Intellectual Contributions
Missouri State University
January 1, 2012 - December 31, 2012

Department of Mathematics

Blanton, Patti A.

Other Intellectual Contributions

Newsletter Article
Blanton, P. A. “Daring to Tread in New Territories.”.

Bray, William O.

Refereed Journal Articles

Journal Article, Academic Journal (Published)
Filomat/University of Nis, 26(4), 755-760. 
www.pmf.ni.ac.rs/pmf/publikacije/filomat/filomat_pocetna.php

Guo, Kanghui

Books

Book, Scholarly-New (Published)

Refereed Journal Articles

Journal Article, Academic Journal (Published)

Journal Article, Academic Journal (Published)

Harbaugh, Adam

Book Chapters

Book, Chapter in Scholarly Book-New (Published)

Book, Chapter in Scholarly Book-New (Accepted)

**Refereed Journal Articles**

*Journal Article, Academic Journal (Published)*

*Journal Article, Academic Journal (Accepted)*

**Non-Refereed Journal Articles**

*Journal Article, Professional Journal (Published)*

Hu, Shouchuan

**Refereed Journal Articles**

*Journal Article, Academic Journal (Published)*

*Journal Article, Academic Journal (Accepted)*
www.aimsciences.org/journals/home.jsp?journalID=3

Kemp, Paula

**Refereed Journal Articles**

*Journal Article, Academic Journal (Accepted)*

**Non-Refereed Journal Articles**

*Journal Article, Academic Journal (Submitted)*
Kemp, P. Application in Analysis.

*Journal Article, Academic Journal (Submitted)*

**Other Intellectual Contributions**
Manuscript (In Preparation; Not Yet Submitted)
Shah, K., Kemp, P. Tentative: Coefficients and Common Roots of Polynomials.

Ragan, Gay A. (Associate Professor)

Other Intellectual Contributions

Manuscript (Revising to Resubmit)

Manuscript (Submitted)

Rebaza, Jorge

Books

Book, Textbook-New (Published)

Book, Textbook-New (In Preparation; Not Yet Submitted)

Refereed Journal Articles

Journal Article, Academic Journal (Published)

Journal Article, Academic Journal (Published)

Journal Article, Academic Journal (Accepted)

Journal Article, Academic Journal (Accepted)

Other Intellectual Contributions

web page (Published)
Rebaza, J. Applied Mathematics Web page. math.missouristate.edu/jrebaza/appliedm.html

Reid, Les

Refereed Journal Articles
Journal Article, Academic Journal (Accepted)

Non-Refereed Journal Articles

Journal Article, Academic Journal (In Preparation; Not Yet Submitted)
Reid, L., Bennett, C. Click and Clack's Clock.

Journal Article, Academic Journal (In Preparation; Not Yet Submitted)
Reid, L., Bohanon, J. P. Eulerian Properties of Subgroup Graphs.

Journal Article, Academic Journal (In Preparation; Not Yet Submitted)
Reid, L., Collins, V. On the chromatic number of subgroup graphs.

Journal Article, Academic Journal (In Preparation; Not Yet Submitted)
Reid, L., McLaughlin, I., Owens, A. The Hamiltonicity of Certain Subgroup Graphs.

Shah, Kishor

Other Intellectual Contributions

Manuscript (In Preparation; Not Yet Submitted)
Shah, K., Kemp, P. Tentative: Coefficients and Common Roots of Polynomials.

Sherman, Clayton C.

Refereed Journal Articles

Journal Article, Professional Journal (Accepted)

Other Intellectual Contributions

(In Preparation; Not Yet Submitted)
Sherman, C. C. G1 of Certain Noetherian Rings.

Stanojevic, Vera B.

Refereed Journal Articles

Journal Article, Academic Journal (In Preparation; Not Yet Submitted)
Stanojevic, V. B. Structures and Divergence Modes of Real Sequences in Tauberian Retrieval Classes.

Su, Yingcai

Refereed Journal Articles

Journal Article, Academic Journal (Published)

Sun, Xingping

**Refereed Journal Articles**

*Journal Article, Academic Journal (Published)*

**Conference Proceedings**

*Conference Proceeding (Accepted)*
Lin, S., Sun, X. *Discretizing spherical integrals and its applications*. Americal Institute of Mathematical Sciences.

Wickham, Cameron G.

**Refereed Journal Articles**

*Journal Article, Academic Journal*
Maimani, H. R., Wickham, C. G., Yassemi, S. (2012). Rings whose total graphs have genus at most one. *Rocky Mountain Journal of Math*.

Wright, Matthew

**Non-Refereed Journal Articles**

*Journal Article, Academic Journal (In Preparation; Not Yet Submitted)*
Wright, M., Mitrea, M. A transmission problem for the bi-Laplacian.

*Journal Article, Academic Journal (In Preparation; Not Yet Submitted)*
Wright, M., Escauriaza, L., Mitrea, M., Pipher, J. The transmission problem for the Lamé system in Lipschitz domains.

*Journal Article, Academic Journal (In Preparation; Not Yet Submitted)*
Wright, M., I. M., K. O. Transmission problems and spectral properties of layer potential operators.

**Other Intellectual Contributions**

*Monograph (Published)*

Zheng, Songfeng

**Refereed Journal Articles**

*Journal Article, Academic Journal (Published)*

*Journal Article, Academic Journal (Published)*


*Journal Article, Academic Journal (Published)*

Presentations
Missouri State University
January 1, 2012 - December 31, 2012

Department of Mathematics

Blanton, Patti A.


Blanton, Patti Ann, Henson, Pamela J (Presenter & Author), Twigger, Dianne M (Presenter & Author), CNAS Series, "Course Redesigns in Mathematics," MSU CNAS, Temple Hall. (September 2012).

Harbaugh, Adam


Harbaugh, Adam (Presenter & Author), Missouri Council of Teachers of Mathematics, "Video stories to graphs to video stories," Missouri Council of Teachers of Mathematics, Columbia, MO. (November 30, 2012).

Henson, Pamela J.

Blanton, Patti Ann, Henson, Pamela J (Presenter & Author), Twigger, Dianne M (Presenter & Author), CNAS Series, "Course Redesigns in Mathematics," MSU CNAS, Temple Hall. (September 2012).

Kemp, Paula


Killion, Kurt


Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), CNAS Course Transformation Sharing Seminar, "Lessons Learned from the Transformation of MTH 320 & 360"," CNAS, Missouri State University. (October 5, 2012).

Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), Richards, Bruce (Presenter Only), 27th Showcase on Teaching and Learning, "Blended Format in Multi-Instructor, Activity-Based, Technology-Based and


Plymate, Lynda M.

Plymate, Lynda M (Leader), Piccolo, Diana L (Presenter Only), Edwards, Sara (Presenter Only), Greenlee, Syeda (Presenter Only), Gurley, Judith (Presenter Only), LaFevers, Jan (Presenter Only), MCTM Fall Conference, "Teaching Algebra in a 1 to 1 Environment," Missouri Council of Teachers of Mathematics, Columbia, Missouri. (November 30, 2012).

Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), CNAS Course Transformation Sharing Seminar, "Lessons Learned from the Transformation of MTH 320 & 360," CNAS, Missouri State University. (October 5, 2012).

Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), Richards, Bruce (Presenter Only), 27th Showcase on Teaching and Learning, "Blended Format in Multi-Instructor, Activity-Based, Technology-Based and Manipulative-Based Courses," Faculty Center for Teaching and Learning, Missouri State University. (August 15, 2012).

Plymate, Lynda M, Elementary Education Offsite Bootcamp, "Journey from a Face-to-Face Class to a Blended Class (MTH 320 & MTH 360)," Faculty Center for Teaching and Learning, Missouri State University. (August 1, 2012).

Ragan, Gay A. (Associate Professor)


Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), CNAS Course Transformation Sharing Seminar, "Lessons Learned from the Transformation of MTH 320 & 360," CNAS, Missouri State University. (October 5, 2012).

Plymate, Lynda M (Presenter Only), Killion, Kurt (Presenter Only), Ragan, Gay A (Presenter Only), Richards, Bruce (Presenter Only), 27th Showcase on Teaching and Learning, "Blended Format in Multi-Instructor, Activity-Based, Technology-Based and Manipulative-Based Courses," Faculty Center for Teaching and Learning, Missouri State University. (August 15, 2012).


Rebaza, Jorge


Shah, Kishor

Shah, Kishor (Other), MAA (sectional), "A Problem in Number Theory," MAA (national), Cheek Hall, MSU.

Twigger, Dianne M.

Blanton, Patti Ann, Henson, Pamela J (Presenter & Author), Twigger, Dianne M (Presenter & Author), CNAS Series, "Course Redesigns in Mathematics," MSU CNAS, Temple Hall. (September 2012).

Zheng, Songfeng

Zheng, Songfeng (Presenter & Author), Department of Statistics Colloquia, "Compositional Noisy-logical learning," Univ. of Missouri, Columbia, Columbia, MO.
Department of Mathematics

Blanton, Patti A.

**Department**

Committee Member, Algebra Transformation Committee. (February 2011 - Present).
Committee members met repeatedly to arrive at a plan to redesign the gen ed algebra classes. We researched current practices, explored technology options and created a plan for our own transformation.

Committee Member, Contest Committee. (March 2010 - Present).
As a committee member, I have helped to write, edit, and implement mathematics contests for high school students. This includes Pummill Relays and area conference contests.

Committee Member, Department Head Search Committee. (September 2011 - May 2012).
Through many meeting, checking with references, phone interviews and on-campus interviews, this is a long and intense process.

**Public/Community**

**State**

Assistant Coach, ARML (American Regions Mathematics League)Team. (September 2004 - Present).
I serve as an assistant coach for this team of high school students who prepare throughout the school year to complete in the national ARML contest each spring. For the national contest, we travel to University of Iowa in Iowa City.

I serve as a local contest manager for MAA, AMC Contest Manager. (November 2009 - Present).
I advertise the availability for students to come to the MSU campus to take the prestigious AMC10/12 mathematics contests. I administer the contest and provide the necessary paperwork and information back to MAA.

Cheng, Yungchen

**Professional**

Department Liaisons Coordinator, Missouri Mathematical Association of America. (2012 - Present).

**Public/Community**

**Local**

Student Org Advisor (Professional Org), Southwest Missouri District Association of Mathematics Teachers. (2002 - Present).

Other
Local
Conducting monthly math enrichment sessions to area high/middle school students.

Hu, Shouchuan

College
Committee Member, College Council.

Department
Committee Chair, Program Committee.

Kemp, Paula

University
Committee Chair, University Library Committee.
Committee Member, Annual Committee for Statewide Collaborative Diversity Conference.
(August 2012 - May 2013).
Committee Chair, Honorary Doctorate Committee. (January 2012 - May 2013).
Committee Chair, Honorary Doctorate Committee. (2011 - 2012).
The Honorary Doctorate Committee selects the person to be recommended to receive
the Honorary Doctorate Award.
Board of Advisors/Directors of a Company, Missouri Association of Faculty Senate’s Advisory
Graduate Forum Judge. (April 2012).

College
Committee Chair, CNAS Diversity and Inclusion committee. (January 2012 - May 2013).
Committee Chair, CNAS Diversity and Inclusion Committee. (2011 - 2012).
I am Co-Chair with Kevin Evans

Professional
Member, Sonia Kovalevsky High School Days Committee. (2011 - 2012).

Killion, Kurt

University
Participant, academic Development Center series on the evaluation of teaching.

Other
Committee Member, NCTM’s NCATE Program Report Compiler Training.

Committee Member, Springfield Public Schools Curriculum Development Council.

Plymate, Lynda M.

University

Committee Member, Faculty Senate Rules Committee. (2009 - Present).

Committee Member, BSEd-Secondary Oversight Committee. (2006 - Present).

MSU Professional Education Unit. (1996 - Present).

College

Committee Member, CNAS Women in Science (WISTAM) Committee. (1994 - Present).

Committee Member, Expanding Your Horizons in Science and Mathematics, A Conference for Young Women. (1994 - Present).

Department

Faculty Advisor, Educational comprehensive exams for MSEd students. (2005 - Present).

Committee Chair, Math Contests Committee. (1998 - Present).

Committee Member, Recruitment and Retention Committee. (1998 - Present).

Committee Member, Curriculum Committees. (1994 - Present).

Math Education (MTH 320/360/343/377/479), 1994-current

Service Learning/Senior Seminar/Geometry/Topology (MTH 300, 460, 497, 567, 575, 582, 681) 2004 – current


Pre-Service Statistics (MTH 340/343), Chair, 1998-2000

Other

Director, Annual MCTM Elementary Student Mathematics Contest.

Organize and coordinate the 25-28 regional site contests, followed by a state finals competition for winners from regions. An informational handbook is prepared and sent to each regional contest coordinator.

• Prepare and send announcement flyer with entry form to the 2400 public and private Missouri schools.
• Prepare and send 12 contest exams to regional and state site coordinators for each competition.
• Arrange for and send contest awards (participation ribbons, winning ribbons and trophies) to sites.
• Prepare and distribute a sample test to all teachers, parents, students and schools requested it.
• This year I put the sample test on a web-page for everyone to download.
• Arrange for regional and state T-shirts, using a winning design from the Poster ‘n Art Contest.
• Handle all problems, questions, concerns and suggestions from coordinators, teachers, and parents.
• Manage all finances associated with this state-wide contest, approximately $14,000 per year.

Pursley, Jennifer

**Department**

Attendee, Meeting, Intermediate/College Algebra Committee.

Attendee, Meeting, Recruitment Committee.

Ragan, Gay A. (Associate Professor)

**University**

Mathematics Education Program Representative, Professional Education Unit. (January 2011 - Present).

Associate Professor Rank Senator, Faculty Senate. (August 2009 - Present).

**Department**

Committee Chair, Contemporary Mathematics Committee. (2010 - Present).

Committee Member, Math Education Committee. (2005 - Present).

**Professional**

Evaluator, Missouri Council of Teachers of Mathematics Conference. (2010 - Present).

Secondary Mathematics Program Reviewer, National Council for Accreditation of Teacher Education Board of Program Reviewers. (2009 - Present).


**Public/Community**


volunteer, Wesley United Methodist Church. (2008 - Present).


Rebaza, Jorge

**University**

Committee Chair, Applied Mathematics Differential Equations and Program Assessment committees.
Committee Member, MSU/ Senate Ad Hoc Committee Issues in Higher Education. (October 2011 - Present).

