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Kaput Center for
Research and Innovation in STEM Education

200 Mill Rd., Suite 150B
Fairhaven, MA 02719, USA

ANNUAL REPORT FY2017

KAPUT CENTER FOR
RESEARCH AND INNOVATION IN
STEM EDUCATION

July 28, 2017

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 FY17.

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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, Public Policy and Civic Engagement.

**Beste Güçler, Ph.D. – Interim Academic Director
Chandra Orrill, Ph.D. – Interim Administrative Director
Walter Stroup, Ph.D. – Interim Co-Director**

EXECUTIVE BOARD AT END OF FY16

Chairperson of the Board: Michael Goodman, Ph.D. Associate Professor of Public Policy, UMass Dartmouth Term Expires: 5/18	Marylou T. Clarke, C.A.G.S. <i>Assistant Superintendent of Dartmouth Public Schools (Retired)</i> Term Expires: 05/17	Paul Fredette, President & CTO – Promptus Communications CTO - American Doctors Online Term Expires: 11/16
<i>Beste Güçler, Ph.D.</i> <i>Associate Professor of Mathematics Education, UMass Dartmouth</i> Term Expires: 5/17	Rebecca L. Harrison, B.A. <i>Research Associate, UMass Dartmouth</i> Term Expires: 05/17	Chandra Orrill, Ph.D. Associate Professor of Mathematics Education, UMass Dartmouth Term Expires: 05/17
John Russell, Ph.D. <i>Emeritus Professor of Physics, UMass Dartmouth</i> Term Expires: 05/18	Dave Welty, Ph.D. Chair of STEM, Fairhaven Public Schools Term Expires: 5/18	

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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 1st 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 July 1st 2016 to June 30th 2017, which is Fiscal Year 2017. This document was prepared by Dr. Chandra Orrill, Interim Administrative Director of the Center.

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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 14th 2007 and its was officially established by Dr Anthony Garro, Provost of the University of Massachusetts Dartmouth, on March 1st 2007.

Dr. Stephen Hegedus, Professor in the Department of Mathematics (at the time), 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 has agreed to continue serving in his capacity as Chairperson of the Board.

This report documents the ongoing work of the Kaput Center through FY2017 and new initiatives.

Directors' End-of-Year Report FY2017

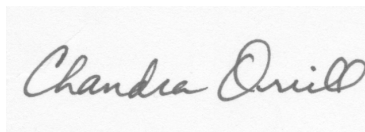
On behalf of the Interim Directors, I present this annual report that shows the collective work of the people of the Kaput Center: faculty, students, staff, and Executive Board Members. This year has been a positive one in some ways and a steady state year in other ways.

The Kaput Center has been extremely successfully in attracting grant funding this year. In addition to the ongoing NSF-funded Teach SouthCoast STEM grant (PI: Witzig) and the sunsetting NSF-funded CAREER grant (PI: Orrill), researchers in the Center received three new NSF grants this year. Professor Stroup leads a \$1million DRK-12 grant. Professor Kayumova was awarded an NSF CAREER grant worth \$779,000. And, I received an NSF-funded DRK-12 grant for \$738,337. While these numbers are impressive, more notice should be paid to the content of the awards and the ways in which they move forward the work of Kaput and the mission of this Center. Professor Stroup's research is focused on how to use cloud-based computing in K-12 classroom to make mathematics accessible to all learners and to promote collaboration and communication around that mathematics. Professor Kayumova's work focuses on teacher development to support students who have been identified as English Language Learners. She is particularly interested in the language requirements in science and, to support the teachers, her work includes intense workshops with students in which the students experience STEM through hands-on work while their teachers learn how to support the students' language needs. In my grant, we are looking at how to support teachers' reasoning about proportions using dynamic environments that allow the teachers to manipulate the relationships, thus making mathematics visible and tangible. These are exciting and innovative projects that meet real needs in the community while also pushing forward what is known about teaching and learning in STEM.

We hosted three symposium events this year. We expanded our focus to include ELL and computer science educators among our guests in addition to math educators. We also continued our Research to Practice sessions. In an effort to address attendance concerns, we tried holding these sessions out in the schools. While this was not immediately helpful, we will continue experimenting with it as a way to raise attendance.

