An Innovative and Collaborative CC and HS Contextualized Math Project:
Applied Algebra 1 & 11
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Abstract

Rogue Community College (RCC) received two National Science Foundation (NSF) Advanced Technological Education grants (2010-12 and 2014-17) to transform the college math sequence Algebra I (MTH60) and Algebra II (MTH95) into an applied MTH 63 & MTH96 curriculum that is entirely contextual-based, using examples, problems, and data from Career Technical Education (CTE) disciplines. Two textbooks and a Summer Math Institute, for high school and community college math instructors, have resulted from the grant. The summer math institute is designed to expose instructors to the curriculum and to a more relevant approach to teaching and understanding algebra. These courses can each be taught in one term at community college or both over a full academic year in high school.

MTH63 (Applied Algebra I) has been offered since spring 2011. The student outcomes are very positive in both critical thinking advancement and achievement of credit. The pass-rates for CTE students in this course is 25% higher as compared to CTE students in our traditional MTH60. Qualitatively, our CTE faculty can readily identify students coming from MTH63 over MTH60 due to their comprehensive understanding and application skills.

MTH96 (Algebra II) textbook/curriculum was completed winter 2015 and has been offered for four terms. Preliminary results are promising but based on a relatively small sample. The project hypothesis is that if requisite mathematical skills in industry dictate the curriculum that students will more quickly and successfully complete courses, and improve their readiness to apply math in CTE and STEM disciplines. The project evaluation is formative and summative. The project is about the formation of a new math pathway that leads to college level math and is a departure from the traditional theoretical math sequence. Offering students this applied algebra sequence in high school or at the community college is an integral part of pathways in technical and STEM careers as well as success in college level math required for university transfer.

The overall goal of this project is to improve pedagogical approach, course design, and course articulation to improve student math skills, so that they are better prepared for their post-secondary education in a STEM pathway, and ultimately, for work as CTE technicians in the workforce. The Co-Principal Investigators propose to present the project status and findings from both courses and to discuss the innovative teaching effectiveness in an Applied Algebra sequence to high school and community college students.

Keywords: Contextualize Math Curriculum, Innovation in Math Education, Career Technical Education (CTE) and Math, Secondary to Post-Secondary Alignment, Vocational Math, Applied Algebra

Intellectual Merit: This project is grounded in NSF funded work by Harold L. Schoen and Christian R. Hirsch, and Sol Garfunkel; and by the National Research Center for Career and Technical Education (NRCCTE). According to Dr. Stone, NRCCTE Director, that project distinguished itself by wholly adopting a contextual math-in-CTE curriculum mode, and advances the President’s American Graduation Initiative—“transitioning youth to a successful community college experience.” RCC’s Instructional Division uses the new course as a prerequisite for CTE programs, and as a dual credit course for high school students. The project has transformed how the traditional math sequence leading to college algebra math is taught in high school and at the community college as an integral part of career preparation. MTH63 and MTH96 is supported by positive evidence of impact on student pass/fail rate and attitudes about mathematics in a Applied Algebra 1 & 11 course, and teacher professional development gains as evidenced by qualitative evaluation. This project has transformed the traditional math sequence and eliminated an entire required math class.
**Broader Impacts:** Both NSF grants used an interdisciplinary approach to develop math curriculum necessary for competence in five (5) community college CTE programs of study (Diesel, Welding, Manufacturing, Electronics, and Construction Technologies). At RCC, over 90% of students, including first-generation, female and minority students, place into developmental math on the college placement test. Since this lack of math success is a universal problem in the U.S., creating math curriculum that is industry-driven and focused on CTE programs is a promising practice model. Project evaluation determined that contextualizing lessons in math curriculum increased content relevance, and boosted course retention and academic progress.

Per the research, course conversion to a contextualized format is a promising but rarely used treatment in community college developmental math reform efforts for low-skilled students. The success and dissemination of this project will help advance the research and practice. The project has both strong local buy-in and connections between RCC and regional high schools, and broader application in Oregon through the Summer Math Institutes for out-of-district teachers and nationally through conference presentations. The project is also informed by local employers and industry standards in curriculum development. Student recruitment is assured because Math 96 is required for targeted RCC CTE programs and for the college math course required for a transfer degree. Additional resources are added to reach and retain veterans and under-represented students at RCC.

To date, these courses have been adopted at 15 high schools and 8 community colleges.
*Math 96 students can satisfy MTH 111 prerequisite by taking MTH 65*
PROJECT OVERVIEW

Rogue Community College’s goal is to improve pedagogical approaches, course design, and course articulation to increase students’ math skills so that they are better prepared for post-secondary education and, ultimately, for work as CTE (Career Technical Education) technicians in the workforce.

MTH63 Applied Algebra I project objectives were to: (see Appendix A)

1. Develop a one-term community college and a year-long high school Math 63 course with Algebra I and geometry concepts driven by contextualized applications from five career technical areas (CTE). This delivery includes writing a textbook to hold this curriculum.
2. Offer an in-depth Summer Math Institute (SMI) based on the curriculum to 25 regional high school, community college, and industry teaching professionals and to continue professional support when teachers were utilizing the new MTH63 text.
3. Integrate Math 63 into all CTE college programs as the requisite math and add as a dual credit offering for secondary schools that also satisfies State of Oregon diploma requirements as an eligible third-year high school math course.

