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 FY12.
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The information and analysis in this report does not represent an official statement of view of the University of Massachusetts.

Annual Report Series No. 5
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.

Stephen J. Hegedus, Ph.D.
Director

EXECUTIVE BOARD AS AT END OF FY12

<table>
<thead>
<tr>
<th>Name</th>
<th>Title and Affiliation</th>
<th>Term Expires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dona Apple, M.S.</td>
<td>Senior Consultant for Research &amp; Staff Development, UMass Dartmouth</td>
<td>05/13</td>
</tr>
<tr>
<td>Marylou T. Clarke, C.A.G.S.</td>
<td>Assistant Superintendent of Dartmouth Public Schools (Retired)</td>
<td>05/13</td>
</tr>
<tr>
<td>Jane Daly, M.Ed.</td>
<td>Assistant Superintendent of Accountability and School Improvement, New Bedford Public Schools</td>
<td>08/13</td>
</tr>
<tr>
<td>Michael Goodman, Ph.D.</td>
<td>Associate Professor of Public Policy, UMass Dartmouth</td>
<td>8/12</td>
</tr>
<tr>
<td>Beste Güçler, Ph.D.</td>
<td>Assistant Professor of Mathematics Education, UMass Dartmouth</td>
<td>8/13</td>
</tr>
<tr>
<td>Edward Lambert, M.Ed.</td>
<td>Director, The Urban Initiative, UMass Dartmouth</td>
<td>05/14</td>
</tr>
<tr>
<td>Luis Moreno-Armella, Ph.D.</td>
<td>Senior Research Scientist/Professor of Mathematics Education, Cinvestav</td>
<td></td>
</tr>
<tr>
<td>Rebecca L. Moniz, B.A.</td>
<td>Research Associate/Project Manager, UMass Dartmouth</td>
<td>05/13</td>
</tr>
<tr>
<td>Chandra Orrill, Ph.D.</td>
<td>Research Scientist/Assistant Professor of Mathematics Education, UMass Dartmouth</td>
<td>05/13</td>
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<tr>
<td>Louis Petrovic, Ph.D.</td>
<td>Director, Advanced Technology &amp; Manufacturing Center, UMass Dartmouth</td>
<td>05/13</td>
</tr>
<tr>
<td>Ismael Ramirez-Soto, Ed.D.</td>
<td>Dean, School of Education, Public Policy &amp; Civic Engagement, UMass Dartmouth</td>
<td>05/13</td>
</tr>
<tr>
<td>John Russell, Ph.D.</td>
<td>Emeritus Professor of Physics, UMass Dartmouth</td>
<td>05/14</td>
</tr>
<tr>
<td>Isa Kafftal Zimmerman, Ed.D.</td>
<td>Principal, IKZ Advisors, STEM Education &amp; Leadership</td>
<td>08/13</td>
</tr>
</tbody>
</table>

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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 mathematics 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 mathematics 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 2011 to June 30th 2012, which is Fiscal Year 2012. This document was prepared by Dr Stephen Hegedus, Director of the Center, and presented to the Kaput Center Executive Board on August 29th 2012.
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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.

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 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.

This report documents the ongoing work of the Kaput Center through FY2012 and new initiatives.
Director’s End-of-Year Report FY2012

The Kaput Center is a center of creativity and innovation. It aims to break down barriers through its research, outreach and global community. This year we have welcomed many provocative and interesting people to the Center to challenge the way we think.

We have continued to address our primary mission in investigating fundamental foundational issues in STEM Education in two diverse ways. First, we have brought communities closer together at the local and regional level. Our research reaches out in very direct ways to what is being taught in schools locally. We are transforming how teachers think through our work, as well as how decisions are made at the classroom and district level. This transformation of content and knowledge will continue next year through the work of new faculty and research associates. Second, we are making a global impact in our work. Our MOUs have led to three international students joining the doctoral program this Fall 2012. We have also solidified many of our research partnerships overseas. A direct product of such work is a 40-author volume of reports focused on 15 years of research and development by members of the SimCalc project from around the world. This will be published by Springer later this year.

In addition, we have joined hands with the international Greenlight for Girls organization and welcomed over 150 young ladies to the UMass Dartmouth campus this June to engage in STEM activities. We have documented the work of the girls and our partners including faculty and scientists on our web portal here: http://www.kaputcenter.umassd.edu/events/g4g/2012/

Undergraduate and graduate students from various disciplines have enjoyed internships at the Kaput Center during the summer and throughout the academic year with support from the NSF’s Robert Noyce Teaching Scholarship program led by the Center for University, School and Community Partnerships at UMass Dartmouth. Young people have enjoyed experiencing cutting-edge development in mathematics education and technology at the Kaput Center and have a say in how mathematics can be taught in transformative ways to more children in the future. They have learned to think about teaching in new ways and have applied their knowledge to helping us understand how students think. This was the highlight of my year.

Next year I wish to focus on the theme of decision making from what a teacher decides to do in one classroom, through how curriculum is reformed, to how politicians make decisions regarding the functionality of schools. I aim to bring in various speakers and voices through our highly successful colloquium series.
which we will continue to stream live, as well as re-ignite our regional K-20 STEM Network, which involves local teachers, school leaders, SouthCoast legislators and STEM faculty from various departments at UMass Dartmouth.

Finally, I welcome Chancellor Divina Grossman as the new leader of UMass Dartmouth and who is firmly behind advancing STEM Education and research in our region and more globally. We have an exciting year ahead and I am looking forward to directing the Kaput Center in new ways.

