are beneficial. In her analysis of four popular Algebra 1 textbooks, she found several ways in which these textbook supports are not as beneficial as believed. Dr. de Araujo argues quite convincingly that these textbook supports are based on incorrect implied needs of ELL students, which can lead teachers to believe that ELL students are incapable of completing more challenging tasks resulting in the marginalization of this student population.

In the second part of her talk, Dr. de Araujo questions the very prevalent assumption among teachers that personalized teaching materials are best. In her Flipped Math Instruction study, Dr. de Araujo compared 50 eighth and ninth grade Algebra 1 classrooms, half of which were



traditional classes and half were flipped classrooms. In a flipped classroom, students typically watch an instructional video at home, and work on problem solving activities in class the next day. The study revealed that teachers spent an extreme amount of time making personalized videos, all of which were very similar to and no better than Khan Academy videos which are available for free online. In addition, based on student surveys and hit counts, a majority of students were not even watching the videos. Dr. de Araujo questions the value of these personalized videos and considers how teachers can use their limited prep time in better ways.

Most educators would agree that changing the instructional format throughout a lesson is an important factor to increasing student learning outcomes. In math education, a very popular belief is that having whole-class discourse is impactful for building competence. However, in her Flipped Math Instruction study, Dr. de Araujo made a shocking discovery that the classrooms that devoted more time to whole-class discourse correlated with lower student learning outcomes! Dr. de Araujo acknowledged that she has many questions about this result, and that more study is needed to understand this finding.

In the last portion of her talk, Dr. de Araujo describes her current research project, which questions the assumption that professional development (PD) programs should aim to change dramatically the way teachers teach. Many PD programs in math want teachers to transform from the traditional teacher-centric, lecture-based model to the student-centric, whole-class discourse model. However, Dr. de Araujo argues that because teachers are human beings and human beings do not change easily, PD programs that aim for radical change are ineffective in the long-run. In her new grant, she wants to develop a professional development model that is incremental, sustainable, and aims for modest improvements in teachers' practice. Instead of aiming to make 10% of teachers 90% better with transformative changes, Dr. de Araujo wants to find small ways to make 90% of teachers 10% better.

Dr. Zandra de Araujo's talk was truly thought-provoking and made us challenge our deep-seated assumptions of what constitutes good teaching. For more details, the entire presentation can be accessed at: <https://www.youtube.com/watch?v=a2EDdsqEzRE>



Citizen Science in Action – Integration of Biology and Computer Science. A Colloquium by Dr. Robert Gegear

By Hamza Malik, STEM Education PhD Student

On April 29th, the Kaput Center hosted Dr. Robert Gegear a Professor in the Department of Biology at the University of Massachusetts Dartmouth. He has been studying the neuroecology and conservation of pollination systems native to North America for over 25 years. He is the founder of the Beecology Project, a citizen science

effort to rapidly collect ecological data on threatened pollinator species in New England. For his community outreach activities related to wild pollinator conservation, Dr. Gegear was awarded the 2018 Regional Impact Award by the Native Plant Trust (formerly New England Wildflower Society).

During his talk, Dr. Gegear explained how the pollinators around the world are on verge of declining to the lowest level which is a huge threat to our ecosystem and biodiversity. He further explained that Beecology Project has also been beneficial in creating transdisciplinary opportunities to develop and implement various content area ideas. Some of these opportunities include creating a fully integrated STEM+C high school curriculum (the BIO-CS Bridge) that combines scientific practices such as experimental design and hypothesis testing with computational thinking and skills such as modeling, simulation, and systems approaches biology. During the session, he also shared some of the freely available BIO-CS Bridge educational tools that his team has developed for teachers, which include a mobile web app, computer simulations, online data visualization tools, and other online resources.

We appreciate Dr. Gegear helping us identify and understand the integration of biology and computer science fields that yielded an interactive citizen science project.

Dr. Gegear's talk is available at <https://www.youtube.com/watch?v=Ou1FD452tKw>

For more information on Kaput Center colloquium series, email kaputcenter@umassd.edu, or visit <http://kaputcenter.org/events/>.

Quick Notes:

- STEM4Girls is back!!! October 1, 2022
- STEM Week will be October 17-21. We are planning some great activities. Watch for them on social media.
- The Kaput Center Executive Board is delighted to welcome James Burke, Karen Chang, and Jay Wang as its newest members. All members serve 3 year, renewable terms.
- Board Member Paul Fredette was elected as Chair of the Board for a second term that will begin in September 2022.
- Chris Hoadley (NYU) and Pratim Sengupta (Univ of Calgary) are our newest Advisory Board members.
- The Kaput Center is under periodic review. This is a required process for all UMass Centers. We hope to get our report back in the Fall. If you are contacted to complete a survey as one of our stakeholders, PLEASE take a moment to do that for us!
- We were delighted to host Dr. Rita Borromeo Ferri and Dr. Andreas Meister from the University of Kassel in Germany. They are creating the STEM-Hub, a new STEM Center at their university being created by a grant from the state of Hesse. We spent our meeting talking about various structures, partnerships, and other considerations to build a strong Center. The Kaput Center is excited to watch STEM Hub grow and to seek out partnership opportunities with them!
- Congratulations to Center Director Chandra Orrill on her recent \$1.7 million NSF grant, Rational Numbers Playground. Working with Rachael Brown (Penn State Abington) and Al Cohen (Univ of Georgia), she will be continuing her work on developing PD for middle school math teachers that uses playful engagement with tasks supported by interactive technologies to strengthen teachers' knowledge and their teaching of proportions and fractions.
- Congratulations to Executive Board Member and Research Scientist Dr. Stephen Witzig. He has worked with the Lloyd Center for the Environment to develop the Lloyd Center - STEM Education Ph.D. Program Fellowship. This will create an ongoing opportunity for a doctoral student in STEM Education to be supported in their research related to Lloyd Center activities.