MTH96 Applied Algebra II project objectives were to: (see Appendix A)

1. Student Focus: Course Redesign, Articulation, Recruitment, and Tutoring. (a) Develop and pilot Math 96 (CTE contextualized Algebra II) community college course and textbook with algebra, geometry, graphing, and statistical concepts driven by contextualized applications from career technical areas (CTE) employed in our region. (b) Integrate Math 96 into all CTE college curricula in years 2-3. (c) Offer to high schools to infuse into existing high school courses or incorporate wholly into Math 63, which satisfies State of Oregon diploma requirements as an eligible third-year high school math course. (d) Conduct outreach activities to interest RCC students in the Math 96 course, targeting career technical education (CTE) students including veterans, and under-represented populations especially females and minority students. (e) Work with college and high school academic advisors/counselors on understanding new math sequence to assist students in math sequence selection.
2. Teacher and Faculty Focus: Summer Math Institutes and Professional Learning Community. (See Appendix B) Offer an in-depth Summer Math Institute (SMI) annually for 20-30 high school and community college math and CTE teachers for Math 63 & Math 96. SMI sustainability and dissemination will be piloted as “SMI On the Road” taking Math 63 SMI in Year 1 and Math 96 SMI in Year 3 to different regions in Oregon. The PI leads an email-based blog and website-based professional learning community (PLC) to support high school and community college instructors as they implement the curriculum.

Motivating rationale:

There is universal agreement that high schools and community colleges are experiencing an epidemic of failure to produce the numbers of competent CTE graduates needed to fuel our modern economy. The abysmal quality of math and science instruction in the United States is summed up by the following organizations:

Research Based Rationale:

Research below reflects on the need to reform developmental math and its application to CTE/STEM students, and the NSF’s interest in recruiting and retaining students, including veterans and under-represented students.

Contextualization in College Developmental Math Reform: A literature review of developmental mathematics found that contextual learning is a successful strategy for course redesign (Bonham and Boyle, 2011). Perin’s (2011) review of 27 studies found support for “contextualized instruction, which is taught by developmental education instructors...has the potential to accelerate the progress of academically underprepared college students.” She
noted that while **course contextualization at community colleges is rare** it “seems to have the strongest theoretical base and perhaps the strongest empirical support” among innovations for low-skilled college students.

**Professional Learning Community (PLC):** To be effective, PLC’s must be supportive with shared leadership, shared vision, structures to support collaboration, shared accountability through shared practice, and collective inquiry and creativity. Hargreaves (2010) notes the ineffectiveness of PLC’s characterized by contrived rituals of enforced collegiality. Bausmith and Barry (2011) draw attention to the overlooked aspect of pedagogical content knowledge and suggest its absence in a PLC is unlikely to increase student achievement. Van Driel and Berry (2010) note the complex nature of pedagogical content knowledge as highly topic, person, and situation specific.

**Tutoring:** A qualitative study of 15 community colleges found that learning centers offering tutoring “…are an important means of increasing students’ academic preparedness for postsecondary study” (Perin, 2004). A key strategy for students struggling in developmental mathematics is professional tutoring (Boylan, 2011) Use of small group instruction, especially with underrepresented STEM students such as female and minority students “increases math confidence” (Bonham and Boylan, 2011). Formation of small groups such as for tutoring helps returning veterans who need to identify, bond with, and support each other (Moon and Schma, 2011).

**Contextualized Math for Secondary Students:** NSF funded research by Schoen and Hirsch on curriculum development indicates that “students perform particularly well on measures of conceptual understanding, interpretation of mathematical representations and calculations, and problem-solving in applied contexts” (Schoen & Hirsch, 2003). A CTE-in-Math study with 131 CTE teachers and almost 3,000 high school students found after 1 year of math-enhanced CTE lessons…students in the experimental classrooms performed significantly better on 2 tests of math ability—the TerraNova and ACCUPLACER®—without any negative impact on measures of occupational/technical knowledge (Stone, et al, 2006).

**Senior Year Math:** Many students not taking high school math their senior year need remediation in college, and fail to complete degrees even when aspiring to do so (T.R. Bailey & Morest, 2006; Kane & Rouse, 1999; National Commission on the High School Senior Year, 2001). Research indicates that placing into college-level math following high school can be increased simply by taking a math course in the senior year (National Commission on the High School Senior Year (ACT, 2005; Berry, 2003; Hoyt and Sorenson, 2001; Roth, et. al 2001).

**In addition, direction was also found in the following:**

Reporting on the **Third International Mathematics and Science Study (TIMMS-1995) Conley** noted that when the U.S. is compared to other countries for teaching math, American students do not excel because “students in U.S. classes do not engage actively in problem solving or develop a deep understanding of mathematical concepts” (Conley, 2005). He writes that the current secondary structure emphasizes completing required courses instead of mastering important skills and intellectual development; and noted that high school teachers receive little guidance regarding the knowledge and skills that students should be developing to be ready for entry-level college courses