The STEM4Girls event remains our best known educational outreach effort. We ran it entirely in-house without partners for the first time ever.

On behalf of the leadership team: myself, Beste Güçler – Interim Academic Director, and Walter Stroup – Interim Co-Director, I submit this report of the Center's activities.



Chandra Orrill
Interim Administrative 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 or a qualified professional practitioner with a documented record of scholarship or professional experience in education or educational policy, particularly, but not constrained to, mathematics education research. The Director invites and accepts nominations for members of the Executive Board for review by the Executive Board.

The Executive Board exists to assist the Director and Associates of the Center in fulfilling the goals of the Mission. They are expected to advise the Director on the strategic agenda of the Center because of their expertise in matters of research, community outreach, professional development and higher education in general.

The Executive Board convenes quarterly by the Director of the Kaput Center. 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 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 Senior Research Scientists, Research Scientists, and 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 reject the establishment and termination of research publications that are longitudinal in nature,
- to approve or reject the Director's recommendations for a standardized schedule of fees and charges for labor, photocopying, document sales, and other services,
- 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, and
- 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 two (2) years and renewable.

Advisory Board & Duties

The Kaput Center is linked to the wider community through an International Interdisciplinary Advisory Board. The Advisory Board is 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 worldwide. 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 members of 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.

During FY16, there were 108 members on the Advisory Board. 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.

A full list of advisors can be found in Appendix A and on-line at:

<http://www.kaputcenter.umassd.edu/associates/ab/>

Research Scientists, Associates & Staff

In FY 17, we added one Research Scientist to the Center, Professor Walter Sturup. The Leadership Team and Advisory Board agree that one responsibility of a new Director, when appointed, will be to revisit these appointments to determine which should stay active.

Physical Layout & Equipment

At the end of FY14, the Kaput Center space was reduced so that it now occupies approximately 2100 square feet at a rented facility in Fairhaven, MA. In FY2017, we were forced to relinquish our conference room, but were given access to the conference room in the space previously occupied by the Center for Marketing Research. The lease for our current space ends in August 2017. Plans for the future location of the Kaput Center are being negotiated by the Assistant Vice Chancellor for Campus Planning. While we do not yet know where we will move, it is anticipated that the Kaput Center will remain housed in the building at 200 Mill Road in Fairhaven.

Currently, the Center is a high-fidelity research facility with a high-tech physical infrastructure largely funded by research grants from external agencies, the Director's Indirect accounts and start-up funds from UMass Dartmouth. These include:

- High-speed connectivity to the Internet and a secure pipeline to Campus e-resources via hardware VPN
- Gigabit connectivity within the Center and secure 802.11a/b/g/n wireless connectivity
- Video-Conferencing/audio casting equipment incorporating the UMass Wimba service
- Blog and podcasting via an XServe Mac OS 10.5 Leopard Server
- Several projectors appropriate for use as needed
- 20-computer Apple Wireless Learning Lab with Apple and Windows OS and a suite of mathematical and mathematics educational software (e.g., Mathematica, Maple, Matlab, SPSS, Geometer's Sketchpad®, Cabri, MS Office, Adobe, Macromedia, etc.)
- iPads for use on research projects
- HDTV + HD equipment for high quality broadcasting and presentation
- HD/DV cameras
- High speed digital video processing machines with large screen displays (Mac)
- Part-ownership of the SAN Campus backbone system (safe and reliable back up of server side resources including web and database administration)
- Public and Private Wiki sites and other digital software to manage projects and e-portfolios
- On-line secure databases and data-mining facilities including quantitative and qualitative software (e.g., SPSS, HLM6, nVivo)

In addition, the Kaput Center has a terabyte server of multi-media data from several projects and teaching experiments that are digitally available under a secure network at the Center. All materials are signed and protected and permission to use such materials is obtained via the Center Director under IRB requirements.

Our 8-core terabyte XServe allows users to create workflows from digital cameras, either directly or after recording an event, straight to a Podcast or Blog, completely automating the video process and publishing procedure. This is especially useful for PhD students wishing to record classrooms or events at the Center.