Stephen J Hegedus, PhD
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.

During FY12, Brenda Berube, Dr Marjorie Condon, Dr Bal Ram Singh and Dr Maria Blanton stepped down from service.

Dr Beste Güçler, Assistant Professor of Mathematics Education at UMass Dartmouth, Dr. Isa Zimmerman, Principal at IKZ Advisors, and Jane Daly, Assistant Superintendent of Accountability and School Improvement for New Bedford Public Schools joined the board.

Two seats remain open on the Board and we are seeking to fill at least one in early in FY13.

**Advisory Board & Duties**

The Kaput Center is linked to the wider community through an 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. 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 mathematics 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 mathematics education research and innovation.
During FY12, there were 100 members on the Advisory Board. It should be noted that each person accepted and was honored to be elected to the Board. The Advisory Board has 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.

A full list of advisors can be found in Appendix B and on-line at: http://www.kaputcenter.umassd.edu/associates/ab/

**Research Scientists, Associates & Staff**

During FY09 certain titles were revised. There are no longer any executive titles. The title of Research Associate (for Kaput Center staff) and Research Assistant (for Kaput Center students) were kept. The titles of Research Scientist, Senior Research Scientist and adjunct versions of these were created for faculty and staff leading projects and collaborating closely with the Kaput Center. The Director nominates these positions to the Executive Board.

At the end of FY12 there were 12 Senior Research Scientists, 21 Research Scientists, 5 research associates, and 4 research assistants. We will continue to build our core faculty and staff and adjunct scientists in FY13 in establishing new projects and providing a rich and diverse environment for students in the PhD in Mathematics Education, which the Center closely supports.

**Physical Layout & Equipment**

The Kaput Center occupies approximately 3000 square feet at a rented facility in Fairhaven, MA, 8 miles from the main Dartmouth Campus. The Center is split between an Audio Visual Creativity Studio (formally known as the Resource Room), a 20-person conference room, an equipment and data storage room (formally known as the Library space, which has since been moved to the STEM Education Department), and office space. See Figure 1 for a floor plan.
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 (as if we were on campus)
- 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
- DVI/VGA video projection with podium facilities
- Ceiling mounted projectors + HD/DVI Document Cameras (video recording available)
- 66-inch rear projection SmartBoard with connection to the Internet & Public Wiki
- 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.)
- 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 Math Ed 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. In addition, the Center stocks the majority of wide-readership journals including Nature, Science, and The Economist, to name a few. 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). In addition, the resource room has a wide selection of K-16 mathematics curriculum.

**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.

The Center has total capital assets and related service plans of $275,891. Table 1 summarizes areas of assets.

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<thead>
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<th>Type</th>
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<td>Furniture</td>
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<td>Cables/Adapters</td>
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<td>Service Plans</td>
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</table>

Table 1: Main Areas of Assets

Summary of Fiscal Activity
Table 2 below presents the revenues and costs of the Center during FY12. In addition to these accounts are revenues and expenditures related to externally funded research projects that faculty within the Center are principle investigators. Total revenue for FY12 was $1,363,598 ($84,000 from the University, $1,201,402 from grants (which includes recovered indirect funds), $39,006 from contracts, $3,822 from donations/SimCalc license revenue and $35,368 from carry-forwards from accounts) with associated direct costs of $765,972. The majority of remaining revenue is encumbered grant funds. However, it is important to note that in September 2012, $269,695 from a grant was transferred to another institution along with the PI.

The majority of this income comes from external grants. Through FY11, there has been a steady increase in revenue into the Center. However, there was a drop in FY12, as 3 of the 6 center grants had federal agency approved no-cost extension (see Figure 2 below).
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 FY12 was $84,000 with operational expenses of $84,135.
<table>
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<tr>
<th>Expense Type</th>
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<td>Revenue</td>
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<td>$84,000</td>
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<td>Carry-forward FY11 (Operational budget &amp; other)</td>
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<td><strong>Total Revenue</strong></td>
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<td>Direct Expenses</td>
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<td><strong>Total Direct Expenses</strong></td>
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<td><strong>Remaining Balance</strong></td>
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Table 2: Revenue & Costs for FY12
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:

- Early Algebra
- Touching, feeling and seeing mathematics and science ideas through new technologies
- Transforming communication & expression with wireless connectivity—aspects of participation, motivation & identity
- The development of proof and reasoning across the grades K-16
- Transforming teaching practice across districts
- Teacher knowledge and teacher professional development
- District-wide improvement of mathematics and science teaching in elementary and middle grades
- International Studies

The mission of the SimCalc program is to “democratize access to the mathematics of change and variation.” The main software product of the SimCalc program is called SimCalc MathWorlds® and is available at http://kaputcenter.umassd.edu/. SimCalc supports learning about rate and accumulation by connecting students’ experience of animated motion to mathematical functions, which are portrayed in algebraic, graphical, verbal and tabular representations. The SimCalc research program and its software have been evolving over more than a decade of research, spanning at least 8 major funded research projects.

The SimCalc Learning and Motivation Project (LAMP) incorporates the use of wireless technology from Texas Instruments, and integrates activity structures into high school algebra classrooms. The present project (completing Year 4 of 4 in FY11) is funded by the US Department of Education, Institute of Education Sciences, and is a longitudinal efficacy study measuring impact on student learning and motivation to learn over time. (See http://www.kaputcenter.umassd.edu/products/technical_reports/)

The central goal of the Early Algebra Project, recently funded by the National Science Foundation is to understand (1) how young children reason algebraically, the ways in which they express their reasoning and how these
forms of reasoning evolve in their thinking and (2) how teachers’ learning of mathematics and teaching evolves as they incorporate algebraic thinking into their daily classroom practices. It has led to important insights on teaching and learning algebraic ideas in the elementary grades. See, e.g., *Algebra in the Early Grades* (Kaput, Carraher & Blanton, 2008) and *Algebra and the Elementary Classroom: Transforming Thinking, Transforming Practice* (Blanton, 2008) that sets the stage for exploring the impact of students’ understanding of algebra as they transition through and beyond elementary grades.