**Goldin** (2002), a scholar in Mathematics Education states that “there is a pressing need for shared, scientific, non-ideological framework for empirical and theoretical research in mathematical learning and problem solving”. He describes the theories and methods that have been tried in mathematics education as a pendulum of methods over the hundreds of years. Relatively recently (1970’s) we were more traditional by teaching rote [simplicity] of computational arithmetic and consumer mathematics which works when well drilled. However, he guesses that a subset of these students-20% or fewer- are able to “attain real understanding of algebra and geometry at the high school level. He ascribes to what he terms the “reform camp” in the 1990’s which advocated for “curriculum that addresses higher level reasoning works best when students are instructed and assisted in finding patterns, making connections, communicating mathematically, and engaging in real-life contextualized, and open-ended problems.” In short he states “Contextualized mathematics is valued for its meaningfulness and relevance”. However, post 2001 we have swung around to the back to basics movement which he thinks is an ironic twist with academic mathematicians leading the charge. He challenges this traditional approach by stating “Mathematical power consists...
not only in being able to detect, construct, invent, understand, or manipulate patterns, but in being able to [communicate] these patterns to others.” He makes a strong case for contextualized understanding because he states that using familiar contexts that are encoded internally such as: common words, images, strategies and operations, expectations, beliefs, competencies. Everyday experiences that can be easily referred to, widely shared and understood, culturally reinforced serve as the construction of “in context” mathematical representations which can help encode contextual understanding.

Hoyt and Sorenson (2001) found that college faculty repeatedly responded that recent high school graduates may have completed required math courses for graduation without gaining any significant grasp on the subject matter. They cited a typical situation of high school students completing “college level algebra/trigonometry” at their local high school but with entrance exams scores that would not admit them into college algebra on campus. Their study on the connection between remediation education in college and high school preparation suggests that “there is a substantial difference in the rigor of high school math courses compared with the college curriculum.”

Orr and Bragg (2001) found student academic and vocational preparation, particularly to meet the demands of growth industries and changing labor markets for the global economy, is increased when there is increased cooperation between secondary schools and community colleges and other higher-education institutions.

The National Research Center for Career and Technical Education’s report titled “Rigor and Relevance” (Stone, Alfeld and Pearson, 2008) noted that in an effort to improve post-secondary preparation many states have increased the number of math courses required to graduate, but this move in and of itself is not effective. They suggest enhancing CTE courses with rigorous and relevant mathematics which mean learning through a concrete problem will support the understanding of the abstract math concept. “Applied learning is the delivery of content area curricula within a relevant, authentic, and presumably more motivating context.”

Reporting on the Third International Mathematics and Science Study (TIMMS-1995) Conley noted that when the U.S. is compared to other countries for teaching math, American students do not excel because “students in U.S. classes do not engage actively in problem solving or develop a deep understanding of mathematical concepts” (Conley, 2005). He writes that the current secondary structure emphasizes completing required courses instead of mastering important skills and intellectual development. He also noted that high school teachers receive little guidance regarding the knowledge and skills that students should be developing to be ready for entry-level college courses.

The Southern Regional Education Board’s major report on school reform postulated that a key solution in educational reform is in harnessing “the applied teaching strategies of career/technical education (CTE)” and infusing “them into college-preparatory academics” to re-engage and challenge students. Among the report’s recommendations were (1) “Align new and existing career/technical curricula with essential college and career-readiness standards”; and (2) “prepare and enable career/technical teachers to teach essential academic skills through application in authentic activities, projects, and problems.” The Carl D. Perkins Career and Technical Education Improvement Act of 2006, often referred to as Perkins IV, provides states unprecedented latitude to align CTE with broader high school redesign programs.

SUPPORTING DATA

Research indicates that low student achievement in math is often a function of lack of interest, boredom, difficulty with the content and lack of support, and/or a sense that the math is not relevant to their lives (Stone, et al 2008). A good example of the decline in math skills is the 2008 report from School Data Direct for the State of Oregon (Table #1) shows a steady decrease in math proficiency on state math tests as students progressed through school.

<table>
<thead>
<tr>
<th>Grade 3</th>
<th>Grade 5</th>
<th>Grade 6</th>
<th>Grade 8</th>
<th>High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>63%</td>
<td>57%</td>
<td>59%</td>
<td>65%</td>
<td>68%</td>
</tr>
<tr>
<td>M-63%</td>
<td>F-62%</td>
<td>M-58%</td>
<td>F-57%</td>
<td>M-59%</td>
</tr>
<tr>
<td>M-59%</td>
<td>F-58%</td>
<td>M-64%</td>
<td>F-65%</td>
<td>M-69%</td>
</tr>
<tr>
<td>M-69%</td>
<td>F-68%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
And yet, there is an urgency of addressing this nationwide problem as illustrated in a study published by the National Research Center for Career and Technical Education (NRCCTE): “Mathematics is no longer a requirement only for prospective scientists and engineers. Instead some degree of mathematical literacy is required for anyone entering a workplace or seeking advancement in a career.” From a societal viewpoint, improving the mathematics transition of high school graduates attending college is an important step in preparing a generation for work in the age of globalization (Hammer 2009).

Researchers have identified various strategies to begin addressing the problem including:

- **Dual credit** programs have long supported the concept that if students begin college-level technical training in high school, they are more likely go directly to community college to finish their education (2+2 concept) (Bailey, 2002).