In addition to these technical facilities, the Kaput Center has a large library that supplements the Campus library facility and which includes many Mathematics Education journals and periodicals dating back 20+ years. We have access to these resources and a full searchable electronic bibliography of these materials. The Center will continue to add cutting edge, contemporary, and cross-disciplinary literature that is not always available on the main University Campus. The Center's library houses over a thousand books covering areas of: 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, and Quantitative and Qualitative Methodology (over \$20K worth of major Handbooks in this category alone).

Inventory

The Center has a wide range of resources to conduct the work necessary to achieve the goals of its mission. In summary, these include:

- Conducting funded and unfunded (proof-of-concept) research and development programs,
- Provide professional development services (both on-site and on-line) and,
- Host various professional meetings and events throughout the year.

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 FY15 was \$40,216.76 with operational expenses of \$40,163.79.

Expense Type	Description	\$
Revenue	University Support (Salaries, Fringe, & Operational Budget)	\$40,215.76
	Total Revenue	\$40,215.76
Direct Expenses		
Payroll	Total Payroll FY16	-\$14,166.60
Fringe	Fringe for FY 16	-\$5,103.87
	Total Payroll & Fringe for FY16	-\$19,270.47
Non-Payroll		
Office/Admin Supplies	Total Office & Admin Supplies	-\$998.38
Business Meetings	Total Business Meetings	-\$4,199.27
Employee Related Expenses	Travel	-\$72.00
	Job-related Expenses (STEM4Girls supplies)	-\$47.93
	Total Employee Related Expenses	-\$119.93
Non-Employee Expenses	Travel	-\$2,551.73
	Honoraria	-\$3,682.75
	Total Non-Employee Expenses	-\$6,234.48
Facility & Operations	Food & Beverage	-\$785.17
	Research Supplies	-\$770.73
	Lab Supplies (STEM4Girls)	-\$324.86
	Books – NonLibrary	-\$1,968.69
	Technology	-\$3,815.85
	Waste Removal (Shredding Service)	-\$259.54
	Total Facility & Operations	-\$7,924.84
Printing Expenses	CORE charges	\$0
	Total Printing Expenses	-\$0
Conference Misc & Temp Space	Total Conference Misc & Temp Space	-\$120.00
Postage & Freight	Total Postage & Freight	-\$0.42
Telecom Services Voice	Total Telecomm Services Voice	-\$1,296
	Total Non-Payroll	-\$20,893.32
	Total Direct Expenses	-\$40,163.79

Table 2: Revenue & Costs for FY17

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 six funded grants in the Kaput Center in FY 17:

Teach SouthCoast STEM. This project was funded by the National Science Foundation and moved to the Kaput Center in FY 2016 under PI Stephen Witzig. The grant includes 21 Master Teaching Fellows and Teaching Fellows. The goals of the project are to (1) deepen educators' STEM content knowledge and instructional practices through content-intensive learning experiences; (2) develop critical 21st Century Skills through active exploration of emerging technologies; and (3) develop participants' teacher leadership skills.

UMass Dartmouth PhysTEC: Establishing a Collaborative Interdisciplinary Model for Recruiting and Preparing Physics Teachers. This project was funded by the Physics Teacher Education Coalition (PhysTEC) to help increase the number of Physics majors pursuing careers in K-12 teaching. Stephen Witzig is the Co-PI.

CAREER: Coherence as a Basis for Understanding Teachers' Mathematical Knowledge for Teaching Project. This project, under the director of Chandra Orrill, was funded by the National Science Foundation in April 2011. This project aims to explore a hypothesis about mathematics teacher knowledge formed through work with teachers both in research settings and professional development. The hypothesis is that being a good mathematics teacher requires not only developing a certain body of knowledge, but also having mapped that content into a coherent and connected understanding of the domain that includes insights into what the content being taught grows out of and where it goes next. The hypothesis is that teachers with more connections in their understanding will have more tools to draw upon in their classroom teaching, thus using their knowledge in different ways from teachers with a less coherent understanding.

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.

Group-Based Cloud Computing for STEM Education. This project was funded by the National Science Foundation DRK-12 program. Walter Stroup leads a four-campus team developing tools that allow students to engage in science and mathematics in the classroom using the collaborative computing power available through cloud-based solutions. This is an exploratory project seeking to demonstrate how group-based learning based in generative design can support learning.