The *Scaling Up SimCalc research project* (led by Jeremy Roschelle of SRI International) investigated, through a randomized experiment, whether a wide variety of teachers could use SimCalc to support their students’ learning of conceptually complex mathematics in 7th and 8th grade classrooms in TX. The Kaput Center has been a major partner on this project. (See [http://math.sri.com](http://math.sri.com).) Last year we completed a diffusion study of what factors lead to teachers sticking with and/or spreading SimCalc resources.

The *Proof Project*, a National Science Foundation ROLE Project, uses a sociocultural lens on teaching and learning to explore the development of undergraduate students’ thinking about proof and how classroom practice can support this. As part of this, through symposia designed to bring together scholars whose work looks at proof across grades K-16, the project has sought to articulate how different forms of proof and argumentation evolve in students’ thinking across the grades and the curricular and instructional issues associated with a K-16 approach to teaching and learning proof. See *Teaching and Learning Proof Across the Grades: A K-16 Perspective* (Stylianou, Blanton, & Knuth, 2009)

The *Haptics Project*. This was recently funded in June 2009 by the REESE division of the National Science Foundation. We are aiming to investigate the impact of integrating haptic “force-feedback” devices with Geometer’s Sketchpad and analyzing the impact on students’ understanding of conceptually-rich mathematical and scientific ideas in elementary and undergraduate classrooms.

The *Does it Work? Project*. This is funded by the REESE division of the National Science Foundation. The project concentrates on the InterMath-Number Concepts course, a 50-hour course aimed at developing teacher content knowledge about numbers. The project studies 4 implementations of the course that were offered to 6th and 7th grade teachers. The proposed work is vital for improving educational opportunities for mathematics learners. Growing bodies of evidence show that professional development can have a positive effect on teacher knowledge and that teacher content knowledge is positively correlated to student achievement. This project will collect an extensive body
of data with which to gain insight into the links between professional development, teacher learning, and teacher practice and student achievement.

The Diagnosing Teachers’ Multiplicative Reasoning (DTMR) Project. This is funded by the DR-K12 division of the National Science Foundation. It is an exploratory project that addresses the assessment component of the KR-K12 Contextual Challenges strand. The project will develop and evaluate a test form that diagnoses teachers’ capacities in two closely connected cases of reasoning about multiplicative relations among quantities. The first has to do with measurement that often relies on multiplicatively nested levels of units when partitioning a given quantity. The second has to do with covariation that often relies on multiplicative relations between distinct quantities. The project will focus on aspects of such reasoning that are interconnected and fundamental to addition and subtraction of quantities, multiplication of quantities, quotative and partitive division of quantities, and ratios of quantities. We will consider fractions, decimals, and ratios. A main goal of the project is to address content and construct validity of the demonstration form in sufficient depth so that larger scale work and predictive validity studies may follow.

CAREER: Coherence as a Basis for Understanding Teachers’ Mathematical Knowledge for Teaching Project. This project is recently 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. This project will focus specifically on middle grades teachers’ knowledge of proportional reasoning. A mixed methods approach will be used in the first phase to develop profiles of understanding that highlight not only the body of knowledge teachers have developed, but also the connections among facets of that knowledge. Once those profiles are complete, phase 2 will focus on looking at teachers’ practice to develop interconnected profiles of understanding that consider not only the ways in which teachers understand the domain, but also how those interconnected understanding manifest themselves in the classroom. 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.
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 ...

The Center features prominent speakers from multiple fields in its monthly colloquium series.

This year 10 speakers were invited (3 in the Fall semester & 7 in the Spring semester) to present on their research and perspectives of creativity & innovation that reached across disciplines. Each talk led to rich and open-ended discussion. A streaming video of each talk and associated materials can be found at the Center’s website (http://www.kaputcenter.umassd.edu/events/cs/11-12/).

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

The Design of Digital Institutions: Honest Signaling and Trust Frameworks
Dr John Clippinger, MIT Media Lab

Communicating Through Interdisciplinary Modeling in the Elementary and Middle School Years
Dr Lyn English, Queensland University of Technology, Australia

Technology-Enhanced Inquiry Teaching and Learning in Science
Dr Marcia Linn, University of California, Berkeley

The Exographic Revolution
Dr Merlin Donald, Queen’s University, Ontario, Canada

Understanding Student Engagement with Mathematics as it Occurs “in the Moment”
Drs. Roberta Schorr & Gerald Goldin, Rutgers University and Dr Lisa Warner, William Paterson University

Complex Systems Principles and Education: Focusing on Universal Principles and Individual Differences
Dr Yaneer Bar-Yam, New England Complex Systems Institute (NECSI)

Towards an Assessment for the Mathematics of Change
Dr Guadalupe Carmona, University of Texas at Austin

The Great Recession: Implications for Education, Workforce and STEM Policy
Dr Michael Goodman, University of Massachusetts Dartmouth

This year we used the university’s on-line streaming service for all of the lectures and integrated our new Blog site so that speakers could interact with their audience. See http://kaputcenter.blogs.umassd.edu/

Greenlight for Girls Day SouthCoast (June 2nd 2012)

On Saturday, June 2nd 2012, the Kaput Center, in partnership with Greenlight for Girls (http://www.greenlightforgirls.org), hosted an all-day FREE event at the University of Massachusetts Dartmouth for over 130 girls ages 10-15 years old to learn about Science and Technology. The girls attended 3 out of a possible 11 hands-on workshops related to topics in the fields of Science, Health & Beauty, and Engineering. Workshop presenters came from various organizations/institutions, including, UMass Dartmouth, NUWC (Naval Undersea Warfare Center), Our Sisters’ School, Acushnet Company, New Bedford Ocean Explorium, Raytheon, and New Bedford Symphony Orchestra.