- **Math in the senior year**: Many students who do not take high school math in their senior year, need remediation in college, and fail to complete degrees even when aspiring to do so (T.R. Bailey & Morest, 2006; Kane & Rouse, 1999; National Commission on the High School Senior Year, 2001). (20-22) Research on student placement into college math indicates that placing into college-level math following high school can be increased simply by taking a math course in the senior year (National Commission on the High School Senior Year (ACT, 2005; Berry, 2003; Hoyt and Sorenson, 2001; Roth, et. al 2001).

- **Applied math**: Among the high school math reform efforts in the 1990s funded by the National Science Foundation was research and curriculum development by Schoen and Hirsch indicating that “students perform particularly well on measures of conceptual understanding, interpretation of mathematical representations and calculations, and problem-solving in applied contexts” (Schoen & Hirsch, 2003). (18) Students, however, did not score any higher than students in the traditional math sequence on a placement test at a major university. One problem with contextual learning is the student’s inability to apply learned knowledge in one context to another because the learning is so embedded in the original context. One key to improving student success is a need for students “to practice math skills in a variety of ways so that they become proficient in knowing when and how to apply them” (Stone, et al, 2008).

Like the rest of the nation, many Oregon high school students are graduating with math skills that leave them unable to enter college-level math (see Table 1). The impact on career technical education (CTE) graduation is clear—students who test into developmental (remedial) math, even with recent high school diplomas, experience slowed progress in their CTE programming and have a strong potential of not completing. The developmental math courses at Rogue Community College (RCC) include: Math 20 (Pre-Algebra), Math 60 (Fundamentals of Algebra I), Math 65 (Fundamentals of Algebra II), and Math 95 (Intermediate Algebra). Table #2 below shows the course content for each.

<table>
<thead>
<tr>
<th>Table #2: RCC Traditional Developmental Math Course Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATH 20</strong></td>
</tr>
<tr>
<td>Review whole numbers, fractions &amp; decimals, percent ratio/proportion, exponents, order of operations, integers, use of variables, and simple equation solving.</td>
</tr>
</tbody>
</table>

Depending on the placement score, a student may place into any one of the four developmental math courses. The math sequence is representative of a contemporary algebra approach which includes technology usage (i.e. the scientific graphing calculator). The reason for offering this course sequence is to prepare students for the rigors of transfer-level college math as part of the Associate of Arts/Oregon Transfer (AAOT) degree.
Students at RCC like those nationwide reflect this under-preparedness (see Table #3 below). Located about five hours south of Portland, Oregon, RCC serves students from Jackson and Josephine counties in southern Oregon. The region is experiencing robust population growth and its economy is expected to produce more jobs than the state as a whole, according to the Oregon Employment Department. However, according to the local economic development agency, the region must prioritize efforts to produce a diversified, trained workforce to effectively compete in the global marketplace.

How are we doing in preparing technicians for the workforce? According to the Alliance for Excellence in Education, the United States is not only not preparing students for the demands of college and the modern workforce but that the country would save $3.7 billion a year in reduced college expenses if in part “more students who graduate from high school were prepared for college, and thus did not require remediation.” (2006) At RCC, all incoming students take a placement test. In the past 5 years, over 90 percent, including incoming high school students, tested into developmental math (Math 60, 65, and 95), see Table #3.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Total Math placement tests</th>
<th>At or below Math 60 (#)</th>
<th>At or below Math 95 (%)</th>
<th>Enrolled at or below Math 60</th>
<th>Not Successful on Math 60 or below(#)</th>
<th>%</th>
<th>Received Poor grade in Math 60 or below (F, NP, W &amp; Z) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>07-08</td>
<td>3188</td>
<td>2362</td>
<td>74.09</td>
<td>93.85</td>
<td>1308</td>
<td>636</td>
<td>48.24</td>
</tr>
<tr>
<td>08-09</td>
<td>4489</td>
<td>3340</td>
<td>74.40</td>
<td>93.72</td>
<td>1639</td>
<td>745</td>
<td>45.45</td>
</tr>
<tr>
<td>09-10</td>
<td>4532</td>
<td>3422</td>
<td>75.51</td>
<td>93.95</td>
<td>1875</td>
<td>910</td>
<td>48.53</td>
</tr>
<tr>
<td>10-11</td>
<td>4526</td>
<td>3430</td>
<td>73.51</td>
<td>92.63</td>
<td>1679</td>
<td>810</td>
<td>48.24</td>
</tr>
<tr>
<td>11-12</td>
<td>4240</td>
<td>2985</td>
<td>70.40</td>
<td>91.72</td>
<td>1308</td>
<td>707</td>
<td>54.05</td>
</tr>
</tbody>
</table>

Although students may enter CTE classes with the pre-requisite math, three typical scenarios unfold as described by RCC career technical education (CTE) department heads: 1) student math skills are so low that substantial in class remediation is required to cover the most basic skills; 2) students succeed in their math classes but cannot apply the concepts to CTE coursework; and/or 3) the traditional math sequence delays the introduction of math topics critical to specific CTE areas which adds considerable time to a student’s training. In a conference funded by NSF and looking at how to approach mathematics, Narayan and Narayan (2002) wrote:

Students who were substantially underprepared reported more conceptual problems and feelings of being overwhelmed in the early stages of their major...Not only did most of these students abandon their ambition to continue in [Science, Math, or Engineering] major, they also suffered emotional damage by attempting what proved an impossible task.

