



Kaput Center for  
Research and Innovation in STEM Education

LARTS 114  
285 Old Westport Road  
Dartmouth, MA 02747, USA

## ANNUAL REPORT FY2022

KAPUT CENTER FOR  
RESEARCH AND INNOVATION IN  
STEM EDUCATION

JULY 31, 2022

## **Foreword**

All Academic Institutes and Centers at UMass Dartmouth are required to prepare an annual report for the fiscal year just completed, and this report fulfills this requirement for FY22.

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**UNIVERSITY OF MASSACHUSETTS DARTMOUTH  
KAPUT CENTER FOR RESEARCH AND INNOVATION IN  
STEM EDUCATION**

The Kaput Center for Research and Innovation in STEM Education is an interdisciplinary University Research Center that conducts innovative research in the teaching and learning of mathematics in all educational contexts. It is an academic Center located administratively with the School of Education in the College of Arts & Sciences.

**Chandra Orrill, Ph.D. – Director**

**EXECUTIVE BOARD AT END OF FY22**

<p>Chairperson of the Board: Paul Fredette, <i>President &amp; CTO – Promptus Communications CTO - American Doctors Online</i> Term Expires: 11/24</p>	<p>James Burke, Ph.D. <i>Computer Science teacher, Somerset Berkley Regional High School</i> Term Expires: 5/25</p>	<p>Karen Chang, Ph.D. <i>Chemistry teacher at Naval Academy Preparatory School – NAPS</i> Term Expires: 3/25</p>
<p>Marylou T. Clarke, C.A.G.S. <i>Assistant Superintendent of Dartmouth Public Schools (Retired)</i> Term Expires: 05/22</p>	<p>Elizabeth Cullen <i>Director/Co-Founder Rhode Island STEAM Academy</i> Term Expires: 11/24</p>	<p>Shakhnoza Kayumova, Ph.D. <i>Associate Professor of Science Education, UMass Dartmouth</i> Term Expires: 10/22</p>
<p>Jay Wang, Ph.D. <i>Professor of Physics, UMass Dartmouth</i> Term Expires: 3/25</p>	<p>Dave Welty, Ph.D. <i>Biology/Chemistry teacher, Fairhaven High School</i> Term Expires: 5/24</p>	<p>Stephen Witzig, Ph.D. <i>Assistant Professor of Science Education, UMass Dartmouth</i> Term Expires: 10/24</p>

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## **Mission**

The Kaput Center for Research and Innovation in STEM Education at the University of Massachusetts Dartmouth was established on March 1<sup>st</sup>, 2007. The Center was established in the spirit and vision of James J. Kaput, whose innovative thinking and leadership inspired many in the field of mathematics education. The purpose of this Center is to provide a focus and support for sustained investigation of foundational issues in the field of STEM education, issues that will be chosen to enhance and deepen ongoing research by its members and associates. The Center is an interdisciplinary research unit where fundamental problems in STEM education are studied, discussed and analyzed through conferences, interdisciplinary colloquium series, basic research and development, commissioned reports, and think-tank meetings.

This document reports the progress toward the fulfillment of this mission for the period ending July 31, 2022, which is Fiscal Year 2022. This document was prepared by Dr. Chandra Orrill, Director of the Center with support from Kimberly Welty, Grant Support Specialist.

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## **Introduction**

The Kaput Center for Research and Innovation in STEM Education at the University of Massachusetts Dartmouth (hereon called the “Kaput Center”) was founded by Professors Blanton, Hegedus and Moreno-Armella of the Department of Mathematics. The Kaput Center grew out of Professor Jim Kaput’s aim of democratizing mathematics for all learners.

President Jack Wilson approved its establishment on February 14<sup>th</sup>, 2007 and its was officially established by Dr. Anthony Garro, Provost of the University of Massachusetts Dartmouth, on March 1<sup>st</sup>, 2007.

Dr. Stephen Hegedus, Professor in the Department of Mathematics, was appointed the Center’s first Director by Provost Garro and Chancellor MacCormack.

During the initial period of its establishment (March – June of FY07) the Director and the founding faculty established an Executive Board and External Advisory Board. Projects of the Mathematics Education faculty were transferred to the Center and an agenda for the operation and events of the Center for the upcoming years was established.

In 2014, Professor Hegedus resigned from UMass Dartmouth, leaving the Kaput Center in the hands of Professors Goodman, Güçler, and Orrill serving as Interim Directors while a permanent director was sought. The search for a permanent director for the Kaput Center in FY 2015 was not successful, thus the leadership structure remained the same for FY2016. In FY2017, Professor Walter Stroup joined the leadership team and Professor Goodman stepped into the role of Chairperson of the Executive Board without additional duties. At the end of FY2017, an internal search was conducted and Professor Chandra Orrill was named the Director of the Kaput Center effective July 1, 2017. Professor Goodman continued serving in his capacity as Chairperson of the Board. Professors Orrill and Goodman resigned from their respective positions in July 2020. At that time, the Kaput Center was put on hiatus because of the limitations of trying to operate during the COVID shutdown. In September 2021, Dr. Orrill was reinstated as the director of the Kaput Center.