K-20 Regional STEM Network

This is an evolving network of local educators, K-12 administrators as well as local business leaders and legislators. Our aims and objectives focus on:

- To provide a forum for teachers, school and business leaders, and state elected officials to share with each other successful initiatives and resources used to improve STEM education
- To build community so teachers can support and provide opportunities to other teachers/schools who are in need
- To discuss the future of education in our region and how we can better serve our students
- To inform the University of what they can do to develop research and development programs to create necessary change.

We have connected with over 30 districts as illustrated on the map below:
Licensing & Commercialization

SimCalc MathWorlds® is now a registered trademark of the Board of Trustees, University of Massachusetts.

SimCalc MathWorlds® software for calculators and computers is a licensed product. We have sold several licenses this year to various institutions around the world. Our aim is to create a community of users who are equally concerned with improving learning and motivation in a wide variety of classrooms. Royalties associated with software sales return to the Center to continue to support research and innovation.

For more details see: [http://www.kaputcenter.umassd.edu/products/software/](http://www.kaputcenter.umassd.edu/products/software/)

There was a new release of SimCalc MathWorlds® for Computer at the end of Summer 2011. This release allows for the ability to import data using commercially known data probes, such as Pasco and Vernier probes, as well as text files.
Support 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. Where possible, courses will be blended with a variety of delivery methods, including on-line video seminars, iTunesU/Podcasting, and active use of Blogs and Wikis as part of the regular mode of sharing and learning content, as well as expressing evolving ideas in and around coursework. A central Blog/Wiki will be available for students to interact and share their on-going work outside of classes. Systematic use of electronic learning support technologies will form the basis for cumulative evaluation of students’ learning and program success, as explained in the section of our proposal on program evaluation.
The program, with its supporting technological infrastructure, research associates and resources from the Kaput Center, will be 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.

**Research Grant Proposal Activity**

**Funded Proposals**

**Title:** Democratizing Access to Core Mathematics Across Grades 9-12 (Award #: R305B070430)
- **PI:** Stephen Hegedus (PI)
- **Program/Agency:** US Department of Education, IES
- **Amount Requested:** $2,215,548 (original funding $1,979,300 w/ supplement received 7/08 for additional $236,248)
- **Dates:** July 1, 2007 – June 30, 2012

**Title:** Dynamic Haptic Geometry in Elementary and Undergraduate Classrooms (Award #: DRL-0835395)
- **PI:** Stephen Hegedus (PI) & Nicholas Jackiw (Co-PI, KCP Technologies)
- **Program/Agency:** National Science Foundation, REESE
- **Amount Requested:** $570,258
- **Project Dates:** July 1, 2009 – June 30, 2013

**Title:** Developing Algebra-Ready Students for Middle School: Exploring the Impact for Early Algebra (Award #: DRK-0918239)
- **PI:** Maria Blanton (PI – UMass Dartmouth) & Eric Knuth (Co-PI, University of Wisconsin, Madison)
- **Program/Agency:** National Science Foundation, DRK-12
- **Amount Requested:** $1,583,670
- **Project Dates:** September 1, 2009 – August 31, 2012
  *Note: This project was moved to another institution in September 2011*

**Title:** Does it Work? (Award #: DRL-1036083)
- **PI:** Chandra Orrill (PI – UMass Dartmouth), Andrew Izsak (Co-PI, University of Georgia), Allan Cohen (Co-PI, University of Georgia)
- **Program/Agency:** National Science Foundation, REESE
- **Amount Requested:** $999,958 ($186,417 brought to UMassD)
- **Project Dates:** December 1, 2007 – December 31, 2011
Title: Diagnosing Teachers’ Multiplicative Reasoning (Award #: DRL-0822064)  
PI: Andrew Izsak (PI – San Diego State University), Joanne Lobato (Co-PI – San Diego State University), Chandra Orrill (Co-PI – UMass Dartmouth), Allan Cohen (Co-PI – University of Georgia), Jonathan Templin (Co-PI – University of Georgia)  
Program/Agency: National Science Foundation, DR-K12  
Amount Request: $944,163 ($21,090 brought to UMassD)  
Project Dates: September 1, 2008 – September 30, 2012

Title: Evaluation of the Implementation of the Smaller Learning Communities (SLC) Program at Dartmouth High School  
PI: Stephen Hegedus (PI – UMass Dartmouth), Brenda Berube (Co-PI, UMass Dartmouth)  
Program/Agency: Smaller Learning Communities, U.S. Department of Education  
Amount Request: $41,000 ($20,500 per year)  
Project Dates: October 1, 2009 – September 30, 2012

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, 2016


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.