RCC students enrolled in career technical education (CTE) courses have varying levels of math pre-requisites and math requirements. Pre-requisites for most include Math 60 through 65, with the exception of the Computer Numerical Control (CNC) Technician students who need MTH 112, an AAOT course. The successful CTE graduate has a mathematics proficiency at the Basic Algebra I level along with some elements of Algebra II, and in some cases must be familiar with applications of right triangle trigonometry and basic statistical analysis. Despite this modest level of proficiency, many CTE students struggle with mathematics and are not well-served by the traditional algebra to calculus course sequence.

MTH63: Applied Algebra I is the alternative for MTH60. MTH96: Applied Algebra II is the alternative for MTH65 and MTH96. The collapse of two course into one was achieved by eliminating the more theoretical math required to build the foundation for the math calculus track. If a student changes their major after taking both of these applied algebra courses, they would be advised to go back and take MTH65 before enrolling in MTH111: College Algebra. This project team will apply for a third NSF grant to build a bridge course from MTH96 to MTH111 designed to fill in the theoretical gaps so that students who experience math success in this applied sequence and want to go down a more rigorous STEM math track.
Table #4: Comparison of Traditional Math Course and Applied Math Course

<table>
<thead>
<tr>
<th>MATH 60</th>
<th>MATH 63</th>
<th>MATH 65</th>
<th>MATH 95</th>
<th>MATH 96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application of real numbers, operation with real numbers, exponents, order of operations, mathematical modeling, linear equations/functions, problem solving, modeling with data and basic geometry.</td>
<td>Introduces the use of formulas and equations in an entirely practical and applied context. Topics include mathematical operations with real numbers, measurement, ratios, proportions, percentages, dimensional analysis, order of operations, solving equations numerically and symbolically, Pythagorean Theorem, trigonometry, area, perimeter, surface area and volume.</td>
<td>Review linear functions and expressions, systems of linear equations, linear inequalities, exponents, polynomials/introduction to quadratic function and factoring.</td>
<td>Quadratic, radical, rational, exponential and logarithmic functions, and their applications.</td>
<td>Introduces the study and application of linear, quadratic, power, exponential, and logarithmic expressions and functions. Working with real data, the mathematics of curve fitting will be developed making extensive use of the graphing calculator. This course concludes the developmental mathematics sequence.</td>
</tr>
</tbody>
</table>

Ganter (2006) discusses the importance of interaction of introductory college mathematics with partner disciplines with the following explicit guidance.

Introductory college math courses should develop the fundamental computational skills the partner disciplines require, but also emphasize the integrative skills; i.e. the ability to apply a variety of approaches to single problems, to apply familiar techniques in novel settings, and to devise multi-stage approaches in complex situations.

She also suggests that we “replace traditional algebra courses with courses stressing problem-solving, mathematical modeling, descriptive statistics, and applications in the appropriate technical areas” which is the exact approach that MATH63 and MATH96 curriculum. She goes onto suggest that colleges should provide alternative route to advanced mathematics which reflects this new applied Algebra course sequence and with the anticipated development of the bridge course to MATH111, this would be a complete alternative pathway in math.

The Summer Math Institute has provided over 150 high school and community college math and CTE teachers/faculty an opportunity to learn a new pedagogical practice in using this applied algebra curriculum. The evaluation and feedback for the institute has been positive, particularly around the fact that all the problems are meaningful applications. Suggested by Davis (1995) “one could argue that no concept in Algebra should be taught unless it can be motivated by a problem that is likely to be part of the students experience in the near future.”

RESEARCH QUESTIONS

Clearly, many students get discouraged which can adversely impact student retention, completion, and financial aid standing. Likewise, CTE instructors spend precious time and resources reviewing pre-requisite math concepts that support their content areas, despite the fact that students have already met the math pre-requisites by transcript or by the placement test. Increasing evidence suggests that CTE programs nationally are appealing to more students because of applied teaching strategies and contextual applications. Math is inherent in CTE coursework and it is inextricably interwoven into individual course and program outcomes. These observations led us to ask “how can the institution better serve its CTE students so that they comprehend and retain the essentials of mathematics needed for future study and career development?”

- Can curriculum be written that is entirely composed of CTE applications and still meet the prerequisites for the next math class in the traditional sequence;
• Can a curricular format matched to the college’s CTE programs and shared with other technical community colleges and high schools in an electronic format allow others to adapt the new curriculum to their CTE applications;
• Can a larger dialogue begin between interested colleges to create a living curriculum be accessed by any high school or college teacher to enliven traditional mathematics courses that gets beyond the expense and irrelevance of a published text?

Research confirms that context-specific instruction is essential if students are to interact with material at more than an algorithmic level, and that selecting applications that will shortly be in practice is an effective and efficient approach to instruction. Consequently, investigators seek to develop curriculum that directly and unequivocally prepare students mathematically for CTE coursework by using curricula that uses the math from CTE programs. These observations led to the development of a second applied math course that created a new math sequence for CTE students and led to several college level math courses required for transfer degrees.