This report documents the ongoing work of the Kaput Center through FY2022.

## Directors' End-of-Year Report FY2022

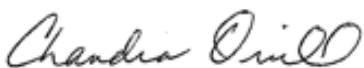
Thank you for reading this annual report of the work of the Kaput Center for Research & Innovation in STEM Education. Much of FY22 was spent trying to reopen a Center that relies on its ability to connect with people at a time when they ways in which we connect are changing. We pivoted from our traditional approaches to meet the challenges of the time and learned a lot along the way. We were able to offer four colloquia this year, all virtually. We believe this allowed us to grow our reach while ensuring our stakeholders stayed healthy. We have also begun to plan STEM4Girls with a planned implementation date of October 1, 2022.

In FY 2022, Dr. Kayumova and I, along with Dr. Pratim Sengupta from the University of Calgary, began work on an EAGER grant from the National Science Foundation focused on cybersecurity and artificial intelligence in middle school. This is a small, exploratory grant that will result in insights about what middle school students do know about these areas, what they should know about them, and how we might be able to support their learning. Also in FY 2022, I was awarded an NSF grant to continue my prior work around using technology and playful approaches to engage mathematics teachers in learning about proportions and, now, fractions. Along with my colleagues, Dr. Rachael Brown at Penn State Abington and Dr. Allan Cohen at the University of Georgia, I will be expanding the scope of the PD, exploring how to support teachers in better connecting their learning to their teaching, and considering innovative ways to use classroom discussion as an assessment tool rather than relying on traditional tests.

We added three new Executive Board Members in FY22. Dr. Jay Wang from the Physics Department joined the board, thus expanding the campus representation on the Board. We were also joined by Dr. Karen Chang, a Chemistry Instructor at the Naval Academy Preparatory School and Dr. James Burke, an Engineering and Technology Teacher at Somerset Berkely Regional High School. With the addition of these three Executive Board members, we reaffirm our commitment to STEM more broadly. We also note that Dr. Burke worked for Dr. Kaput for many years on the SimCalc project and welcome his institutional memory to the Board.

The Kaput Center began its periodic review in FY22. The review should conclude in Fall 2022. This review will provide us with critical feedback on our work toward are mission and toward the university's goals.

As always, the Kaput Center is a reflection of its people. As such, the STEMester in Review continues our tradition of having a variety of authors share their insights about events that happened this year.



Chandra Orrill  
Director

## **Kaput Center Infrastructure**

### ***Executive Board & Duties***

The Executive Board consists of the Director of the Kaput Center, ex-officio, and no more than fifteen other individuals who shall be faculty members at an accredited institution of higher education; qualified professional practitioners with a documented record of scholarship or professional experience in education or educational policy, particularly, but not constrained to, STEM education research; or drawn from positions of leadership in the public, non-profit, and private sectors. The Director will invite and accept nominations for members of the Executive Board for review by the Executive Board. All members of the Executive Board agree to execute the mission of the center in collaboration with other Executive Board members and abide by the policy on center operations. A full list of members will always be displayed in the Kaput Center and included in the Annual Report.

The Executive Board convenes quarterly. The Director of the Kaput Center must notify all members of the Executive Board of the time, date, and place of all quarterly meetings at least one week prior to said meetings. A simple majority of the Executive Board shall constitute a quorum. Meetings are run subject to Robert's Rules of Order. The Provost and the Chancellor of the University of Massachusetts Dartmouth as well as the Dean of the College of Arts and Sciences, can attend all Executive Board Meetings, although they are not members of the Executive Board.

The Executive Board exercise the following powers and authority:

- to review the Director's quarterly update on research projects, service agreements, sponsored research agreements, and other activities,
- to review the Director's quarterly statement of the budget for the Center and to make recommendations for expenditures and encumbrances from the budget,
- to approve or reject nominations of individuals for appointment to the Center as Research Associates or Visting Research Associates,
- to approve or reject nominations of individuals for appointment to the Executive Board,
- to approve or reject the Director's recommendations for creating or discontinuing functional Divisions of the Kaput Center,
- to approve or reject the Director's nominations of individuals for the appointment and removal of Heads of Divisions,
- to review, recommend, and approve any policies governing the Center's operations as specified in the Mission Statement and By-Laws,
- to approve or amend the Director's proposed annual report, financial statement, and proposed budget before it is submitted to the Provost or other officers of the University,
- to approve all recommendations from standing committees of the Executive Board,
- to advise and assist with graduate student recruitment strategies.