Reid, Les

**University**

Graduate Advisor, Department of Mathematics, Missouri State University.

Student Chapter Coordinator, MAA – Missouri Section.

Faculty Sponsor, Mathematical Association of America, MSU student chapter.

Leader, Missouri State Undergraduate Research/Problem Solving Group.

**Department**

Graduate Advisor, Department of Mathematics.

Shah, Kishor

**University**

Member, Faculty Senate of MSU. (August 2011 - Present).

Mathematics Departmental Representative on the Faculty Senate.

Member, Graduate Council of MSU. (August 2011 - Present).

Mathematics Departmental Representative on the Graduate Council of MSU.

**Department**

Committee Member, Departmental Analysis Committee. (2005 - Present).


Committee Member, Departmental Tenure, Promotion, and Reappointment Committee. (1995 - Present).

Shand-Hawkins, Carolyn H. (Instructor)

**University**

Committee Member, BearClaw Advisory Committee. (January 2011 - Present).

**Department**

Committee Member, Course Transformation Committee for Intermediate and College Algebra. (September 2010 - Present).

Committee Member, Dual Credit College Algebra. (August 2005 - Present).

Committee Member, Intermediate/College Algebra. (August 2005 - Present).
Committee Member, Math Contests. (August 2005 - Present).

Committee Member, Placement Committee. (August 2005 - Present).

Su, Yingcai

**College**
Committee Member, Environment and Policy Committee.

**Department**
Committee Chair, Actuary.
Committee Member, Awards.
Committee Member, Program / Assessment.
Committee Member, Statistics.

Sun, Xingping

**Other**
Organizer of the Special Session on Approximation Theory, 873rd Regional Conference of American Mathematical Society.

Organizer of the Special Session dedicated to Will Light, International Conference on Advances in Constructive Approximation.

Wickham, Cameron G.

**University**
Committee Member, Faculty Concerns Committee. (April 2006 - Present).

**Department**
Committee Member, Algebra Curriculum Committee.
Committee Member, Applied Math Curriculum Committee.
Committee Chair, Service Learning/Senior Seminar/Geometry/Topology Curriculum Committee.

**Public/Community**
Member, Springfield-Drury Civic Orchestra. (2004 - Present).

**Other**
National Departmental Liaison, Mathematical Association of America. (August 2003 - Present).
Zheng, Songfeng

Department

Committee Member, Statistics.

Other

Reviewer, European Conference on Computer Vision (ECCV).
Reviewer, IEEE Transaction on Pattern Analysis and Machine Intelligence (PAMI).
Reviewer, Image and Vision Computing.
Background:

In fall 2010, the instructors in the math department were charged with redesigning our general education college algebra course with a primary objective of increasing student success and comprehension in the course. It was apparent to this group from the beginning that in order to achieve this goal, it was imperative to examine our developmental mathematics courses as well, given that these are feeder courses for college algebra. With the support of the department head and dean, the course transformation committee began researching various course transformations throughout the nation. These committee members also researched various technologies and reviewed current course content. Three committee members (Blanton, Henson, Twigger) applied for and were awarded an internal grant of $12,000 in March 2011 to develop and implement pilot courses in the 2011-2012 school year. The first pilot, MTH 101, began in fall 2011.

While researching redesigned courses, we came across one university that had both five contact hour and three contact hour intermediate algebra courses. As we continued to brainstorm redesign options, it became clear that a one semester option for our MTH 101 and 102 sequence would be beneficial for the following reasons:

1. Students will be better prepared for their general education math course (MTH 130, 135, or 138) in terms of speed and amount of coursework. In these general education courses, students coming from the MTH 101/102 sequence had a particularly low success rate their first time in the course. By creating a five contact hour course for these students they would become accustomed to a faster pace and workload, consistent with the general education course.

2. Students needing to repeat the course would repeat all of intermediate algebra, whereas repeating MTH 101 or 102 separately would only revisit half of the topics. In particular, a student needing to retake MTH 102 would most likely have trouble recalling MTH 101 material when they progressed to their general education course, given the time lapse.

3. Students have the opportunity to progress to general education courses faster. This is a benefit that we thought the students would particularly enjoy, giving them more motivation to enroll in this course and complete the coursework.

Given the rationale above, it was decided in April 2011 to pilot a course that covers both MTH 101 and 102 material for the fall 2011 semester, presented in five contact hours. Given the short time frame to develop this course, we were restricted by scheduling issues as the fall semester was about to open for registration.
Two sections of the redesigned MTH 101 courses were offered in fall 2011. Contact was made with advisors to make them aware of the change in the design via flyers and email. As of the second week of classes, 43 students were enrolled in two sections of the redesigned course. These students were informed about the structure and main components of the course during the first week, and signed a contract stating that they understood the attendance policy as well as the structure of the course.

Students in the pilot course would attend classes for 75 minutes on Tuesdays and Thursdays of each week. They would be required to also log two hours in an evening tutoring lab, run by graduate assistants. The evening lab was open Sundays through Thursdays from 5-9PM. Tuesday and Thursday lectures were similar in pace to MTH 103 lectures as well as incorporating a few activities to enhance understanding. Evening lab hours were used to complete homework assignments, ask questions, and complete a few self-guided sections. Students used MyMathLab for homework and self-guided sections, allowing them to receive immediate feedback and assistance.

An attendance policy was also put into effect for the course. Students missing 7 or more Tuesday and/or Thursday class periods would receive an automatic F grade in the course. Students could appeal this with documentation of extraordinary circumstances. Completion of the lab hours each week counted as part of the homework component of the grade.

Students in the pilot course were administered a pre-test and post-test comprised of 25 multiple choice questions. Students enrolled in traditional MTH 101 courses were given these pre-tests and students enrolled in MTH 102 were given the post-test as well. No significant differences were found between pilot and non-pilot courses for both the pre-tests and post-tests. Also, no significant differences were found between the pre-tests and post-tests for the pilot courses. This was most likely due to the anonymity of the tests – students did not record any identifying information and scores did not count towards their overall grade.

Pilot students completed the same final exam as those students in MTH 102, which is a comprehensive final exam over MTH 101 and MTH 102. Data on these exams is in the chart below:

<table>
<thead>
<tr>
<th>FINAL EXAM (same as MTH 102)</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>26</td>
<td>130</td>
<td>156</td>
</tr>
<tr>
<td>Mean</td>
<td>58%</td>
<td>60.5%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Not only did pilot students fare as well as their counterparts on the common final exam, they completed the material at a faster pace. It is important to note that all students in MTH 102 have completed MTH 101 with a C or better, while the pilot course most likely contained students who would not have passed MTH 101 with a C or better.
Success rates for the pilot courses are below. It is important to note that these results should not be compared to traditional MTH 101 sections, since these students have completed two semesters of material. It would be more reasonable to compare these rates to the percentage of students who pass MTH 101 and MTH 102 consecutively, which is approximately 40%.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>ABC%</th>
<th>DFW%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 101-12</td>
<td>36.8</td>
<td>63.2</td>
</tr>
<tr>
<td>MTH 101-22</td>
<td>33.3</td>
<td>66.7</td>
</tr>
<tr>
<td>OVERALL</td>
<td>34.9</td>
<td>65.1</td>
</tr>
</tbody>
</table>

If the goal of the pilot course is to create better prepared students, it is also important to track their progress in their future courses. As of the completion of fall 2012 semester, 64.3% of the students who passed the final were successful in the next course. This is consistent with future success of students who complete MTH 102 and MTH 135 successfully on the first try (59.24%).