FINDINGS:

MTH63: Applied Algebra I
The MTH 63 Textbook, solutions manual, and course were piloted spring term 2011 at Rogue Community College with 12 students. They readily received the course and text with evident enthusiasm, generally reporting that it was refreshing to work in an environment where the purpose of the mathematics they were learning was so pervasive and applicative to their CTE coursework. One student, who had failed the traditional MTH 60 course twice, noted that the processes and procedures of algebra finally made sense and that although this class was harder, he understood it and passed it this time. Seeing a CNC (Computer Numerical Control-Manufacturing) part on a coordinate axis in the MTH 63 book he exclaimed, “Now I get what all those x’s and y’s were about that I never understood in MTH 60”. It was also interesting to note that one of the younger high school students realized that being asked to think and assimilate the material at this level and apply it was harder than simply memorizing and repeating processes. Investigators concluded that although no curriculum can be considered a singular panacea for the nation’s mathematical failings, this has made a significant and positive contribution. It helped them pay the right kind of attention. College students, and often high school students, will pay attention in the sense that they are listening and taking notes, but must be engaged and assimilating if they are to make any permanent gains in their mathematical capacity.

Investigators established a professional learning community among the high school instructors and are successfully carrying on email conversations as to the use and application of the activities. Their feedback is being considered and assimilated by the investigators in the improvement of the course and its activities.

Investigators designed the Summer Math Institute (SMI) to acquaint 25 community college and high school instructors with the text, its applications and this philosophy of teaching mathematics. It consisted of four days where the attendees were immersed in one CTE area per day and its attendant mathematical applications. They calculated and cut rafters, designed and built electrical circuits with resistors and volt meters, and put their hands on Cummins diesel engines to see what makes them work. Participants were universally enthusiastic, engrossed in the activities, and made numerous comments about the value of the institute. One participant said that, “it was the best professional development that he had ever attended”. Another made a point of finding the investigators at the end expressing that he arrived skeptical but left inspired and has since made efforts to include the material in his community college courses.

The investigators conclude that their efforts to enliven the understanding of mathematics, by taking their curricular cues from real world applications, universally increased enthusiasm and engagement in students and teachers. Math teachers, by necessity, train at university mathematics and seldom have opportunity to be exposed to the myriad of uses that people are making every day of that mathematics. Simple exposure to some of these applications and a curriculum of interesting problems made a measureable and obvious qualitative and quantitative difference in the students and teachers in the pilot course and summer math institute.
During summer 2015, we developed and piloted an instrument measuring attitudes toward math and problem-solving skills in math. For the attitudes questions, we selected fifteen items from Siew Yee Lim and Elaine Chapman, “Development of a short form of the attitudes toward mathematics inventory,” Educ. Stud. Math (2013) 82:145-164. For the problems, our math consultant (an experienced RCC/SOU math instructor) selected ten problems from the RCC math placement test, representing increasing levels of skill. This consultant scored the problems reported in these tables. On the first day of the Fall 2015 term, we administered the pre-test to three Math 95 classes and three Math 96 classes, and administered the same attitude survey and a modified set of problems with different numbers but the same skill level required, as a post-test at the end of the term to those same classes. A total of 144 students completed both the pre-test and the post-test. Thus, all analyses are based on 144 cases – 80 in Math 95, 64 in Math 96.

We repeated the same procedures used in fall in the Winter 2016 term. We administered the instrument to three Math 95 classes and three Math 96 classes. Enrollments were smaller in the winter term than in the fall term. A total of 80 students – 43 in Math 95 and 37 in Math 96 – completed both the pre-test and the post-test. The smaller number of cases in the winter term means less statistical power, and indeed fewer results are statistically significant.

For Fall attitude means, Math 96 classes showed considerably more changes than Math 95 classes between the pre-test and the post-test. Math 96 students reported significantly less nervousness, less strain, less confusion, and less insecurity about math at the end of the term than at the beginning. They were also more likely to like math, feel happy in math class, and think math is important. Math 95 students were less likely, at the end of the term compared to the beginning, to feel nervous or insecure about math, but they were also less likely to think math could help them in their future jobs, an anomalous finding.

For Winter attitude means (data not shown), as for fall, Math 96 students showed considerably more changes than Math 95 students, between the pre-test and the post-test. Math 96 students over the term became significantly less likely to be nervous about studying math or even thinking about it, to feel confused in math class, or insecure about math. These same students were significantly more likely to see math as their happiest class and to believe math is important to study. Math 95 students experienced only two of these six changes, becoming less nervous about studying math and more apt to see math as their happiest class. Unlike in fall data, there were no anomalous findings in the winter pre-post attitude comparison.

In the fall means of the problem scores, there were eight statistically significant improvements between the pre- and post-test scores within both the Math 95 and Math 96 groups. The magnitude of the difference, i.e., the amount of improvement, was higher on five problems within the Math 96 group, on four problems within the Math 95 groups, and on one of the problems there was no difference in either group.

In the winter term (data not shown), Math 96 students improved between the pre-test and post-test on five of the problems (numbers 5, 6b, 6c, 7a, and 7b). Math 95 students improved on 8 of the 10 problems (numbers 1, 3, 4, 5, 6a, 6b, 7a, and 7b). The magnitude of the improvement was higher for the Math 96 students on three of the problems, and for Math 95 students on six of the problems. Thus, in winter term, our data show that there was greater improvement among Math 95 students, but that there were still significant improvements among Math 96 students.

**Overall conclusion from Fall 2015 data.** From a decidedly disadvantageous starting point in both math attitudes and problem-solving skills, Math 96 students greatly improved over the term in their attitudes toward math, and made considerable progress in catching up to the Math 95 students, even from a lower starting point, in problem-solving proficiency. They were still less able to solve problems in the middle range of the test, compared to Math 95 students.