A simple majority of those members present and voting shall be sufficient to grant or withhold the approval of the Executive Board on all matters, except as specified elsewhere in the Mission Statement and By-Laws. Membership is for three (3) years and renewable.



### ***Advisory Board & Duties***

The Kaput Center is linked to the wider community through an Advisory Board. The Advisory Board shall be composed of individuals, appointed by the Director in consultation with the Executive Board, who are drawn from positions of leadership in the public, non-profit, and private sectors. The Board will assist in setting the Center's research agenda and in developing research resources. The Board will also advise and assist the Director and Executive board in developing strategic plans to achieve its mission that responds to educational need both locally, nationally and internationally in the field of STEM education. The Advisory Board are considered advocates of the Center, promoting the work of the Center and establishing new associations with leaders in STEM education research and innovation.

The Advisory Board has historically been extremely helpful in advising the Director in planning the Center's events and its operation more globally, particularly on realizing the scope and possibilities of how the Center can make an impact over time. Some advisors have also visited and assisted associates of the Center in their R&D programs, and hosted graduate students at their institutions.

### ***Research Scientists, Associates & Staff***

As part of the bylaws editing process, we revisited the Research Scientists, Associates, and Staff and decided to simplify the structure for associates of the Center. There are now three primary designations: Research Scientists, Visiting Research Scientists, and Research Assistants. They are described as follows:

- a. Research Scientist: (1) a tenured or tenure-track faculty member at the University of Massachusetts Dartmouth, who is developing or executing a research, public service, or educational project under the auspices of the Kaput Center, or (2) a qualified professional practitioner, who is locally developing or executing a research, public service, or educational project under the auspices of the Kaput Center,
  
- b. Visiting Research Scientist: (1) any faculty member at an accredited college or university, who is developing or executing a research, public service, or educational project related to the mission of the Kaput Center and will have a physical presence at the Kaput Center or (2) a qualified professional practitioner, who is developing or executing a research, public service, or educational project related to the mission of the Kaput Center and is visiting the Center. Visiting Research Scientists are expected to make a substantive contribution to the Kaput Center in collaboration with Center faculty and students. Appointment to the position of Visiting Research Scientist requires the approval of the Kaput Center Executive Board.
  
- c. Research Assistant: (1) any PhD student accepted onto the Doctoral Program in STEM Education at the University of Massachusetts Dartmouth who is appointed as a Research Assistant to a Center-based grant-funded project.

These positions are two-year, renewable appointments.

## *Physical Layout & Equipment*

The Kaput Center was moved to Room 114 in the LARTS building on the UMass Dartmouth campus in Fall 2019. While this move was important to move the work of the Center forward, it resulted in a dramatic reduction in space as well as liquidation of many of our older technologies. At the end of FY2020, the following technologies are housed in the Kaput Center:

- Several overhead projectors appropriate for use as needed
- 7 Apple Laptop computers for use in research projects and demonstrations
- iPads for use on research projects for use in research projects and demonstrations
- 6 Chromebooks for use in research projects and demonstrations
- 11 Photon Robots
- HD/DV cameras
- Wireless lavalier microphones
- 4 audio recorders
- Augmented reality sandbox
- A variety of common “Makerspace” technologies including Arduinos, robots, Makey Makey, and Raspberry Pis

Some of these materials are housed in the Kaput Center without being the property of the Kaput Center (e.g., the Augmented Reality Sandbox and the Photons), but they are available for use by any faculty or students affiliated with the Center.

Kaputcenter.org, our new website, went live in fall 2018. We own this URL for five years. The InterMath website conversion was also completed and we now own the intermath.org domain for five years.

In addition to the devices, the Kaput Center has a large library that supplements the Campus library facility and which includes a small sampling of journals and books relevant to STEM Education. The Center’s library includes journals and books focused on: Mathematics Education, Anthropology/Evolutionary Theory, Cognitive Psychology/Science, Representation theory, Computer Science and Design, Learning Sciences, Linguistics and Discourse Analysis, Complexity Theory, Mathematics, Philosophy, Socio-Cultural Studies, Curriculum Design, and Quantitative and Qualitative Methodology. The books are indexed in Libib, which makes it possible to see the holdings for the Kaput Center on the Web:

<https://www.libib.com/u/kaputcenter>

## Summary of Fiscal Activity

We report in detail here the Center's main operational budget and not the revenue/cost structure of externally funded grants. Total operational budget for FY22 was \$31,597 with operational expenses of \$30,629.