An interesting note can be made about the students who received a D in the course. Four students who received a D in the course registered for MTH 103 the next semester. All four of these students were successful in MTH 103. While these students were technically unsuccessful in the pilot, they completed their intermediate algebra sequence in a year and so were no worse off than the traditional MTH 101 and MTH 102 students.

As with any pilot, it is important to note that the data set for these courses is very small. As a result, an expansion of the pilot courses is necessary to determine their true potential.

Overall impressions of the first semester pilot:

While student success remained low, it is important to remember that these scores represent the concurrent success in two courses. Upon reflection, the following changes were made to the overall structure:

- The lab component needs to be a structured and scheduled time in the course. By the end of the semester, many students were not attending the mandatory lab hours. Also, a scheduled lab time would allow for more group activities, review sessions, and would allow for more elaboration on certain lessons. A more feasible structure would be a five day a week course with MWF lectures and TR lab times.
- If lab time is scheduled, lab attendance should be recorded as absences in the attendance policy.
- The creation of a more effective pre-test and post-test is necessary. The post-test should count in some form, while still finding a way to keep data anonymous.
Two sections of the pilot courses were offered in spring 2012. A better effort was made to contact advisors and discuss advantages and disadvantages of the course through flyers, emails, and in person meetings with groups of advisors. As with the previous semester, these students were informed about the structure and main components of the course during the first week, and signed a contract stating that they understood the attendance policy as well as the structure of the course. Due to limited labs and classrooms, class sizes were capped at 20 students. As of the second week of classes, 33 students were registered for the MTH 101 pilot courses.

Students were now required to attend class five days a week, with lectures on Mondays, Wednesdays, and Fridays, and labs on Tuesdays and Thursdays. Lectures were similar to those presented in MTH 103, but with more elementary material, detail, and practice. Students were also given frequent quizzes and other forms of assessments during these times. Lab times primarily consisted of activities to enhance understanding or to prepare students for the next day’s lesson. Group projects, pre and post-quizzes on material, and homework help were also a part of the scheduled lab time. At some points in the semester, lab time was also used for lectures to help with more difficult material. Lab time was run by a graduate assist in order to keep contact hours for the instructor consistent with current teaching loads.

The attendance policy for the course remained in effect. Since attendance was now counting five times a week, students would receive an automatic F at the thirteenth absence.

As a part of the changes for the spring semester, students were administered a pre-test and a similar post-test at the beginning and end of the semester. It was a six question free response test. Students were informed that the pre-test would not count towards their overall score in the course, but that the post-test would count in the overall grade for the course. Students enrolled in traditional MTH 101 courses were given these pre-tests and students enrolled in MTH 102 were given the post-test as well. All pre-tests and post-tests were graded by the same instructor to ensure consistency in grading. Scoring guidelines were also predetermined.

Pre-test and post-test data are given below. Scores were out of 30 points.

<table>
<thead>
<tr>
<th>Pre-Test</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>36</td>
<td>146</td>
<td>182</td>
</tr>
<tr>
<td>Mean</td>
<td>2.1667</td>
<td>2.3288</td>
<td>2.2967</td>
</tr>
<tr>
<td>Median</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Std Dev</td>
<td>2.5441</td>
<td>3.4544</td>
<td>3.2950</td>
</tr>
</tbody>
</table>
Pre-test data confirms that students in the pilot sections were comparable to students in the non-pilot sections. Post-test data showed a lower score (roughly 10 percentage points) for pilot sections; however, it is important to note that students in MTH 102 have completed MTH 101 with a C or better, while the pilot course most likely contained students who would not have passed MTH 101 with a C or better, which could account for the difference in scores. Another limitation of the pre-test and post-test data was the lack of participation from some sections, particularly those taught by adjunct instructors.

Pilot students completed the same final exam as those students in MTH 102, which is a comprehensive final exam over MTH 101 and MTH 102. Data on these exams is in the chart below:

<table>
<thead>
<tr>
<th>Post-Test</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>27</td>
<td>152</td>
<td>179</td>
</tr>
<tr>
<td>Mean</td>
<td>16.5185</td>
<td>19.6645</td>
<td>19.1899</td>
</tr>
<tr>
<td>Median</td>
<td>17</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Std Dev</td>
<td>4.9693</td>
<td>4.9696</td>
<td>5.0922</td>
</tr>
</tbody>
</table>

While pilot sections have significantly lower final exam scores, two particularly low-lying scores affected the pilot mean. Again, it is important to note that all students in MTH 102 have completed MTH 101 with a C or better, while the pilot course most likely contained students who would not have passed MTH 101 with a C or better.

Success rates for the pilot courses are below. It is important to note that these results should not be compared to traditional MTH 101 sections, since these students have completed two semesters of material. It would be more reasonable to compare these rates to the percentage of students who pass MTH 101 and MTH 102 consecutively, which is approximately 40%.
If the goal of the pilot course is to create better prepared students, it is also important to track their progress in their future courses. As of the end of the fall 2012 semester, 16 out of 33 pilot students (48.5%) have not attempted their next course. This is not unexpected, given that little time has lapsed since the completion of the spring 2012 semester. As of the completion of fall 2012 semester, 63.6% of the students who passed the final were successful on the first try in the next course. This is consistent with future success of students who complete MTH 102 and MTH 135 successfully on the first try (59.24%).

An interesting note can be made about the students who received a D in the course. Three students who received a D in the course registered for MTH 103 the next semester. Two of these students were successful in MTH 103. While these students were technically unsuccessful in the pilot, they completed their intermediate algebra sequence in a year and so were no worse off than the traditional MTH 101 and MTH 102 students.

Students in the pilot courses were also given a 32 question survey to determine their attitudes about the course. Students had positive results to all components of the course, and especially liked the online component of the course. More details of this survey are attached at the end of this document.

As with any pilot, it is important to note that the data set for these courses is very small. Taking into account the changes to the pilot and student enthusiasm for the course, it was recommended that the pilot courses be expanded for fall 2013 to incorporate more students as well as increase section capacities.

Overall impressions of the second semester pilots:

While the success of the pilot students increased with the new course structure, as the pilot is refined one would hope that it would rise even more. Scheduled lab time was successful. It is important to see at this point if another instructor can replicate these findings.

**Fall 2012 – Pilot Semester 3**

Three sections of the pilot courses were offered in fall 2012. Another instructor, Kim White, taught one section of the pilot. The goal of adding another instructor was to see if an instructor to take the created lectures and labs and be able have findings consistent with the original instructor, Dianne Twigger. As with the previous semester, these students were informed about the structure and main components of the course during the first week, and

<table>
<thead>
<tr>
<th>GROUP</th>
<th>ABC%</th>
<th>DFW%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 101-3</td>
<td>53.3</td>
<td>46.7</td>
</tr>
<tr>
<td>MTH 101-4</td>
<td>33.3</td>
<td>66.7</td>
</tr>
<tr>
<td>OVERALL</td>
<td>42.4</td>
<td>57.6</td>
</tr>
</tbody>
</table>
signed a contract stating that they understood the attendance policy as well as the structure of the course. Class sizes were raised to 28 students in an effort to be more consistent with class sizes of traditional courses. As of the second week of classes, 83 students were registered for the MTH 101 pilot courses.