Proportions Playground: A Dynamic World to Support Teachers' Proportional Reasoning. This project, also supported by the National Science Foundation, examines how dynamic environments support teachers in reasoning about proportional situations. This work grew out of Chandra Orrill's CAREER grant in which the researchers noticed that teachers approach the same mathematics in different ways in dynamic environment than they do using paper and pencil.

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 ...

This year 3 speakers presented their research and shared perspectives of long-term research mathematics education that reached across disciplines. Each symposium was a 1-day event including a workshop in the morning and a public keynote address on contemporary issues in the afternoon. The colloquia included only the afternoon keynote talk. A streaming video of each talk and associated materials can be found at the Center's website.

Full abstracts of the talks can be found in Appendix B.

Fall 2016

Symposium: Dr. Jill Neumeyer-DePiper

Visual Access to Mathematics: Professional Development for Teachers of English Learners

EDC

Colloquium: Dr. Ben Shapiro

Future Directions in Computer Science Education Research

University of Colorado Boulder

Spring 2017

Symposium: Dr. Luciana D. deOliveira

Language in STEM Content Areas for English Language Learners

University of Miami

We used the university's on-line streaming service for all of the lectures and videos from each remain available on the Kaput Center Website.

STEM4Girls (May 20 2017)

On Saturday, May 20, 2017, the Kaput Center, hosted the annual STEM4Girls event on the campus of the University of Massachusetts Dartmouth campus. The 110 girls, ages 10-15, participated in a keynote event, participated in hands-on workshops, and got to ask their own questions in a panel discussion.

This was the first time the Kaput Center has hosted this event without a partner organization.



Research to Practice Events

In FY 2017, we offered one Research to Practice session in which faculty and graduate students were able to work with local teachers to explore various aspects of how research can impact practice. We charge a nominal fee for each workshop, but have not seen enough participation from local teachers yet to see this as a revenue source. We plan to continue these workshops in the next year as the feedback we have received on them is consistently positive.

Professor Walter Stroup

Function-Based Algebra and the Common Core State Standards

November 16, 2016

Offered at Durfee High School in Fall River

Professional Development Partnership

Professors Orrill and Stroup led a professional development partnership with mathematics teachers at Dartmouth High School. We focused on function-based algebra and relied extensively on using CBRs and graphing calculators to use these approaches in the classroom. As part of the professional development, the participating teachers led after-school sessions with their own students to try out ideas they were developing in professional development.

Supporting the PhD Program

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

Faculty in the Center developed a proposal for a PhD in Mathematics Education that is housed in the STEM department where they are tenured. This program was approved at the April 30th 2009 meeting of the MA Board of Higher Education. The program started in September 2009. The Kaput Center has worked closely with the STEM department offering research opportunities and authentic learning experiences for students through the work that is conducted on a daily basis.

The PhD in Mathematics Education program is split into three phases: (1) Introduction to Mathematics Education Research, (2) Preparation Phase for transfer to Advanced Doctoral Status, (3) Production Phase of Advanced Courses and Final Dissertation.

The program includes a mixture of core courses, authentic learning experiences in research institutions and projects, and an interactive thinking/writing process to develop cutting-edge research and discovery as part of their experience.

The program, with its supporting technological infrastructure, research associates and resources from the Kaput Center, is a single coherent experience for students, bringing their learning in courses and interaction outside courses, to be an on-going and continual social experience for students at all times. Working together to develop their own skills and become innovative and creative thinkers, meeting critical educational issues and needs, in the 21st Century.

In FY 2015, the faculty of the Mathematics Education Ph.D. program completed a proposal for the expansion of the program to include other areas of STEM Education. In FY 2016, the proposal was approved by curriculum committees on the UMass Dartmouth Campus and it went through an external review process. The proposal will next be reviewed by the President's office and the Board of Trustees as well as the Board of Higher Education. If approved, the proposal will allow the Department of STEM Education and Teacher Development to offer a STEM Education Ph.D. with concentrations in Mathematics Education, Science Education, and (eventually) Engineering Education. This expansion is consistent with the mission of the Kaput Center and will allow the Center and the academic department to engage in all areas of STEM Education in our research and outreach.