**Table 2: Revenue & Costs for FY20**

<b>Expense Type</b>	<b>Description</b>	<b>Amount</b>
<b>Revenue</b>	University Support (Salaries, Fringe & Operational Budget)	\$31,597
	Indirect Revenue	\$17,878.12
	<b>Total Revenue</b>	\$49,475.12
<b>Direct Expenses</b>		
<b>Payroll</b>	Total Payroll FY22	\$ 14,994.03
	Fringe for FY22	\$ 6,141.68
	<b>Total Payroll FY22</b>	<b>\$ 21,135.71</b>
<b>Non-Payroll</b>		
Office/Admin Supplies	<b>Total Office &amp; Admin Supplies</b>	<b>\$ 692.92</b>
Employee Related Expenses	Travel	\$ 0.00
	<b>Total Employee Related Expenses</b>	<b>\$ 0.00</b>
Non-Employee Expenses	Travel	\$ 500.00
	Honoraria	\$ 1,000.00
	<b>Total Non-Employee Expenses</b>	<b>\$ 1,500.00</b>
Facility & Operations	Food & Beverage	\$ 0.00
	Rchg Admin Exp	\$ 7.50
	Subscriptions	\$ 147.36
	Research Supplies	\$ 286.85
	Books - Non Library	\$ 589.83
	<b>Total Facility &amp; Operations</b>	<b>\$ 1,031.54</b>
Printing Expenses	Copier Expense	\$1,450.25
	<b>Total Printing Expenses</b>	<b>\$ 1,450.25</b>
Conference Misc & Temp Space		\$ 0.00
	<b>Total Conference Misc &amp; Temp Space Expenses</b>	<b>\$ 0.00</b>
IT Equipment	Software Licenses	\$ 135.98
	IT Equipment	\$3,376.99
	<b>Total IT Equipment</b>	<b>\$3,512.97</b>
	<b>Total Postage &amp; Freight</b>	<b>\$ 0.00</b>
	<b>Total Telecom Services Voice</b>	<b>\$ 1,305.50</b>
	<b>Total Non-Payroll</b>	<b>\$ 9,493.18</b>
	<b>Total Direct Expenses</b>	<b>\$30,628.89</b>

## Functional Areas of Operation

### *Research & Development*

*Addressing Mission Need: Provide a focus and support for sustained investigation of foundational issues in the field of mathematics education ...*

The faculty and staff of the Kaput Center and their associates continue to conduct cutting-edge research in mathematics education focusing on the following core areas:

- Enhancing mathematical communication in K-16 classrooms
- Transforming teaching practice across districts
- Addressing the needs of all learners in STEM Education
- Teacher knowledge and teacher professional development
- District-wide improvement of mathematics and science teaching in elementary and middle grades
- Teaching and learning mathematics at the undergraduate level

There were five funded grants in the Kaput Center in FY22 with one addition grant funded and scheduled to start in August 2022:

**CAREER: Analyzing the Nexus between Advantaged Social Positioning and Science Identity Development Among English Language Learners.** This project was funded by the National Science Foundation with a start date of September 2017. This grant to Shakhnoza Kayumova explores how to support students in developing as STEM learners while they are also learning to speak English. The goal of the grant is to better support teachers to support students who are grappling with language acquisition.

**Usable Measures of Teacher Understanding: Exploring Diagnostic Models & Topic Analysis as Tools for Assessing Proportional Reasoning for Teaching.** This project is housed at University of Southern California with Yasemin Copur-Gencturk as the PI. Chandra Orrill serves as a Co-PI and as the lead project person at UMass Dartmouth. This is an NSF-funded project. In this project, we are creating an assessment of teacher knowledge for proportional reasoning. We aim to measure content knowledge (CK) and pedagogical content knowledge (PCK) using emerging psychometric models including Diagnostic Classification Models and Topic Models.

**Advancing Middle School Teachers' Understanding of Proportional Reasoning for Teaching.** This is an IES-funded research grant housed at University of Southern California with Yasemin Copur-Gencturk as the PI. Chandra Orrill serves as a Co-PI and as the lead project person at UMass Dartmouth. In this project, we are attempting to create online professional development for proportional reasoning. We are focused on both the mathematical knowledge (CK) and the strategies teachers use to teach proportions (PCK). The resulting PD will be entirely online with a virtual facilitator and an assessment system that places teachers into submodules based on their abilities.

**Computational Thinking Counts in Elementary Grades: Powerful STEM Teaching and Learning for the 21<sup>st</sup> Century.** This NSF-funded research grant is led by Chandra Orrill (PI), with Shakhnoza Kayumova and Ramprasad Balasubramanian as co-PIs. The research team seeks to help elementary school teachers engage their students in computational thinking, the kind of thinking that computer programmers use. For example, students will be challenged to think about problem solutions in ways that would allow a computer to solve them; create solutions that require a series of ordered steps to carry out; identify, analyze, and implement solutions that are efficient, effective, and creative; and use models and simulations to represent data.