Structure of the course was the same as the structure from the second semester pilot. Lab activities and lectures were reviewed and adjusted as necessary based on outcomes from the previous semester. The attendance policy, pre-test, and post-test remained the same.

Pre-test and post-test data are given below. Scores were out of 30 points.

<table>
<thead>
<tr>
<th>Pre-Test</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>80</td>
<td>473</td>
<td>553</td>
</tr>
<tr>
<td>Mean</td>
<td>2.0875</td>
<td>3.7082</td>
<td>3.4738</td>
</tr>
<tr>
<td>Median</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Std Dev</td>
<td>2.430</td>
<td>3.4278</td>
<td>3.3510</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-Test</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>58</td>
<td>52</td>
<td>110</td>
</tr>
<tr>
<td>Mean</td>
<td>19.0172</td>
<td>19.0962</td>
<td>19.0545</td>
</tr>
<tr>
<td>Median</td>
<td>19</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Std Dev</td>
<td>4.7868</td>
<td>5.5271</td>
<td>5.1502</td>
</tr>
</tbody>
</table>

Pre-test data confirms that students in the pilot sections were comparable to students in the non-pilot sections, and pilot students actually fared worse than non-pilot sections. Post-test data showed similar scores for non-pilot and pilot sections. Given that students in MTH 102 have completed MTH 101 with a C or better, while the pilot course most likely contained students who would not have passed MTH 101 with a C or better, one could argue that the pilot students actually fared better on the post-test. A limitation of the pre-test and post-test data was the lack of participation from some sections, particularly those taught by adjunct instructors.

Pilot students completed the same final exam as those students in MTH 102, which is a comprehensive final exam over MTH 101 and MTH 102. Data on these exams is in the chart below.
Not only did pilot students fare BETTER than their counterparts on the common final exam, they completed the material at a faster pace. When comparing averages on the final exam for individual sections, the three pilot sections were all above the overall average, holding three of the five highest means. Again, it is important to note that all students in MTH 102 have completed MTH 101 with a C or better, while the pilot course most likely contained students who would not have passed MTH 101 with a C or better, making the results even more surprising.

Success rates for the pilot courses are below. It is important to note that these results should not be compared to traditional MTH 101 sections, since these students have completed two semesters of material. It would be more reasonable to compare these rates to the percentage of students who pass MTH 101 and MTH 102 consecutively, which is approximately 40%.

These scores are very impressive. Not only did the pilot students improve significantly, these students even exceeded the overall success rate for traditional 101 students, which was 54.7%. Drops consisted of 15% of the students in the pilot courses, which was consistent with drop rates in the traditional MTH 101 courses (14%).

It is not yet possible to track future success as we are not a full semester out at this point. However, the following information is available:

- 41 out of the 48 students successful in the pilot are enrolled in a MTH course in spring 2013. Follow up on these students will be necessary.
- Four students who received a D in the course are enrolled in MTH 103. Again, follow up with these students will be necessary.

<table>
<thead>
<tr>
<th>FINAL EXAM (same as 102)</th>
<th>Pilot</th>
<th>Non-Pilot</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>61</td>
<td>116</td>
<td>177</td>
</tr>
<tr>
<td>Mean</td>
<td>72%</td>
<td>65%</td>
<td>68%</td>
</tr>
</tbody>
</table>
Recommendations

It is the recommendation of the Co-Pilots of the grant as well as the instructors in the department of mathematics to move forward with full implementation by spring 2014, and sooner if possible. In order to make this a reality, the following items will need to be addressed:

• Dedicated lab space for the pilot courses will need to be made available. It is estimated that pilot courses would need a 36 seat lab and creative scheduling to accommodate all sections of the pilot courses in a given semester.
• Substantive course revisions will need to be presented to college council and all other necessary groups to obtain approval.
• Changes on banner will need to reflect the course revisions. It is my recommendation that the pilot course is renamed MTH 102 for the following reasons:
  o If named MTH 101, faculty and staff will be unable to verify if students completed the pilot course or the traditional MTH 101 course with less content. In renaming the course to MTH 102, the issue is resolved since students cannot enroll in a traditional MTH 102 course without the completion of the traditional MTH 101 course.
  o Courses for which the MTH 101 and 102 sequence were listed as a prerequisite will not need to be changed, leaving other departments unaffected.
• Credit hours for the pilot course should be raised from two to three credit hours. This will be more reasonable for instructors teaching the course.
• Advertisement of the changes will need to be addressed.
A Brief Report on Data Collection for Constructed Responses on the MTH 135 Final Exam – Spring 2013

Following group grading of the final exam for MTH 135, in which each constructed response was scored by an individual instructor on all student papers, data was then collected on thirteen of the twenty-three constructed response test items.

For all students, scores tended to be higher for multi-part questions that allowed students to more easily earn points for each part. Problems in which there was little opportunity for partial credit (like #26 where students were to find the equation of the inverse of a rational function) tended to have lower means. In general, students often have difficulty working with rational equations and graphing exponential functions.

Comparisons were made between the students in the two pilot sections and students in the twenty-one non-pilot sections. One of the goals of the pilot was that students would do as well on procedural types of problems on the final exam as the non-pilot students. For all but one of those test items, there was no statistical difference between the means of the pilot versus non-pilot students. For one of the procedural items, students in the pilot had a mean that was statistically significantly lower in comparison to the non-pilot students. That problem was finding the equation of the inverse of a rational function. This difference is probably due, in part, to the fact that there was very little credit earned for making the first step which showed understanding of an inverse. Most of the credit on this problem came from solving the resulting rational equation. Some non-pilot students had recently been tested over this skill and the pilot students had been tested on this skill on Test 1. The process of isolating the output variable is often non-intuitive for students.

Another goal of the pilot is for students in the pilot to out-perform non-pilot students on conceptual types of problems. For this type of problem, there were two test items that showed statistically significant difference in the means. For those two test items, the pilot students outperformed the non-pilot students. One test item was graphing a piecewise function and the other item required students to understand function notation and perform function operations. The difference is probably due, in part, to the fact that the pilot instructors used hands-on, active lessons for these topics.

Data was also collected on the eighteen multiple choice items and that data will be analyzed in the near future. However, preliminary results show some level of efficacy for the active learning approach of the pilot course.

Patti Blanton – Co-Pilot for MTH 135 Course Redesign
Pamela Henson – Co-Pilot for MTH 135 Course Redesign
Findings for the MTH 135: College Algebra Course Redesign

Pilot Sections for Spring 2012

July 2012

Patti Blanton and Pamela Henson

In the fall of 2010 the Algebra Transformation Committee was formed by instructors in the Mathematics Department of Missouri State University. The committee members were charged with the task of redesigning MTH 135 to teach it better and more efficiently, with an invitation to define “success” for the redesign. Members wanted to achieve this charge with a broad definition of “success.” While no formal definition of success was written, discussions ensued that indicated the desire to improve students’ abilities to apply mathematics to their lives and within their careers, as well as to improve the A-B-C rate for the course.

Discussion indicated that it was necessary to also include the developmental courses in this redesign as well, since many of our students in MTH 135 first take one or more of the developmental courses. In fact, for the spring of 2012, 51.6% of the students who completed the course had ACT Math sub scores below the required level for enrollment. Those 289 students had to have performed satisfactorily on a placement test or taken one or more developmental courses.