Grant Proposal Activity

Funded Proposals

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: 2017-2022

Title: Group-Based Cloud Computing for STEM Education

PI: Walter Stroup

Co-PI: Corey Brady (Vanderbilt U), Anthony Petrosino (UT-Austin), and Uri Wilensky (Northwestern U)

Funding Agency: National Science Foundation (DRK-12)

Amount: \$1,045,549

Project Dates: 9/2016-8/2019

Title: Proportions Playground: A Dynamic World to Support Teachers' Proportional Reasoning

PI: Chandra Orrill

Funding Agency: National Science Foundation (DRK-12)

Amount: \$783,337

Project Dates: 9/1/2016-2/28/19

Title: UMass Dartmouth PhysTEC: Establishing a collaborative interdisciplinary model for recruiting and preparing physics teachers.

PI: Jay Wang, Department of Physics

Co-PI: Stephen Witzig

Program/Agency: Physics Teacher Education Coalition (PhysTEC).

Amount: \$29,886

Project Dates: Fall 2014 – Fall 2017

Title: TEACH! SouthCoast STEM

PI: Stephen Witzig

CoPI: Tesfay Meresi

Funding Agency: National Science Foundation

Funds Received: \$2,867,243

Project Dates: October 1, 2011 - September 30, 2017

Title: CAREER: Coherence as a Basis for Understanding Teachers' Mathematical Knowledge for Teaching

PI: Chandra Orrill (PI – UMass Dartmouth)

Program/Agency: National Science Foundation, CAREER Program

Amount Requested: \$699,082
Project Dates: April 15, 2011 – March 30, 2017

Proposals Under Review

Title: Who's Doing the Thinking: Understanding Elementary Teachers' Approaches to Mathematics & Science.

PI: Chandra Orrill (Co-PI: Shakhnoza Kayumova)

Funding Agency: Spencer Foundation.

Amount Requested \$49,857.

Project Dates: 9/1/17-8/31/18

Due Date: May 1, 2017

Title: Integrating Computing in Chemistry Classrooms (iC3)

Co-PI: Walter Stroup

Funding Agency: National Science Foundation DRL - STEM + Computing (STEM+C) Program

Amount Requested: \$1,249,891 to UT Austin with \$215,209 Subaward to UMassD

Status: under review

Declined Proposals

Title: Wareham Middle School Expanded STEAM Academy.

PI: Andrea Schwamb (Wareham Public Schools) (CO-PIs: Chandra Orrill & Stephen Witzig)

Funding Agency: MA Department of Elementary and Secondary Education

Amount Requested: \$119,677

Project Dates: 6/1/17 – 7/31/18

Due Date: 1/7/17

Status: Declined

Title: 21st Century Formative Assessments for STEM

Agency: National Science Foundation (DRK-12)

PI: Chandra Orrill (Co-PI: Stephen Witzig, Allan Cohen, Shiyu Wang, & Hye-Jeong Choi)

Amount Requested: \$2.5million

Dates: 9/1/17-8/31/22

Due Date: 12/5/16

Status: Declined

Publications of the Kaput Center (2009-2015)

2009

- Hegedus, S. J., & Moreno-Armella, L. (Eds.) (2009). Transforming Mathematics Education through the Use of Dynamic Mathematics Technology. *Special issue of ZDM: The International Journal on Mathematics Education*, August 2009, Vol. 41, Issue 4.
- Sriraman, B., & English, L. (Eds.) (2009). *Theories of Mathematics Education: Seeking New Frontiers*. New York: Springer.
- Stylianou, D. A., Blanton, M. L., & Knuth, E. J. (Eds.) (2009). *Teaching and Learning Proof Across the Grades: A K-16 Perspective*. New York/Washington, DC: Routledge/National Council of Teachers of Mathematics.
- Tapper, J. (2009, August). Evaluating Teacher Perceptions of the SimCalc Connected MathWorlds Intervention (Report). Hadley, MA: UMass Donahue Institute.