**EAGER: SaTC AI-Cybersecurity - Opening Doors for Cybersecurity & AI: An Interdisciplinary Approach to Engaging Middle School Students.** This NSF-funded grant is led by Chandra Orrill (PI) with Shakhnoza Kayumova and Pratim Sengupta (University of Calgary and Kaput Center Advisory Board member) serving as Co-PIs. We are exploring what middle school students should know at the intersection of cybersecurity and how we can support them in learning those things. To this end, we have developed a think tank comprised of cybersecurity researchers, cybersecurity and AI professionals, K-12 teachers, and educational researchers. We are looking at the big ideas this group developed to create a pilot unit of instruction for middle school students. We are also creating a survey for middle school students to be used as a baseline for determining what those students know about this area.

**Funded, starting August 2022:**

Title: Rational Numbers Playground: Applying and Refining a Model for Dynamic, Discussion-Based PD for Fractions, Ratios, and Proportions

PI: Chandra Orrill

Funding: National Science Foundation

Amount Requested: \$980,175 for UMassD, \$1.7 million total

Project Dates: 8/2022-7/2026

## ***Symposium & Colloquium Series***

*Addressing Mission Need: The Center is an interdisciplinary research unit where fundamental problems in mathematics education will be studied, discussed and analyzed through conferences, interdisciplinary colloquium series ...*

Our colloquium series returned in Spring 2022 as a series of four talks. All were offered online. Full abstracts of the talks can be found in Appendix B.

All of the past Colloquium talks are available on the Kaput Center YouTube channel and are accessible through the Kaput Center Website.

## ***STEM4Girls (Coming October 2022)***

With the reset due to the pandemic, the Kaput Center is taking the opportunity to move STEM4Girls to the fall. We believe that this timing will be better because schools, students, and faculty are all very busy in the spring. We have been able to schedule Dr. Megan Winten, a UMassD alum and Research Scientist at the Atlantic White Shark Conservancy as our keynote speaker. And, we have scheduled with STEAM the Streets to do a closing session for everyone. We are actively seeking volunteers to provide workshops and support for the efforts that day.

## ***Supporting the PhD Program***

*Addressing Mission Need: The Center is an interdisciplinary research unit where fundamental problems in mathematics education will be studied ...*

The Department of STEM Education and Teacher Development was able to start the STEM Education Ph.D. program in Fall 2018. The Kaput Center supports the program through the colloquium series. We also make available key Handbooks and other materials, such as the APA guide for writing papers. With our move to campus, we were able to use an ID reader to grant all of the doctoral students and faculty access to the Kaput Center any time they needed it, thus making the physical materials in the Kaput Center more accessible. Ph.D. students use these materials, such as video cameras and tripods, in their own research projects.

## ***K-12 Outreach***

In FY22, the Kaput Center engaged in minimal outreach, largely because of the continued presence of COVID. We have resumed our grant work in local schools, thus we are still impacting learners in the area.

## Grant Proposal Activity

### ***Funded Proposals*** (bolded names indicate Research Scientists in the Kaput Center)

Title: Usable Measures of Teacher Understanding: Exploring Diagnostic Models & Topic Analysis as Tools for Assessing Proportional Reasoning for Teaching

PI: Yasemin Copur-Gencturk (Univ of Southern CA)

Subaward PI: **Chandra Orrill** (PI on UMassD Subaward)

Co-PIs: Allan Cohen (Univ of Georgia) & Jonathan Templin (Univ of Kansas)

Funding Agency: National Science Foundation

Amount: \$2.1 million

UMass Dartmouth Award Amount: \$377,973

Project Dates: 6/1/18-5/31/22

Title: Advancing Middle School Teachers' Understanding of Proportional Reasoning for Teaching

PI: Yasemin Copur-Gencturk

Subaward PI: **Chandra Orrill** (PI on UMassD Subaward)

Co-PIs: Benjamin Nye (USC), Allan Cohen (UGA)

Funding Agency: Institute for Educational Sciences

UMass Dartmouth Award Amount: \$237,413

Project Dates: 7/1/18-6/30/22

Title: CAREER: Analyzing the Nexus between Advantaged Social Positioning and Science Identity Development Among English Language Learners

PI: **Shakhnoza Kayumova**

Funding Agency: National Science Foundation, CAREER program

Amount: \$779,000

Project Dates: 9/1/2017-8/31/2022

Title: Computational Thinking Counts in Elementary Grades: Powerful STEM Teaching and Learning for the 21<sup>st</sup> Century