In the Fall Semester of 2011, the first pilot sections for a redesigned version of MTH 101 were offered with one instructor and a supporting graduate assistant. In the Spring Semester of 2012, two pilot sections were offered for the redesigned version of MTH 135 with two instructors, each teaching one section, and one supporting graduate assistant for both sections. In all sections of the original pilots, class size was smaller than the non-pilot sections due to available computer and classroom space. The MTH 135 sections were limited to twenty students for enrollment. Students from the MTH 101 pilot who needed to continue into MTH 135 were recommended to enroll in a pilot section of MTH 135, and three students did so. One withdrew with a passing grade the other two completed the course each with a grade of B.

One of the major differences that students noticed in the pilot is that they were required to attend a lab each week, increasing their contact hours to four, while earning still three credit hours. Students were also presented with an attendance policy that included the following statement:

**Students accumulating absences consisting of any number combination of missed labs and lectures totaling nine will receive an automatic F in the course upon the tenth absence.**

The other major difference for students in the pilot was the focus on modeling and problem-solving and the use of more varied methods of instruction. An emphasis was placed on
implementing active learning in appropriate lessons to facilitate conceptual understanding and retention. Examples of active learning that were used include: group interaction for problem-solving and discussion of concepts, experiential lessons in which students act out the mathematical concepts, and hands-on activities. A free, web-based application for graphing and statistical computations called Geogebra was used to aid visualization in classroom presentations and to motivate student explorations.

The following serves as the research hypothesis for this redesign project:

In relation to students in non-pilot sections of College Algebra, students in the pilot will exhibit better conceptual understanding and improved attitudes toward mathematics while performing equivalently on measures of procedural abilities.

In order to measure the extent to which this hypothesis is supported, researchers will collect data to illustrate the following Project Goals.

Students in the pilot will:

1. Show a higher A-B-C rate than students in the non-pilot sections.
2. Perform significantly better than students in the non-pilot sections on items on the common final exam that are primarily conceptual in nature.
3. Perform equivalently to students in the non-pilot sections on items on the common final exam that are primarily procedural in nature.
4. End the course with higher responses on an affective survey than the students in the non-pilot sections.
5. Perform significantly better than students in the non-pilot sections in the application of college algebra concepts to a data modeling problem.
6. Show better success in subsequent courses that list MTH 135 as a prerequisite course.

Project Goal 1

The ABC-DFW rates for sections of MTH 135 in the spring semester of 2012 are provided in the following table and show similar data for the A-B-C rate.

<table>
<thead>
<tr>
<th>Population</th>
<th>%ABC</th>
<th>%DFW</th>
<th>No. ABC</th>
<th>No. DFW</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot</td>
<td>56.8</td>
<td>43.2</td>
<td>21</td>
<td>16</td>
<td>38</td>
</tr>
<tr>
<td>Non-Pilot</td>
<td>52.9</td>
<td>47.1</td>
<td>332</td>
<td>296</td>
<td>631</td>
</tr>
<tr>
<td>All Students</td>
<td>53.1</td>
<td>46.9</td>
<td>353</td>
<td>312</td>
<td>669</td>
</tr>
</tbody>
</table>

The data set was quite small and easily affected by small variations, but Project Goal 1 results showed a higher ABC rate, though not substantially higher.
**Project Goals 2 and 3**

After all of the Spring MTH 135 common final exams had been aggregately scored by MTH 135 instructors, (each of the MTH 135 instructors was assigned to assess a given problem on all final exams to maintain consistency of assessment), thirteen of the twenty-three constructed responses were selected for data analysis. The thirteen problems were selected to equally represent a varied sampling of problem types on the exam, including equations, functions, graphing, and application problems. A two-tailed t-test was then performed on the selected data.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Pilot N</td>
<td>455</td>
</tr>
<tr>
<td>Pilot N</td>
<td>33</td>
</tr>
<tr>
<td>Alpha</td>
<td>0.05</td>
</tr>
<tr>
<td>df</td>
<td>486</td>
</tr>
<tr>
<td>Critical Value for t</td>
<td>1.966</td>
</tr>
</tbody>
</table>

**Assessment of Procedural Skills on Constructed Responses on the Final Exam**

Items with no significant difference:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pts Poss</th>
<th>Non-Pilot Mean</th>
<th>Non-Pilot $\sigma$</th>
<th>Pilot Mean</th>
<th>Pilot $\sigma$</th>
<th>t-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q20: Solve a nonlinear system of equations</td>
<td>6</td>
<td>3.71116</td>
<td>2.406171</td>
<td>4.242424</td>
<td>2.38217</td>
<td>1.233965</td>
</tr>
<tr>
<td>Q23: Solve equation involving logarithms</td>
<td>6</td>
<td>3.586433</td>
<td>2.27864</td>
<td>3.727273</td>
<td>2.246516</td>
<td>0.347465</td>
</tr>
<tr>
<td>Q24: Solve quadratic equation with complex roots</td>
<td>6</td>
<td>3.827133</td>
<td>2.048292</td>
<td>4.121212</td>
<td>2.07083</td>
<td>0.788411</td>
</tr>
<tr>
<td>Q26: Find the rule for the inverse of a given function</td>
<td>6</td>
<td>2.901532</td>
<td>2.650531</td>
<td>2.30303</td>
<td>2.504358</td>
<td>-1.32049</td>
</tr>
<tr>
<td>Q36: Graph an exponential function with transformations</td>
<td>6</td>
<td>3.356674</td>
<td>2.61993</td>
<td>3.515152</td>
<td>2.618364</td>
<td>0.335766</td>
</tr>
<tr>
<td>Q38: Compute future value with compounded interest</td>
<td>4</td>
<td>3.050328</td>
<td>1.424882</td>
<td>2.787879</td>
<td>1.683387</td>
<td>-0.8733</td>
</tr>
<tr>
<td>Q39: Work with given equation for uninhibited growth</td>
<td>6</td>
<td>3.730853</td>
<td>2.141542</td>
<td>4.393939</td>
<td>1.937499</td>
<td>1.884634</td>
</tr>
</tbody>
</table>
There were no items testing procedural skills on which either group performed better with statistical significance. Hence, students in the pilot section performed equivalently on the common final exam to students in the non-pilot sections on items that were primarily procedural in nature, demonstrating successful accomplishment of Project Goal 3.