**Apple, Inc.**
In January 2008, Stephen Hegedus and members of the SimCalc Research Team, and Jeffrey Wolfman (Vice-Chancellor for Advancement) were invited to Apple Headquarters in Cupertino, CA, to meet with John Couch, Vice-President for Education and Apple Senior Executives in Marketing. The team presented the work of the SimCalc Research Program. We are now working on establishing a relationship with Apple that supports and focuses on the following areas of development
- Developing a network of researchers and practitioners on the Apple Learning Interchange
- Research and Development on new platforms including the iPod Touch/iPhone
- Distribution of SimCalc MathWorlds® on Apple’s Learning Carts
- Supporting Diffusion of Kaput Center initiatives through the Professional Development Network
- Establishing the Kaput Center as an Apple Center of Excellence

Establishing International Collaborations
The Director has 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:

- CINVESTAV, Mexico City, Mexico
- Tecnologico 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 Cinvestav, 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:
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 100-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 Sfard - University of Haifa
Dina Tirosh - Tel Aviv University

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
Häkan Sollervall - Linnaeus University

UNIVERSITY
Celia Hoyle - 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
Maria Blanton - TERC
Corey Brady - Inquire Learning LLC
David Carraher - TERC
Allan Cohen - University of Georgia
Jere Confrey - North Carolina State University
APPENDIX B

Abstracts of Colloquium Series
**Title**: The Design of Digital Institutions: Honest Signaling and Trust Frameworks  
**Speaker**: Dr John Clippinger, MIT Media Lab  
**Abstract**: As more and more human activities are supported by or embedded in cloud services and the Net, there is the opportunity to design and test new kinds of digital institutions that are potentially more effective, accountable and consonant with ecological constraints. Given what the neurosciences, complexity sciences and evolutionary biology are telling us about Human Nature and new models of control and cooperation, is it possible to design and field test new kinds of social, cultural and political institutions that evolve, learn and generate sustainable value? This talk explores this challenge in the area of privacy/sharing through the notion of honest signaling and trust frameworks.

**Title**: Communicating Through Interdisciplinary Modeling in the Elementary and Middle School Years  
**Speaker**: Dr Lyn English, Queensland University of Technology, Australia  
**Abstract**: The world’s increasing complexity, competitiveness, interconnectivity, and dependence on technology generate new challenges for nations and individuals that cannot be met by continuing education as usual (Katehi, Pearson, & Feder, 2009). With the proliferation of complex systems have come new technologies for communication, collaboration, and conceptualization. These technologies have led to significant changes in the forms of mathematical and scientific thinking that are required beyond the classroom. Modeling, in its various forms, can develop and broaden children’s mathematical and scientific thinking beyond the standard curriculum. This colloquium will consider future competencies in the mathematical sciences within an increasingly complex world. Consideration will be given to interdisciplinary problem solving and models and modeling. Examples of complex, interdisciplinary modeling activities across grades will be presented, with data modeling in 1st grade, model-eliciting activities in 4th grade, and engineering-based modeling in 7th-9th grades.

**Title**: Technology-Enhanced Inquiry Teaching and Learning in Science  
**Speaker**: Dr Marcia Linn, University of California, Berkeley  
**Abstract**: Technology-enhanced materials can guide student learning, improve student outcomes, automate assessment, and strengthen teaching. Using results from classroom research, I will illustrate uses of scientific visualizations to improve learning, showcase technologies such as MySystem that help students develop coherent ideas, demonstrate how tools such as the Idea Manager can support the process of knowledge integration, and discuss how automated scoring of embedded assessments might guide student activities. Using results from our recent review of professional development programs, I will highlight promising
roles for teachers using technology-enhanced materials. Open source solutions such as the Web-based Inquiry Science Environment enable the global community of educators to take advantage of new technologies.

**Title:** The Exographic Revolution  
**Speaker:** Dr Merlin Donald, Queen’s University, Ontario, Canada  
**Abstract:** The technological and symbolic innovations of the last few centuries have forced cultures to value certain kinds of nervous systems because they fit the current high-tech agenda. Modern culture hunts for, and picks for training, those brains that lend themselves best to the particular sort of cognitive rewiring imposed by the new technology, and this in turn drives the emergence of new kinds of literate elites. Whether viewed in terms of the functional architecture of the brain, or the larger cognitive capacities of the human species, this trend toward externalizing memory and restructuring the larger social-cognitive system has generated a radical change in the intellectual powers collectively at the disposal of humankind. Human society is now governed by a distributed, technologically-aided cognitive system that is evolving at a rapid pace.

**Title:** Understanding Student Engagement with Mathematics as it Occurs “in the Moment”  
**Speaker:** Drs. Roberta Schorr & Gerald Goldin, Rutgers University and Dr Lisa Warner, William Paterson University  
**Abstract:** Studies of the affective and cognitive interactions of students in urban middle school mathematics classrooms have led us to develop the concept of "engagement structures" (Goldin, Epstein, Schorr, Warner, 2011). An engagement structure is an idealization that helps account for and describe recurring, dynamical patterns of interaction around mathematics. It involves a characteristic motivating desire or goal, actions including social behaviors toward fulfilling the desire, supporting beliefs, "self-talk," sequences of emotional states, meta-affect, strategies, and possible outcome. Thus it is a kind of behavioral/affective/social constellation, situated in the person that becomes active in social contexts. Importantly, such structures do not feature exclusively "positive" or "negative" emotional feelings, attitudes, beliefs, and/or values, a characterization, which can obscure important ambiguities and complexities. For example, under some conditions, "negative" emotions or beliefs can contribute to constructive mathematical engagement, and conversely, "positive" feelings or beliefs can detract from such engagement. In contrast to traditional classifications, we stress that we do not regard some engagement structures as "good" and others as "bad." We see them as universally or near universally present in individuals, each regulating affect, cognition, and social behavior in ways that can be adaptive. We discuss examples to which we give the following names: Get The Job Done, Look How Smart I Am, Don't Disrespect Me, Check This Out, I'm Really Into This, Let Me Teach You, It's Not Fair, Stay Out
of Trouble, and Pseudo-Engagement. We also consider some interesting issues of observation, instrumentation, and measurement.