PI: **Chandra Orrill**

Co-PIs: **Shakhnoza Kayumova** & Ramprasad Balasubramanian (Computer Science)

Funding Agency: National Science Foundation

Amount Requested: \$2,116,315

Project Dates: 1/1/20 – 12/31/23

Title: EAGER: SaTC AI-Cybersecurity - Opening Doors for Cybersecurity & AI: An Interdisciplinary Approach to Engaging Middle School Students

PI: **Chandra Orrill**

Co-PIs: **Shakhnoza Kayumova**, Pratim Sengupta

Funding: National Science Foundation

Amount: \$299,483

Project Dates: 9/1/2021-8/31/2023

**Funded, starting August 2022:**

Title: Rational Numbers Playground: Applying and Refining a Model for Dynamic, Discussion-Based PD for Fractions, Ratios, and Proportions

PI: **Chandra Orrill**

Co-PIs: Rachael Brown (Penn State Abington) and Allan Cohen (University of Georgia)

Funding: National Science Foundation

Amount Requested: \$980,175 for UMassD; \$1.7 million total

Project Dates: 8/2022-7/2026

**Declined Proposals:**

Title: Collaborative Research: CS through STEM RPP - Engaging Teachers in a Pedagogical Shift to Broaden CS Education in Middle School

Co-PIs: Robert Gegear, **Shakhnoza Kayumova** (subaward with WPI as lead institution)

Funding: National Science Foundation

Amount Requested: \$338,697

Project Dates: 9/2022-8/2025

Title: Kids Engaged in Environmental Literacy (KEEL)

Co-PIs: **Stephen Witzig**, Katherine Kavanagh

Funding: National Science Foundation

Amount Requested: \$299,968

Project Dates: 7/2022 – 6/2024



## Publications of the Kaput Center (2015-2022)

### 2015

- Bazzul, J. (2015). Towards a politicized notion of citizenship for science education: Engaging the social through dissensus. *Canadian Journal of Science, Mathematics and Technology Education*, 15(3), 221-233.
- Bazzul, J., & Kayumova, S (2015). Toward a Social Ontology for science education: Introducing Deleuze and Guattari's Assemblages. *Educational Philosophy and Theory*  
DOI: 10.1080/00131857.2015.1013016
- Buxton, C. A., Allexaht-Snider, M., Kayumova, S., Aghasaleh, R., Choi, Y. J., & Cohen, A. (2015). Teacher agency and professional learning: Rethinking fidelity of implementation as multiplicities of enactment. *Journal of Research in Science Teaching (JARST)*, 52(4), 489-502.
- Güçler, B., Wang, S., & Kim, D. J. (2015). Conceptualizing Mathematics as Discourse in Different Educational Settings. *International Education Studies*, 8(12), 25-32. doi: [10.5539/ies.v8n12p25](https://doi.org/10.5539/ies.v8n12p25)
- Hegedus, S. J., Dalton, S., & Tapper, J. (2015). The impact of technology-enhanced curriculum on learning advanced algebra in US high school classrooms. *Educational Technology Research and Development*, 63(2), 203-228. doi: 10.1007/s11423-015-9371-z
- Kayumova, S., Karsli, E., Allexaht-Snider, M. & Buxton, C. (2015). Latina mothers and daughters negotiating, contesting and appropriating science and language identities in hybrid spaces: Pasos hacia la universidad/steps to college. *Anthropology and Education Quarterly*. 46(3), 260-276.
- Kwon, N. Y., & Orrill, C. H. (2015). Reflection as professional knowledge for mathematics teachers. *Journal of the Korea Society of Mathematical Education Series D: Research in Mathematical Education*, 19(1), 1-17.
- Orrill, C. H. (2015). Formative assessment. In J. M. Spector (Ed.), *Encyclopedia of educational technology* (pp. 291-294). Thousand Oaks, CA: Sage Publications Ltd.
- Orrill, C. H., (2015). Foreword. In D. Polly (Ed.), *Cases on technology integration in mathematics education* (pp. xx-xxii). Hershey, PA: Information Science Reference.
- Orrill, C. H., Kim, O.-K., Peters, S. A., Lischka, A. E., Jong, C., Sanchez, W. G., & Eli, J. A. (2015). Challenges and strategies for assessing mathematical knowledge for teaching. *Mathematics Teacher Education and Development*, 17(1), 12-29.
- Orrill, C. H., & Kittleson, J. (2015). Tracing learning into practice: Considering the relationship between teachers' professional development and teaching. *Journal of Mathematics Teacher Education*, 18(3), 273-297.
- Siegel, M. A., Roberts, T. M., Freyermuth, S. K., Witzig, S. B., Izci, K. (2015). Aligning assessment to instruction: Collaborative group testing in large enrollment science classes. *Journal of College Science Teaching*, 44(6), 74-82.
- Rebello, C. M., Witzig, S. B., Siegel, M. A., & Freyermuth, S. K. (2015). Assessment practices for understanding science-related attitudes. In M. S. Khine (Ed.), *Attitude measurement in science education: Classic and contemporary approaches* (pp. 203-222). Charlotte, NC: Information Age Publishing, Inc.
- Zhang, D., Orrill, C. H., & Campbell, T. (2015). Using the mixture Rasch model to explore knowledge resources students invoke in mathematic and science assessments. *School Science and Mathematics*, 115(7), 356-365. DOI: 10.1111/ssm.12135