Assessment of Conceptual Skills on Constructed Responses on the Final Exam

Items with no significant difference:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pts Poss</th>
<th>Non-Pilot Mean</th>
<th>Non-Pilot σ</th>
<th>Pilot Mean</th>
<th>Pilot σ</th>
<th>t-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q29: Determine the critical values of a rational inequality, the interval(s) satisfying the inequality, and express those intervals in interval notation.</td>
<td>6</td>
<td>2.013129</td>
<td>1.793449</td>
<td>1.939394</td>
<td>1.631868</td>
<td>-0.24894</td>
</tr>
<tr>
<td>Q32: Given functions f and g, evaluate the composition of the functions at specified values, form the composite function rule, and give domain of the composite rule.</td>
<td>8</td>
<td>4.954048</td>
<td>1.958003</td>
<td>5.151515</td>
<td>2.11948</td>
<td>0.519441</td>
</tr>
<tr>
<td>Q34: Given a graph, interpret the domain &amp; range and requested function values.</td>
<td>10</td>
<td>8.043764</td>
<td>2.333809</td>
<td>7.636364</td>
<td>2.496278</td>
<td>-0.90927</td>
</tr>
<tr>
<td>Q40: Apply the concept of extrema of a quadratic function</td>
<td>6</td>
<td>2.859956</td>
<td>2.789884</td>
<td>3.69697</td>
<td>2.657007</td>
<td>1.741657</td>
</tr>
<tr>
<td>Q41: Apply the concept of mixed variation</td>
<td>6</td>
<td>3.61488</td>
<td>2.82619</td>
<td>3.878788</td>
<td>2.749739</td>
<td>0.531442</td>
</tr>
</tbody>
</table>

Items with significant difference:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pts Poss</th>
<th>Non-Pilot Mean</th>
<th>Non-Pilot σ</th>
<th>Pilot Mean</th>
<th>Pilot σ</th>
<th>t-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q35: Graph and interpret the domain constraints of a piecewise-defined function.</td>
<td>6</td>
<td>2.919037</td>
<td>2.263788</td>
<td>4.060606</td>
<td>2.014183</td>
<td>3.11677</td>
</tr>
</tbody>
</table>

Students in both groups performed at statistically equivalent levels on five of the six items selected as conceptual in nature. Students in the pilot performed better on one of the six
conceptual items at a level that was statistically significant. This data indicates partial, but not complete, success for Project Goal 2.
Results on the Multiple Choice Section of the Final Exam

Computing statistical significance was not possible. A level of 10% was chosen to indicate a level of practical significance.

Percent of Students Who Correctly Answered Each Test Item

<table>
<thead>
<tr>
<th>Item Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students (N = 488)</td>
<td>32.2%</td>
<td>62.1%</td>
<td>69.5%</td>
<td>91.8%</td>
<td>76.0%</td>
<td>81.1%</td>
<td>54.9%</td>
<td>66.4%</td>
<td>60.5%</td>
<td>56.4%</td>
<td>73.2%</td>
<td>53.5%</td>
<td>83.6%</td>
<td>57.6%</td>
<td>49.8%</td>
<td>22.3%</td>
<td>73.4%</td>
<td>50.6%</td>
</tr>
<tr>
<td>Pilot Students (N = 33)</td>
<td>15.2%</td>
<td>81.8%</td>
<td>90.9%</td>
<td>84.8%</td>
<td>75.8%</td>
<td>78.8%</td>
<td>57.6%</td>
<td>75.8%</td>
<td>51.5%</td>
<td>63.6%</td>
<td>72.7%</td>
<td>60.6%</td>
<td>87.9%</td>
<td>72.7%</td>
<td>63.6%</td>
<td>24.2%</td>
<td>60.6%</td>
<td>57.6%</td>
</tr>
<tr>
<td>Non-Pilot Students (N = 455)</td>
<td>33.4%</td>
<td>60.7%</td>
<td>67.9%</td>
<td>92.3%</td>
<td>76.0%</td>
<td>81.3%</td>
<td>54.7%</td>
<td>65.7%</td>
<td>61.1%</td>
<td>55.8%</td>
<td>73.2%</td>
<td>53.0%</td>
<td>83.3%</td>
<td>56.5%</td>
<td>48.8%</td>
<td>22.2%</td>
<td>74.3%</td>
<td>50.1%</td>
</tr>
<tr>
<td>Difference: Pilot - Non-Pilot</td>
<td>-18.2%</td>
<td>21.1%</td>
<td>23.0%</td>
<td>-7.5%</td>
<td>-0.2%</td>
<td>-2.5%</td>
<td>2.9%</td>
<td>10.1%</td>
<td>-9.6%</td>
<td>7.8%</td>
<td>-0.5%</td>
<td>7.6%</td>
<td>4.6%</td>
<td>16.2%</td>
<td>14.8%</td>
<td>2.0%</td>
<td>-13.7%</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

With a level of 10% for practical significance, students in both groups performed similarly on eleven of the eighteen items. For two of the eighteen items, students in the Non-Pilot group performed significantly better.

Procedural items in which Non-Pilot students performed significantly better:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pilot – Non-Pilot Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: Solve a special case of an absolute value inequality</td>
<td>-18.2%</td>
</tr>
<tr>
<td>Q17: Determine the vertical asymptotes of a given rational function</td>
<td>-13.7%</td>
</tr>
</tbody>
</table>
For five of the eighteen items, students in the Pilot sections performed significantly better.

Procedural items in which Pilot students performed significantly better:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pilot – Non-Pilot Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2: Give x- and y-intercepts for a given equation</td>
<td>21.2%</td>
</tr>
<tr>
<td>Q3: Determine the vertex of a quadratic equation in standard form</td>
<td>23.0%</td>
</tr>
</tbody>
</table>

Conceptual items in which Pilot students performed significantly better:

<table>
<thead>
<tr>
<th>Item</th>
<th>Pilot – Non-Pilot Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q8: Relate the graph of a system to its solution</td>
<td>10.1%</td>
</tr>
<tr>
<td>Q14: Compute a value for a difference of two functions when those functions are presented in tabular form.</td>
<td>16.2%</td>
</tr>
<tr>
<td>Q15: Compute a value for a composition of two functions when those functions are presented in tabular form.</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

Based on the comparison of the data showing a practical significance \( \geq 10\% \), there were an equal number of procedural questions for which the Pilot students performed better as there were for those that the Non-pilot students performed better. Note that on the questions with significant difference, the absolute difference in Pilot and Non-pilot performance was greater for the questions on which the Pilot students outperformed the Non-pilot students. The comparison of questions classified as conceptual indicates that the Pilot students significantly performed higher on three questions, and the Non-pilot students did not perform significantly higher on any questions. While the Pilot students did not unvaryingly perform equivalently to the Non-pilot students on the procedural questions, they did perform as well or better as the Non-pilot on the conceptual problems. This data indicates partial, but not complete, success for Project Goals 2 and 3.

**Project Goal 4**

The following questions were asked of the MTH 135 Pilot students and a control group of non-pilot MTH 135 students at the beginning and at the end of the semester. At the end of the semester, the Pilot students were asked four additional questions, numbers 9 – 12, also listed below. For the first eleven questions, students selected from among five choices on a Likert scale, starting with “Very Low” for a response of 1 and “Very High” for a response of 5. Three student responses indicated a value between two Likert scale values and were recorded as the average of the two neighboring values. Question 12 asked students to check “Yes” or “No”.
Survey Questions

1. Based upon my experiences, I rate my ability to do math as:

2. When I am faced with a word problem in math, my level of confidence in my ability to solve the problem is:

3. Based upon my experiences, I rate my willingness to persist in solving a problem as:

4. The usefulness of algebra skills and concepts in my future career or in daily life is:

5. The usefulness of studying math in order to improve my critical thinking skills is:

6. When I am faced with a new type of problem or one that is slightly different, I rate my ability to apply more than one strategy to solve the problem as:

7. When faced with an algebraic process to complete or a word problem (sic) solve, the likelihood that I will attempt the problem if I have not seen a similar problem is:

8. My willingness to consider a career that would use math or might require further training in math is:

9. The effectiveness of the labs in this class in helping me to learn was:

10. The effectiveness of working in groups in some labs and classes in helping me to learn was:

11. The effectiveness of activities like the function machine, the piecewise graph cutting, and algebra aerobics in helping me to learn was:

12. Did the presence of an attendance policy motivate you to attend one or more class periods you might otherwise have missed?