**Overall conclusion from Winter 2016 data.** Because of the small N in winter term, we draw conclusions with extreme caution. At the start (i.e., pre-test), there was no difference between Math 95 and 96 students on attitudes toward math, and by the post-test only one attitude was more positive for Math 96 than 95: “Math is important in
everyday life.” Still, that attitude fits with the applied emphasis of Math 96. At the start, Math 96 students scored lower on two problems than Math 95 students, and by the end of the term they scored lower on those two plus one other. When we look at overall change within Math 95 and 96 student groups, Math 96 students experienced substantially more positive attitude changes than 95 students, but improvement on fewer problems than Math 95 students (5 for 96, 8 for 95). So winter data give us a somewhat more mixed, and unfortunately less reliable, assessment of the impacts of the two courses.

Table 5: RCC Student Performance Data (refer to RCC Math Course Chart Pg. 3)

Data recovered from spring 2015 through winter 2016 Math 95 vs 96

<table>
<thead>
<tr>
<th>Pass Rate Comparison</th>
<th>Pass rate</th>
<th>No pass</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>number</td>
<td>percent</td>
</tr>
<tr>
<td>MTH95</td>
<td>856</td>
<td>589</td>
<td>69%</td>
</tr>
<tr>
<td>MTH96</td>
<td>240</td>
<td>175</td>
<td>73%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsequent Classes</th>
<th>Pass rate</th>
<th>No pass</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>total</td>
<td>number</td>
<td>percent</td>
</tr>
<tr>
<td>MTH105</td>
<td>95</td>
<td>20</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>20</td>
<td>17%</td>
</tr>
<tr>
<td>MTH111</td>
<td>95</td>
<td>139</td>
<td>98%</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>MTH112</td>
<td>95</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>MTH211</td>
<td>95</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>MTH243</td>
<td>95</td>
<td>48</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>96</td>
<td>39</td>
<td>28%</td>
</tr>
</tbody>
</table>

ALL COURSES

|                      | 95        | 214     | 155%    |
|                      | 96        | 67      | 50%     |

Summary - Pass Rate Comparison 95 vs 96:

Pass rate for MTH96 is 4% higher than MTH95 (73% vs 69%).
MTH105 pass rate for MTH96 students is 5% higher than MTH95 (85% vs 80%).
MTH243 pass rate for MTH96 students is 1% lower than MTH95 (72% vs 71%).

Conclusion: Students are tracking close to the same success rate whether coming from MTH95 or MTH96.

Note: Only the MTH105 and MTH243 classes were compared because they are generally the only subsequent classes MTH96 students would take.
Project Summary:

Doug Gardner wrote two textbooks and as a team St. Clair and Gardner have facilitated a Summer Math Institute for five years as a professional development to 30 high school and community college math teachers each year (over 200 teachers from HS, CC). The instructors learned how to use the curriculum through actual math applications in our community college’s CTE labs.

MTH63 (Algebra I) has been offered since spring 2011. The student outcomes are very positive in both critical thinking advancement and achievement of credit. The pass rates for CTE students in this course is 25% higher as compared to CTE students in our traditional MTH60. Qualitatively, our CTE faculty can readily identify students coming from MTH63 over MTH60 due to their comprehensive and applications skills.

MTH96 (Algebra II) textbook/curriculum was completed winter 2015 and has been offered for four terms so far. Results are promising but still a relatively small sample. The project hypothesis, tested by a comprehensive outcome assessment plan, is that if requisite mathematical skills in industry dictate the curriculum that students will more quickly and successfully complete courses, and improve their readiness to apply math in CTE and STEM (Science, Technology, Engineering and Math) areas. The project is about the formation of the new math pathway that leads to college level math and is a departure from the traditional theoretical math sequence. Offering students this applied algebra sequence in high school or at the community college is an integral part of pathways in technical and STEM careers as well as success in college level math required for university.

The overall goal of this project is to improve pedagogical approaches, course design, and course articulation to improve students’ math skills so that they are better prepared for their post-secondary education in a STEM pathway and, ultimately, for work as CTE technicians in the workforce.

The MTH63 classes which used to be only enrolled by CTE students, now have the full array of RCC students (CTE, Transfer, ABS (adult basic skills), with high school students all over the state getting dual credit for this course. MTH96 is being populated by MTH63 students, therefore ensuring a growing demand for this recently added course.

The Summer Math Institute (SMI) became the Winter Math Institute (WMI) after we got requests to offer this course in different regions around the state. We are moving MTH63 into a model called the Traveling Math Institute (TMI) and during the last year of this second NSF ATE grant we will be promoting this professional development opportunity directly in regions where high school math and CTE teachers can learn about the curriculum alongside their community college math faculty to encourage dual credit and an exchange of the relevance of this pedagogical approach.