## 2016

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# **APPENDIX A**

Advisory Board

## ADVISORY BOARD

Advisors are not members of the Executive Board, and do not necessarily have associations with the Center, although that is possible. The Center has an international and interdisciplinary advisory board, which consists of the following members:

### AUSTRALIA

Lyn English - *Queensland University of Technology*

### BRAZIL

Tânia Maria Mendonça Campos - *UNIBAN São Paulo*  
Ubiratan D'Ambrosio  
Lulu Healy - *UNIBAN São Paulo*  
Rosana Nogueira de Lima - *UNIBAN São Paulo*

### CANADA

Pratim Sengupta – *University of Calgary*  
Nathalie Sinclair - *Simon Fraser University*

### CYPRUS

Constantinos Christou - *University of Cyprus*  
Nicholas G. Mousoulides - *University of Cyprus*  
Demetra Pitta-Pantazi - *University of Cyprus*

### FRANCE

Nicolas Balacheff - *Laboratoire Leibniz*  
Raymond Duval  
Colette Laborde - *Equipe IAM*  
Jean-Marie Laborde - *Cabrilog*

### GERMANY

Michael Otte - *Bielefeld University*  
Falk Seeger - *Bielefeld University*

### GREECE

Chronis Kynigos - *University of Athens*  
Joanna Mamona-Downs - *University of Patras*

### ISRAEL

Tommy Dreyfus - *Tel Aviv University*  
Ana Sfard - *University of Haifa*  
Dina Tirosh - *Tel Aviv University*  
Pessia Tsamir - *Tel Aviv University*  
Shlomo Vinner - *Ben Gurion University*  
Michal Yerushalmy - *University of Haifa*

### ITALY

Ferinando Arzarello - *Università di Torino*

### MEXICO

Teresa Rojano - *ILSE*  
Patricia Salinas - *Tecnológico de Monterrey*

### SINGAPORE

Sarah Davis - *National Institute of Education*  
Chee-Kit Looi - *National Institute of Education*

### SWEDEN

Per Nilsson - *Linnaeus University*  
Håkan Sollervall - *Linnaeus University*

### SWITZERLAND

Christof Weber - *FHNW*

### UNITED KINGDOM

Celia Hoyles - *University of London*  
Barbara Jaworski - *Loughborough University*  
Keith Jones - *University of Southampton*  
John Mason - *Open University*  
Richard Noss - *London Knowledge Lab*  
David Tall - *University of Warwick*

### USA

Nancy Ares - *University of Rochester*  
Yaneer Bar-Yam - *New England Complex Systems Institute*  
Hyman Bass – *University of Michigan*  
Corey Brady – *Vanderbilt University*  
David Carraher - *TERC*  
Allan Cohen - *University of Georgia*  
Jere Confrey - *North Carolina State University*  
Al Cuoco - *Educational Development Center*  
Chris Dede - *Harvard University*  
William Finzer - *KCP Technologies*  
Megan Franke - *University of California, Los Angeles*  
Paul Goldenberg - *Educational Development Center*  
Gerald Goldin - *Rutgers University*  
Charles Goodwin - *University of California, Los Angeles*  
Rogers Hall - *Vanderbilt University*  
Eric Hamilton - *United States Air Force Academy*