<table>
<thead>
<tr>
<th>Control Group Survey Scores</th>
<th>Average Score Beginning n=298</th>
<th>Average Score Ending n=226</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>3.18</td>
<td>3.33</td>
<td>+3%</td>
</tr>
<tr>
<td>Q2</td>
<td>2.72</td>
<td>2.92</td>
<td>+4%</td>
</tr>
<tr>
<td>Q3</td>
<td>3.59</td>
<td>3.47</td>
<td>-2.4%</td>
</tr>
<tr>
<td>Q4</td>
<td>2.89</td>
<td>2.83</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Q5</td>
<td>3.43</td>
<td>3.27</td>
<td>-3.2%</td>
</tr>
<tr>
<td>Q6</td>
<td>3.23</td>
<td>3.23</td>
<td>NC</td>
</tr>
<tr>
<td>Q7</td>
<td>3.19</td>
<td>3.12</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Q8</td>
<td>2.46</td>
<td>2.38</td>
<td>-1.6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pilot Group Survey Scores</th>
<th>Average Score Beginning n=40</th>
<th>Average Score Ending n=32</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>2.93</td>
<td>3.16</td>
<td>+4.6%</td>
</tr>
<tr>
<td>Q2</td>
<td>2.48</td>
<td>2.63</td>
<td>+3%</td>
</tr>
<tr>
<td>Q3</td>
<td>3.53</td>
<td>3.38</td>
<td>-3%</td>
</tr>
<tr>
<td>Q4</td>
<td>3.15</td>
<td>3.06</td>
<td>-1.8%</td>
</tr>
<tr>
<td>Q5</td>
<td>3.60</td>
<td>3.50</td>
<td>-2%</td>
</tr>
<tr>
<td>Q6</td>
<td>3.26</td>
<td>3.22</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Q7</td>
<td>3.11</td>
<td>3.03</td>
<td>-1.6%</td>
</tr>
<tr>
<td>Q8</td>
<td>2.58</td>
<td>2.47</td>
<td>-2.2%</td>
</tr>
<tr>
<td>Q9</td>
<td>--</td>
<td>2.97</td>
<td></td>
</tr>
<tr>
<td>Q10</td>
<td>--</td>
<td>3.63</td>
<td></td>
</tr>
<tr>
<td>Q11</td>
<td>--</td>
<td>3.47</td>
<td></td>
</tr>
<tr>
<td>Q12</td>
<td>Yes: 81.25%</td>
<td>No: 18.75%</td>
<td></td>
</tr>
</tbody>
</table>
Observations:

A. Both groups showed an increase in their personal rating of their mathematical ability.
B. Both groups showed an increase in their level of confidence to solve a problem.
C. The control group showed no change in their perceived ability to apply more than one strategy to solve a problem.
D. Both groups showed a decrease for all other items, including the usefulness of studying mathematics to improve their critical thinking skills.
E. The Pilot group’s average rating of the effectiveness of the labs in helping them to learn was 2.97 out of 5, with 1 indicating no effect and 5 indicating extreme effectiveness.
F. The Pilot group rated the average effectiveness of working in groups in the classroom and in the lab to facilitating their learning as 3.63 out of 5.
G. The Pilot group rated the effectiveness of activities like the function machine, the piecewise graph cutting, and algebra aerobics to facilitating their learning as 3.47 out of 5.
H. When asked if the presence of an attendance policy motivated the student to attend one or more class periods they might otherwise have missed, 81.25% of the Pilot students answered “Yes”.

This data indicates that Project Goal 4 was not supported.

Project Goal 5

At the beginning of the semester, students in both the Pilot group and Control group were given a problem involving data that could be modeled with a quadratic function. Using a specified point as the vertex and another specified point to be located in the function, students were asked model the data presented in the problem with an equation they found using the given vertex and point. Students were then asked to use their model to predict other values and to assess how well the model would hold for various values and to explain their reasoning. At the end of the semester, students were given the same problem. The responses to the pre and post-test were scored by the researchers. For both the Pilot and Control groups, work on the papers indicated to the researchers that students in both groups applied themselves to the effort. Since transferring the skill of writing the equation of a quadratic function to an applied quadratic modeling problem was a focus of the implemented instructional change for the pilot sections, the expected outcome should strongly favor the pilot sections.

Researchers computed the mean scores for both groups at the beginning and at the end of the semester. For all of the students for which it was possible, researchers also matched each student’s responses from the beginning of the semester to their answers at the end and computed the difference from the beginning to the end. Most students improved and had a positive
difference, while some students had lower scores at the end of the semester and showed a negative difference.

The results for the students in the Control group were as follows:

<table>
<thead>
<tr>
<th>For ALL Control Group Students:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test: N=299  Mean: 2.344</td>
</tr>
<tr>
<td>Post-Test: N = (225 - 3)*  Mean: 3.410</td>
</tr>
<tr>
<td>Number left blank: 22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For Control Group Students with matched Pre- and Post-Tests:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean change from Pre-Test to Post-Test**: +1.189</td>
</tr>
</tbody>
</table>

*Three scores of zero are dropped from the Post-Test Mean because the students only had time to complete survey and left Post-Test blank after having strong Pre-Test scores.

**Both Pre- and Post-Test scores were dropped for the three students from above in this mean because the students only had time to complete survey and left Post-Test blank after having strong Pre-Test scores.

The results for the students in the pilot sections were as follows:

<table>
<thead>
<tr>
<th>For ALL Pilot Students:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test: N=40  Mean: 2.2</td>
</tr>
<tr>
<td>Post-Test: N =32  Mean: 12.625</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>For Pilot Students with matched Pre- and Post-Tests:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean change from Pre-Test to Post-Test: +10.20</td>
</tr>
</tbody>
</table>

As expected, this data shows strong practical significance in favor of the Pilot group for Project Goal 5.

**Project Goal 6**

Mathematics' educators are often brought to task by educators in partner disciplines because students who have completed pre-requisite mathematics courses do not seem to be able to apply the learning from the mathematics courses into the problem-solving of the partner disciplines. Project Goal 6 is meant to address this issue. The researchers acknowledge that there are many factors related to a student's success in a course, but it is hoped that a longitudinal study will show long-term learning transfer by students receiving the more active learning instructional methods of the pilot course. Students completing the pilot sections in Spring 2012 will be tracked in subsequent courses that list MTH 135 as a pre-requisite. In order to have a control group of reasonable size, two of the non-pilot sections will be chosen as well. To best represent the non-pilot sections, the sample control group will consist of the two sections of students whose mean scores on the final exam are closest in value to the overall mean of all non-pilot
sections. To validate or refute Project Goal 6, it is anticipated that the longitudinal data will be examined for at least three years before any attempt at analysis will be made.

In conclusion, this report provides the analysis of a small body of data. Project Goal 4 was not met. Project Goals 1, 2, and 3 had mixed results. Project Goal 6 could not yet be determined. Only Project Goal 5 showed strong positive results.

Analogous data from the pilots for subsequent semesters will be analyzed. Data from the longitudinal study will be collected and analyzed to determine the success for Project Goal 6. Early results of the pilot could be described as encouraging and the researchers hope to find positive results in the future analyses.