**Title:** Complex Systems Principles and Education: Focusing on Universal Principles and Individual Differences  
**Speaker:** Dr Yaneer Bar-Yam, New England Complex Systems Institute (NECSI)  
**Abstract:** I will present a few perspectives on the current trends in education from the point of view of a complex systems scientist. Among the likely topics: centrally prescribed metrics and standardized testing, charter schools, and innovations in mathematics education. The discussion will be based upon analysis of complexity and scale, the substructure of neural cognition, and other relevant complex systems insights.

**Title:** Towards an Assessment for the Mathematics of Change  
**Speaker:** Dr Guadalupe Carmona, University of Texas at Austin  
**Abstract:** For more than 20 years, the Mathematics of Change has strongly impacted the field of mathematics education in several parts of the world and has provided direction in opening possibilities in the teaching and learning of math and science that have no historical precedent. This vision provides from within at least four different interpretations of the Mathematics of Change as: (1) a new phenomenology of dynamical systems; (2) democratic access of more advanced mathematics to more (all) students; (3) new dynamic technological environments and representations allowing better links to physical and social phenomena; and, (4) new epistemological approaches in the teaching and learning of the mathematics of change. However, through this new phenomenology of the mathematics of change, current assessment results present a rather limited picture of student learning by its insensitivity to instruction and insensitivity to measure change over time. New epistemological approaches, like those brought to bear by the Mathematics of Change, require the designs of assessments that are sensitive to different ways of understanding, in particular, ideas about variation and dynamic systems, and that can also be documented over time. In this talk, some of the limitations with current assessments and their insensitivity to instruction and insensitivity to measure change over time will be presented. Characteristics and developments towards an assessment for the Mathematics of Change will be introduced, including new ways of designing assessments, new ways of documenting student learning, and new ways of representing student understanding; as well as the importance of framing this as formative assessments so that these may be more sensitive to instruction and more amenable to recognize change over time. Results from research and developments in Mexico and how the Mathematics of Change has influenced efforts of systemic educational reform will also be provided.

**Title:** The Great Recession: Implications for Education, Workforce and STEM Policy
**Speaker:** Dr Michael Goodman, University of Massachusetts Dartmouth  
**Abstract:** Much time, energy, and public resources are being invested in efforts to find new ways to fill the workforce pipeline with ever-larger numbers of credentialed graduates in Science, Technology, Engineering and Mathematics (STEM) fields. But to date these efforts have yet to systematically consider the impact of recent and dramatic economic developments. Among other things, these developments have significant implications for our education and workforce policies, particularly those focused on STEM education. This talk will attempt to bridge that gap by reviewing our recent economic history, examining the social and demographic impacts of the "Great Recession," and offering an assessment of the implications for educators and policymakers.
APPENDIX C

5-Year Strategic Plan for the Kaput Center 2007-2011 (revised 12/2009)
5-Year Strategic Plan for the Kaput Center: 2007-2011  
(revised 12/2009)

Preamble

The Kaput Center is a 21st Century R&D operation, which focuses on expanding the learning frontiers of the education of our children in schools and higher education. It is primarily funded by external grants and focuses on long-term cutting edge research that transforms education in the areas of science, technology, engineering and mathematics (STEM). The majority of the members of the center are faculty or students in the newly established STEM department at UMass Dartmouth with other associates coming from higher-education institutions, research institutes and industry. The work of the center continues to inform scientists, policy makers and educational practitioners around the world of new discoveries into how children and adults think, learn, discover and understand mathematical and scientific ideas. In turn, the work of the center fuels new programs in teacher preparation and the fields of mathematics and science education research including the psychology of learning, curriculum that transforms what is normally taught in the early grades, and educational technology that impacts learning, motivation and communication through dynamic and embodied forms of representations.

Operationalizing the Plan

The original Kaput Center 5-year strategic plan was presented conceptually to Provost Garro in 2006 and was incorporated into a memo and submitted to Chancellor MacCormack in 2007. A revised memo was sent to the Chancellor with the FY07 end-of-year report and evolving by-laws in September 2008.

This memo serves as a historical synthesis and presentation of the 5-year plan for the Kaput Center (2007-2011). It also offers an assessment of whether the goals and objectives of the plan have been met to date and what critical needs are in effect from year to year. Unless a critical need is noted all items/goals in the agenda where met and documented in our end-of-year reports that can be found on-line at the Kaput Center’s website. Please note that the items/goals are cumulative from year-to-year unless it has been explicitly revised or removed.

This memo also offers a forward-looking revised proposal for years 4 (2010) and 5 (2011) given the recent restructuring of the Kaput Center to enhance its mission

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1 The Kaput Center was officially created by President Jack Wilson on February 14th 2007 but since the strategic planning began in Fall 2006 we use January 2007 as a start date for year 1.
in incorporating Science, Technology and Engineering education into its general purview of educational research and learning sciences. In addition, three divisions were approved to structure the work of the center, attract new researchers and faculty in an interdisciplinary fashion, establish new forms of R&D and extend the work of the center into policy and broader impact. These are: (1) Learning design, (2) Teacher quality, and (3) Education policy. These changes were approved by the Executive Board in August 2009 and by the Chancellor on September 24th 2009

Stephen Hegedus, PhD
Director
Strategic Plan

2007-8

2007.1. Establish a preliminary set of by-laws and a document on how the Center will operate subject to its mission. This will include a description of the structure of the Center, the duties of all elected members including the Director, the Executive Board, research associates, and standing committees.