2010

- Hegedus, S. J., & Moreno-Armella, L. (2010). Accommodating the Instrumental Genesis Framework Within Dynamic Technological Environments. *For the Learning of Mathematics*, 30(1), 26-31.
- Izsák, A., Orrill, C. H., Cohen, A. S., & Brown, R. E. (2010). Measuring Middle Grades Teachers' Understanding of Rational Numbers with the Mixture Rasch Model. *The Elementary School Journal*, 110(3), 279-300.
- Roschelle, J., Shechtman, N., Tatar, D., Hegedus, S., Hopkins, B., Empson, S., Knudsen, J., & Gallagher, L. P. (2010). Integration of Technology, Curriculum, and Professional Development for Advancing Middle School Mathematics: Three Large-Scale Studies. *American Educational Research Journal*, published online June 2, 2010. doi: 10.3102/0002831210367426.
- Sriraman, B., Bergsten, C., Goodchild, S., Palsdottir, G., Sondergaard, B. D. & Haapasalo, L. (Eds.) (2010). *The First Sourcebook on Nordic Research in Mathematics Education: Norway, Sweden, Iceland, Denmark and Contributions from Finland*. Charlotte, NC: Information Age Publishing.

2011

- Ambrose, D., Sternberg, R., & Sriraman, B. (Eds.) (2011). *Confronting dogmatism in gifted education*. New York: Routledge.
- Hegedus, S., & Moreno-Armella, L. (2011). The emergence of mathematical structures. *Educational Studies in Mathematics*, 77(2-3), 369-388.
- Lee, S., Brown, R. E., & Orrill, C. H. (2011). Mathematics teachers' reasoning about fractions and decimals using drawn representations. *Mathematical Thinking and Learning*, 13(3), 198-220.
- Sriraman, B., & Fyhn, A. B. (2011, May). Circumpolar indigenous issues, knowledge, relations to education, science and mathematics (Special Issue). *Interchange*, 42(2).
- Sriraman, B. (Ed.) (2011). *Crossroads in the history of mathematics and mathematics education*. Charlotte, NC: Information Age Publishing.
- Tapper, J. (2011, September). Democratizing Access to Core Mathematics Across Grades 9-12: Validity Study of Algebra 1 Content Tests. (Report). Hadley, MA: UMass Donahue Institute.

2012

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- **Introduction: Major Themes, Technologies, and Timeline**
Jeremy Roschelle and Stephen Hegedus
- **From Static to Dynamic Mathematics: Historical and Representational Perspectives**
Luis Moreno-Armella and Stephen Hegedus
- **Intersecting Representation and Communication Infrastructures**
Stephen Hegedus and Luis Moreno-Armella
- **Reflections on Significant Developments in Designing SimCalc Software**
James Burke, Stephen Hegedus, and Ryan Robidoux
- **SimCalc and the Networked Classroom**
Corey Brady, Tobin White, Sarah Davis, and Stephen Hegedus
- **Learning and Participation in High School Classrooms**
Sara Dalton and Stephen Hegedus
- **Impact of Classroom Connectivity on Learning and Participation**
Stephen Hegedus, Luis Moreno-Armella, Sara Dalton, Arden Brookstein, and John Tapper
- **Connection Making: Capitalizing on the Affordances of Dynamic Representations Through Mathematically Relevant Questioning**
Chandra Hawley Orrill

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Establishing Industrial Collaborations

Texas Instruments

The Education Technology division of Texas Instruments continues to support the work of the SimCalc Research program presently funded by the US Department of Education. Melendy Lovett (President) and Dave Santucci have helped by loaning TI hardware to the Center for use in local MA districts. The division also promotes the work of the Center in their Research Briefs on-line and distributes versions of the SimCalc software. They also provided a generous donation to support the exposition and dinner on October 8th 2009.

Establishing International Collaborations

The Directors have continued to explore potential relationships with institutions in various countries. These have led to MOUs being established as Partnership Agreements between the University of Massachusetts Dartmouth and the following institutions:

- CINEVESTAV, Mexico City, Mexico
- Tecnológico de Monterrey, Monterrey, Mexico
- UNIBAN, São Paulo, Brazil
- University of Cyprus, Cyprus
- Queensland University of Technology, Australia

The most recent MOU was signed with Queensland University of Technology, Australia in July 2010. MOUs with CINEVESTAV, Mexico, Tec de Monterrey, Mexico, UNIBAN, Brazil and University of Cyprus, Cyprus were signed during the Showcase Event on October 8th 2009.