Published Articles and Proceedings

All of 2021 and Spring 2022. Bolded names are people currently affiliated with the Kaput Center.

Brown, R. E., & Orrill, C. H., (2021, October). Using proportional tasks to explore teachers' ability to make sense of student thinking. In Olanoff, D., Johnson, K., & Spitzer, S. (Eds), Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 419-426). Philadelphia.

Cieto, M. M., & Witzig, S. B. (2022). It starts at home: Building upon students' extracurricular interests and STEM knowledge in the classrooms through socio- scientific issues-based approaches. *Science and Children*, 59(5), 38-42.

Güçler, B. (2021). High school teachers' development of thinking about the limit concept. In Olanoff, D., Johnson, K., & Spitzer, S. M. (Eds.), Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, pp. 707-711. Philadelphia, PA.

Kayumova, S., Arrigo, A. F., Harper, A., Richard, E., & Welty, H. (2022). Supporting STEM identity development through asset-based positioning. Rapid Community Report Series. Digital Promise; International Society of the Learning Sciences. URI.

Kayumova, S. & Buxton, C. (2021): Teacher subjectivities and multiplicities of enactment: Agential realism and the case of science teacher learning and practice with multilingual Latinx students. *Journal of Professional Development in Education*. DOI: 10.1080/19415257.2021.1879225

Kayumova, S. & Tippins, D. (2021). The quest for sustainable futures: Designing transformative learning spaces with Black, Brown, and Latinx young people through critical response-ability. *Cultural Studies of Science Education*. DOI: 10.1007/s11422-021-10030-2

Nagar, G. G., Hegedus, S., & Orrill., C. H. (in press). High school teachers' discernment of invariant properties in a dynamic geometry environment. *Educational Studies in Mathematics*.

Orrill, C. H., & Brown, R. E. (in press). Using design based research to develop a professional development model. In J. M. Spector, B. B. Lockee, & M. D. Childress (Eds.), *Learning, design, and technology: An international compendium of theory, research, practice, and policy*. Springer.

Nagar, G. G., Hegedus, S., & Orrill, C. H. (2021, October). A framework for analysis of variance and invariance in a dynamic geometry environment. In Olanoff, D., Johnson, K., & Spitzer, S. (Eds), Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 1749-1753). Philadelphia, PA.

Orrill, C. H., & Brown, R. E. (2021, October). Teachers' knowledge resources for solving proportions. In Olanoff, D., Johnson, K., & Spitzer, S. (Eds), Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 461-465). Philadelphia, PA.

Orrill, C. H., Epstein, M., Wang, K., Malik, H., & Copur-Gencturk, Y. (2021, October). Designing assessment items for measuring PCK for proportional reasoning. In Olanoff, D., Johnson, K., & Spitzer, S. (Eds), Proceedings of the forty-third annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (pp. 492-493). Philadelphia, PA.

Orrill, C. H., Gearty, Z., & Wang, K. (in press). Continuing evolution of research on teaching & learning: Exploring emerging methods for unpacking research on teachers, teaching, and learning. In A. Manizade, N. Buchholtz, & K. Beswick (Eds.), The evolution of research on teaching mathematics: International perspectives in the digital era. Springer.

Orrill, C. H., & Millett, J. (2021). Teachers' abilities to make sense of variable parts reasoning. *Mathematical Thinking and Learning*, 23(3), 254-270. <https://doi.org/10.1080/10986065.2020.1795567>

Stroup, W & A. Petrosino (2021). Establishing statistical significance at scale for pattern-based items. Virtual poster and paper presented at the American Education Research Association Annual Meeting. Scheduled for Orlando, FL but held virtually.

Takeuchi, M. A., Kayumova, S., de Araujo, Z., & Madkins, T. C. (2022). Going beyond #RetireELL: A call for anti-colonial approaches to languages in STEM education. *Journal of Research in Science Teaching*, 1-4. <https://doi.org/10.1002/tea.21764>

Weiland, T., Orrill, C. H., Nagar, G. G., Brown, R. E., & Burke, J. (2021). Framing a robust understanding of proportional reasoning for teachers. *Journal of Mathematics Teacher Education*, 24, 179-202. <https://doi.org/10.1007/s10857-019-09453-0>

Waight, N., Kayumova, S., Tripp, J., & Achilova, F. (2022). Towards equitable, social justice criticality: Re-constructing the "Black" box and making it transparent for the future of science and technology in science education. *Science & Education*, 1-23. <https://doi.org/10.1007/s11191-022-00328-0>.