Guershon Harel - *University of California, San Diego*  
Steve Harrison - *Virginia Tech*  
Eric Heller - *UMass Donahue Institute*  
Chris Hoadley – *University of Buffalo*  
Andrew Izsák – *Tufts University*  
Nicholas Jackiw - *KCP Technologies*  
David Kirshner - *Louisiana State University*  
Eric Knuth - *University of Wisconsin, Madison*  
Cliff Konold - *University of Massachusetts Amherst*  
Richard Lesh - *University of Indiana*  
Marcia Linn - *University of California, Berkeley*  
Joanne Lobato - *San Diego State University*  
Fred Martin - *University of Massachusetts Lowell*  
James Middleton - *Arizona State University*  
Ricardo Nemirovsky - *San Diego State University*  
William Penuel - *SRI International*  
Norma Presmeg - *Illinois State University*  
Steve Rasmussen - *KCP Technologies*  
Jeremy Roschelle – *Digital Promise*  
Nora Sabelli - *SRI International*  
Adalira Sáenz-Ludlow - *University of North Carolina, Charlotte*  
Deborah Schifter - *Educational Development Center*  
Analucia Schliemann - *Tufts University*  
Roberta Schorr - *Rutgers University*  
Judah Schwartz - *Tufts University*  
Annie Selden - *New Mexico State University*  
John Selden - *New Mexico State University*  
David Williamson Shaffer - *University of Wisconsin, Madison*  
Finbarr Sloane - *Arizona State University*  
Judith Sowder - *San Diego State University*  
Denise S. Spangler - *University of Georgia*  
Bharath Sriraman - *University of Montana*  
Walter Stroup - *University of Texas, Austin*  
Despina Stylianou - *City College of New York*  
John Tapper - *University of Hartford*  
Deborah Tatar - *Virginia Tech*  
Jonathan Templin - *University of Georgia*  
Phil Vahey - *SRI International*  
Keith Weber - *Rutgers University*

## **APPENDIX B**

Abstracts of Symposium & Colloquium Series

**SYMPOSIUM & COLLOQUIUM SERIES**  
**(Spring 2022)**  
*All Virtual*



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

Dr. Pratim Sengupta

Professor of the Learning Sciences, University of Calgary

March 2, 2022

Abstract: In this talk, I will focus on how attending to relationships between discipline, ethics and politics can shape both practice in STEM fields and praxis in STEM education. I will argue how the design of computational models of complexity can be seen as both heterogeneous and ethical endeavours, and consider potential re-orientations for teacher preparation and public education. I will outline

how such approaches may center axiological concerns for both what count as “disciplinary phenomena” and “disciplined interpretation”, and how such re-orientations can be taken up in our praxis as community-engaged education scholars.

*E-Textiles in Schools: Curriculum, Teaching, and Results of Putting Making in Computing Classrooms*

Dr. Deborah Fields

Associate Research Professor of Instructional Technology & Learning Sciences, Utah State University

March 25, 2022



Abstract: In this talk, Deborah Fields shares about the multi-year development, implementation and results of a ten-week long curricular unit, “Stitching the Loop,” which integrates electronic textiles with computer science in schools around the country. Electronic textiles use conductive thread to connect sewable LEDs, microcontrollers (e.g., LilyPad Arduino, Adafruit Circuit Playground), sensors and other inputs and outputs onto fabric or similarly soft media.

Consciously combining traditionally classed and gendered activities such as engineering, computing, crafting and sewing disrupts students’ and teachers’ preconceptions about who can create with computing, engineering, and crafting. The curriculum is situated within Exploring Computer Science (ECS), an equity-focused and inquiry-based year-long introductory computer science course taught in public high school classrooms all over the country. The curriculum seeks to broaden access to both making and coding, deepen learning in both fields, and promote better diversity in what is being made. Research on implementation of the curriculum has demonstrated strong gains in student interest, sense of competence and growth mindset with computing as well as learning gains in computation, problem solving, and computational communication. We will discuss the development and research on the curriculum and share about more qualitative findings about equity-minded teaching practices, peer collaboration, and the important role of aesthetics in students’ learning.



*(Re)Examining Assumptions*

Dr. Zandra de Araujo

Chief Equity Officer & Math Principal, University of Florida's Lastinger Center for Learning

April 8, 2022

Abstract: Humans make assumptions. Many times, these assumptions may be passed along and turn into powerful narratives, whether true or not. In this talk I'll look at some assumptions we have in mathematics education and the ways in which my research has caused me to rethink these assumptions. In particular, I'll focus on my research with students

classified as English learners, teachers using flipped mathematics instruction, and professional learning opportunities for teachers.



*The Bio-CS Bridge: A Transdisciplinary Team Approach to Integrating Biology and Computer Science in High School Curricula*

Dr. Robert Gegear

Assistant Professor of Biology, UMass Dartmouth

April 29, 2022

Abstract: Pollinators are declining at an unprecedented rate worldwide for unknown reasons. These declines pose a significant threat to life on our planet due to the critical role that pollinators play in maintaining ecosystem health and biodiversity. The Beecology citizen science research project aims to improve pollinator conservation efforts in North America through the rapid collection of ecological data on species at risk. I

will discuss how the Beecology Project is being used to create 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 to biology. I will also highlight and demonstrate some of the freely available BIO-CS Bridge educational tools that we have developed for teachers, which include a mobile webapp, computer simulations, online data visualization tools, and other online resources. This work provides a blueprint for the use of transdisciplinary team science to develop highly effective integrated curriculum in many content areas.