These MOUs secure various exchanges to enhance the collaborative educational and research missions of our institutions. They focus on student exchanges in our PhD program, faculty exchanges for the purpose of sabbatical or a focused study, and open exchange of ideas and prior work to develop R&D proposal.

View full MOUs at: <http://www.kaputcenter.umassd.edu/news/index.php?path=localglobal/>

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 a 108-person 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

Luis Radford - *Laurentian University*
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*
Ted Eisenberg - *Ben Gurion University*
Ana Sfar - *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*
Maria Allesandra Mariotti - *Università di Siena*

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*

UNITED KINGDOM

Celia Hoyles - *University of London*
Barbara Jaworski - *Loughborough University*
Keith Jones - *University of Southampton*
John Mason - *Open University*
Elena Nardi - *University of East Anglia*
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 - *Michigan State University*
Corey Brady - *Northwestern 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*
Angappa (Guna) Gunasekaran - *University of Massachusetts Dartmouth*
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*
Andrew Izsák - *University of Georgia*
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*
John Olive - *University of Georgia*
João Paraskeva - *University of Massachusetts Dartmouth*
William Penuel - *SRI International*
Norma Presmeg - *Illinois State University*
Steve Rasmussen - *KCP Technologies*
Jeremy Roschelle - *SRI International*
Susan Jo Russell - *TERC*
Nora Sabelli - *SRI International*
Adalira Sáenz-Ludlow - *University of North Carolina, Charlotte*
Deborah Schifter - *Educational Development Center*
Analucia Schliemann - *Tufts University*

Alan Schoenfeld - *University of California, Berkeley*
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
(2016-2017)**

Dr. Jill Neumeyer DePiper

EDC

December 2, 2016

Abstract:

The ever-increasing population of students who are English Learners (ELs) urgently needs access to rich opportunities to learn mathematical content, and specifically in ways that emphasize mathematical communication and reasoning. The Visual Access to Mathematics project is developing and studying professional development materials to help teachers to support the mathematical reasoning and communication for students who are ELs. Our work emphasizes the use of diagramming, which has been shown to support students' mathematical problem-solving, in conjunction with strategies to promote mathematical communication and attention to mathematical practice. In this talk, I will present how we understand supporting students who are ELs and the principals that guide our work with teachers. We will engage in tasks for mathematics teacher professional learning and explore elements of the professional development program. I will also present our logic model and how we seek to understand and measure teacher learning through their participation.

Dr. Ben Shapiro

University of Colorado Boulder

January 27, 2017

Abstract:

K-12 Computer Science (CS) education is growing in popularity. Variably under the guises of helping students to develop *computational thinking* or "teaching kids to code", a growing number of schools are adopting CS as a topic of study. Some are offering standalone CS courses, and some are finding ways to integrate computing into other areas of study, including math, science, business, and the arts. These efforts are complemented by informal offerings online, in museums, and in libraries, and are supported by an ever growing number of programmable technologies (only some of which are specifically designed for young learners). These efforts come at a time when CS itself is rapidly changing: machine learning (i.e. statistical) and distributed approaches to CS are fundamentally changing the ways in which computer software and hardware are constructed. They redefine several fundamental theoretical (i.e. mathematical) properties of computational systems and alter the processes through which people create and reason about computational tools. Consequently, these

changes should also have deep implications for how we define computational thinking, how we create programmable technologies for learners, and how we integrate computer science with other disciplines. In this talk, I will illustrate the discontinuities between CS as it has been and CS as it is becoming, showing how CS concepts that have been operationalized in educators' definitions of computational thinking and in technologies created for young learners are becoming inauthentic representations of contemporary CS. Then, I will present empirical examples and theoretical conjectures about how the future of CS education might better reflect contemporary and emerging CS. I will conclude by describing how some of these possible future directions for learning and research offer exciting opportunities for CS education and mathematics education researchers to collaborate with one another.

Dr. Luciana C. deOliveira

University of Miami

April 12, 2017

Abstract:

This presentation focuses on the language demands, challenges, and opportunities in STEM content areas for English language learners in K-12 levels. Participants will also have opportunities to think about the role of language in texts and tasks from textbooks, and tests in mathematics and science.