2007.2. Establish an executive board of no more than 15 members from local experts in education research, policy and institutional operations (K-12 and Higher Education).

2007.3. Establish an advisory board from outside the University of Massachusetts Dartmouth that will work with Kaput Center associates on projects and advocate for the work of the Center.

2007.4. Establish the standing committees for research and planning.

2007.5. Establish the K-16 Regional Math Ed network to reach out to the local community to create partnerships that will sustain research efforts and impact local schools directly.

2007.6. Establish the Colloquium Speaker series to invite 5-6 significant speakers to the Center throughout the academic year.

2007.7. Establish an on-line Famous Author Series to study the work of one important author in educational research.

2007.8. Establish a web site to promote the work of the Kaput Center.

2007.9. Seek external funds from federal agencies to support ongoing R&D initiatives.
2008-9

2008.1. Sustain all goals from 2007 seeking to increase capacity where necessary.

2008.2. Widen the scope of the colloquium series to include a more diverse background of speakers.

2008.3. Seek external funds from federal agencies to support the work of the Kaput Center at a national level (a. $500K per year).

2008.4. Establish an electronic and paper system to publicize & promote the work of the Kaput Center at a national and international scale.

2008.5. Document all progress of the Center work on-line. This will include all presentations, end-of-year reports and work.

2008.6. Establish on-line services to support the work of the Kaput Center worldwide, e.g., Wiki.

2008.7. Establish the Foundational Issues Symposium through the Kaput Center advisory board to develop white-papers or position statements for US Congress.

2008.8. Complete the operations and by-laws agreement with full approval from Chancellor MacCormack.


2008.10. Explore commercialization of faculty innovations.

2008.11. Establish a Kaput Center endowment through the UMass Foundation. Work with Advancement to investigate how private investors or foundations can support the work of the Kaput Center, e.g., Apple, Inc., Texas Instruments, Kauffman, Gates, MacArthur, Toyota, ExxonMobil and Siemens.


Critical Needs:

1. The Center deliberated on its identity and position within a new School of Education, Public Policy and Civic Engagement that was being developed and approved during the year. The new school was
established in September 2008. The Kaput Center was affiliated to it but continued to promote itself as an inter-college ("University Center") because of the multi-disciplinary aspects of its work and its mission to conduct innovative work. It became a pressing need to understand how it could work in collaboration with a new STEM department as well as fulfill its original mission. Because of this, the By-Laws and operations document of the Kaput Center has not been signed by the Chancellor.

2. An endowment for the Kaput Center has not been set up. We are still working with Advancement on what our fund-raising plan involves in terms of principal for R&D and return for student scholarships.

3. Whilst we hosted two Symposia, no white-paper was produced. Need to assess what this means in the long-term given the fragmented nature of the advisory board.
2009-10

2009.1. Address critical needs from previous year and sustain all goals from previous years seeking to increase capacity where necessary or establish capacity.

2009.2. Seek external funds from federal agencies to support the work of the Kaput Center at a national level (a.$500-1000K per year).

2009.3. Enhance on-line services to support the work of the Kaput Center worldwide as needs be and evaluate the future of Web 2.0 (or 3.0) applications.

2009.4. Build Kaput Center endowment through the UMass Foundation to $500K. Work with Advancement to investigate how private investors or foundations can support the work of the Kaput Center.

2009.5. Evaluate impact of Kaput Center products on educational policy.


2009.7. Enhance the mission of the Kaput Center to incorporate STEM disciplines.

2009.8. Establish three divisions to structure the work of the Center, attract new researchers and faculty in an interdisciplinary fashion, establish new forms of R&D and extend the work of the Center into policy and broader impact. These are: (1) Learning design, (2) Teacher quality, and (3) Education policy.

Critical Needs:

1. An endowment for the Kaput Center has not been set up. We are still working with Advancement on what our fund-raising plan involves in terms of principal for R&D and return for student scholarships.

2. Now that the MOUs with international institutions are established, what forms of exchanges can occur and how will they be supported? (e.g., US ED Atlantis or Erasmus programs).

3. Assess how the three focus areas will operate and what impact they will have. Do they need resources?

4. With the advancement of a web streaming service, the Kaput Center has invested in hardware to support its online seminars and video conferencing. We need to find a dedicated solution to support equipment, monitoring and management of web services given we have no budgeted IT support.
5. Because of the new STEM department, the Kaput Center is now cost-sharing in terms of space and facilities. It needs to ascertain how temporary this is and how it can be resolved fiscally.

6. There are no pre-doctoral programs this year supported by the NSF or US Education’s Institute of Education Sciences for Math Ed students. It is unclear (outside of private donations) how we can support research students at this time.
2010.1. Address critical needs from previous year and sustain all goals from previous years seeking to increase capacity where necessary or establish capacity.

2010.2. Seek external funds from federal agencies to support the work of the Kaput Center at a national level (a.$1-1.5m per year) expanding to support the new cohort of PhD students in Mathematics Education.

2010.3. Build Kaput Center endowment through the UMass Foundation to $1m. Work with Advancement to investigate how private investors or foundations can support the work of the Kaput Center.

2010.4. Investigate impact of Kaput Center products on educational policy and work with lobbyists to promote the work of the center in DC. Seek earmarked funds, and alternative funds.

2010.5. Establish the operations and agenda of the three focus divisions of the Kaput Center with corresponding Heads.

2010.6. Host a third Foundational Issues Symposium on Creativity and Learning structured by the three new focus areas. Seek to attract a diverse audience to finalize a white paper for MA Governor’s Office and US Secretary of Education on “What is STEM Education?”

Critical Needs:

1. Assess how new plans (in red) affect the overall running and operational budget of the Kaput Center
2011-12

2011.1. Address critical needs from previous year and seek external funds from federal agencies to support the work of the Kaput Center at a national level (e.$2m per year) expanding to support the new cohort of PhD students in Mathematics Education and 1-2 post doctoral fellows. This is a steady state budget to support R&D and pre-/post-doctoral programs at the Kaput Center.

2011.2. Continue to work with Advancement to increase the Kaput Center endowment to $1m. First Kaput Center scholar to be awarded in Fall 2011. Future plans would increase the endowment to $2m with matching stage funds (50%) this would yield 6 doctoral student fellowships per year in perpetuity from 2012 onwards. First cohort of PhD students to graduate in Summer 2013.

Critical Needs:

1. Even with such a donation stream reassess how the endowment would grow as projected with present economic crisis.
APPENDIX: Critical Needs Assessment Presented to MA Officials
(12/2009)

The Kaput Center is a 21st Century R&D operation, which focuses on expanding the learning frontiers of the education of our children in schools and higher education. It is primarily funded by external grants and focuses on long-term cutting edge research that transforms education in the areas of science, technology, engineering and mathematics. Some of the members of the center are faculty or students in the newly established STEM department at UMass Dartmouth. The work of the center continues to fuel new programs for teacher preparation and the fields of mathematics and science education research including the psychology of learning, curriculum that transforms what is normally taught in the early grades, and educational technology that impacts learning, motivation and communication. The PhD program is supported by the Kaput Center by offering research students authentic learning experiences on new projects in MA and with partners around the world.

In order to meet the objectives of the preliminary 2007 5-year strategic agenda of the Kaput Center, critical needs exist in three areas: (1) Research and Program Development, (2) Supporting Collaboration, (3) Diffusion & Advocacy.

(1) Research and Program Development

a. In order to successfully complete federally-funded longitudinal implementations, we need student level data of all the MA children in our projects. Schools have not been forthcoming with such datasets even though our IRB approved consent and assent forms have allowed us the permission we need. We need a state mandated approach to supply data on students in our study in order for us to evaluate what factors predict success in our program. Our hierarchical linear models need the following data on individual students: (i) Ethnicity in DESE 2-digit format, (ii) SES (free/reduced lunch), and (iii) MCAS scores for grades 6, 7, 8, and 10. Student anonymity is upheld at all times.

b. Scale-up the use and implementation of Kaput Center research products that have been developed under rigorous efficacy methodologies (e.g., Randomized controlled trials) to some of the most needy school districts in MA. We are ready to deploy—at a district or regional level—our technology and curriculum programs that have demonstrated a significant impact on learning and motivation. We will continue to collaborate with the UMass Donahue Institute to ensure that fidelity of implementation is achieved, and to evaluate under what conditions inefficiency occurs.
c. **Broader impact:** State funds or matching funds to support the extension of the work of the Center into academic programs that impact the preparation of teachers and scientists. Travel grants for doctoral students.

(2) **Supporting Collaboration**

Our work relies on a diverse network of researchers, educators and industrial partners. In addition to our R&D efforts, the Kaput Center organizes a K-20 Regional Network (see http://www.kaputcenter.umassd.edu/projects/network/schools/) in Massachusetts focused on Science, Technology, Engineering and Mathematics Education to bring people together to establish a professional learning community. We are investigating how the strengths of the people in our network can help regional districts with various needs.

**Needs**

- This work is supported by UMass Dartmouth but seeks collaboration, promotion and further support from the Commonwealth of MA as the network grows
- Evaluation support to assess what educational strengths, weaknesses, opportunities and threats are of the south coast region as a whole
- Understanding the role of local businesses and the legislative delegate in implementing systemic reform initiatives in an effective way
- Identifying this as a regional initiative and the strength of regionalization both for economic as well as educational development
- Building support for public identification as the premier state institution in STEM education research in MA.

In turn, this collaborative can establish the infrastructure necessary to initiate a large-scale Mathematics & Science Partnership grant or a regional systemic reform initiative.

(3) **Advocacy & Diffusion**

Advocacy needs to take place at the state and nation level to meet our goals. The work of the Center is internationally known and our research products are being implemented around the world. Global expansion is happening now and advocates for our current efforts need to educate state leaders in order for us to continue this growth in the future. Grassroots efforts with regional legislative or local industry meetings can cultivate a movement of advocacy for our essential work to flourish and scale-up across the nation. Presentations synthesizing this work can be found here:

http://www.kaputcenter.umassd.edu/events/presentations_and_workshops/
We have recently completed a diffusion study of one of our educational technology projects in Texas (http://www.kaputcenter.umassd.edu/products/technical_reports/). Such studies of how and why teachers continue to use educational technology in an effective way and how they share it with other teachers, offer critical findings that are of relevance on a large scale. This needs to be translated into policy. The Center’s findings are supported by research-based methods and rigorous assessment. Our approach using research and assessment to drive education reform is unique and as such needs to be emphasized and shared by others when advocating its due purpose in influencing education policy.