The work of Gardner, and St. Clair is contributing to the positive reputation of Rogue Community College around the state for this effective, applied algebra math pathway that is opening up the world and relevance of math to high school and community college student alike.
References


MATH 63  Chapter Objectives

Chapter 1: Tools of Algebra (page 5)

Section 1.1: Operations with Real Numbers
- +,-,x,÷ Fractions and Decimals
- +,-,x,÷ Negative Numbers

Section 1.2: Measurement
- Measure with cm, mm, and inches
- Convert fractions to decimals
- Convert decimals to fractions
- Round decimal measures to fractions
- Convert feet-inch-fraction measurements to inches and decimals

Section 1.3: Ratio, Proportion & Percent
- Set up and solve proportion problems
- Convert fractions and decimals to percents
- Convert percents to fractions and decimals
- Solve percentage problems

Section 1.4: Dimensional Analysis
- Convert to different units of measure: length, area, volume, & weight
- Convert from metric to standard units
- Convert from standard to metric units

Section 1.5: Order of Operations
- Understand meaning of an exponent
- Apply order of operations with formulas

Chapter 2: Formulas/Equations (page 63)

Section 2.1: Solving simple equations
- Solving equations with addition, subtraction, multiplication, and division

Section 2.2: Solving for different Variables
- Solving formulas for different letters

Section 2.3: Solving complex equations
- Solving equations with exponents

Chapter 3: Right Triangle Geometry (page 85)

Section 3.1: Pythagorean Theorem
- Find the hypotenuse in a right triangle
- Find a leg in a right triangle
- Solve practical problems

Section 3.2: Angles
- Estimate and measure angles in degrees

Chapter 4: Quantitative Geometry (page 113)

Section 4.1: Area & Perimeter
- Find the perimeter of polygons and circles
- Find the area of polygons and circles
- Solve practical problems

Section 4.2: Surface area
- Find the surface area of solids
- Convert to different units of measure
- Solve practical problems

Section 4.3: Volume
- Find the volume of solids
- Convert to different units of measure
- Solve practical problems

Appendix:
- Abbreviations and Symbols
- Conversions
- Area and Perimeter Formulas
- Volume and Surface Area Formulas
- Decimal/Fraction Conversions
- Steel Design Table
Sample Problems: Math 63

Chapter 1: Tools of Algebra

1. The face frame of a cabinet is made of vertical stiles and horizontal rails. Calculate the width of the rails in the design below so that all nine rails are the same length.

2. In a gable, each trapezoidal piece of lap siding is shorter than the one below by the same amount. A proportion can be used to calculate that amount, allowing a carpenter to cut the pieces without taking measurements. The bottom of each piece of siding is placed 7 inches above the bottom of the piece below. Use the roof’s slope of 5/12 and the long point to long point measurement of the first piece, to set up a proportion and calculate the long point to long point measurement of the 2nd piece. Round your answer to the nearest 16th of an inch.
3. The uniform load deflection (D) of a beam is 
\[ D = \frac{5PL^4}{384EI}. \]

Note: Deflection is simply a measurement of the amount of bend in a beam. 
D = deflection measured in inches, P = weight on the beam measured in pounds, 
L = length of the beam measured in inches, E = elasticity of the beam measured in pounds per square inch (PSI), and I = moment of inertia of the beam measured in inches\(^4\).
Find the deflection of a beam rounded to one decimal place if 
L = 168 inches, P = 358 pounds, E = 2,000,000 psi, and I = 968 inches\(^4\).

Chapter 2: Formulas/Equations

4. The moment of inertia (I) of a beam is
\[ I = \frac{bd^3}{12}. \]

Note: Moment of inertia is a measure of a beam’s effectiveness at resisting bending based on its cross-shape.
I = moment of inertia of the beam measured in inches\(^4\), 
b = width of the beam measured in inches, and 
d = height of the beam measured in inches.
Find the height of a beam rounded to the nearest \(8^{th}\) inch if b = 7 \(\frac{1}{4}\) inches and I = 6.5.

5. The point load deflection (D) of a beam is 
\[ D = \frac{PL^3}{48EI}. \]

Note: Deflection is simply a measurement of the amount of bend in a beam.
D = deflection measured in inches, P = weight on the beam measured in pounds, 
L = length of the beam measured in inches, E = elasticity of the beam measured in pounds per square inch (PSI), and I = moment of inertia of the beam measured in inches\(^4\).
Find the length of a beam rounded to the nearest inch if D = .9, P = 3800, E = 1,700,000, 
and I = 326.
Chapter 3: Right Triangle Geometry

6. Studs in a framed wall are placed 16” inches apart. A sloped wall presents a challenge in that the distance (L) between studs along the top plate is longer. If the top plate has a slope of 4/12, calculate distance L so that the stud layout can be marked on the top plate. Round your answer to the nearest 16th of an inch. Hint: First use the slope to calculate the rise for a 16” run.

7. A CNC operator wants to locate five holes in a plate beginning at the top and evenly spaced around the center. Dividing 360° by five, he realizes the angle between the holes must be 72°. If the holes are to be 27 centimeters from the center, use trigonometry to calculate the distance from the center over (X) and up (Y) to the center of the hole indicated in the drawing. Round your answers to one decimal place.

8. Find the total length of angle iron used to construct the roof truss. Answer to the nearest inch.
Chapter 4: Quantitative Geometry

9. HVAC (heating, ventilation, air conditioning) contractors use a boot to transition from the rectangular register (commonly seen on the floor or ceiling of a house) to a circular duct. To equalize the pressure, the rectangular end of the boot should, ideally, have the same area as the circular end. Calculate the diameter for a circular end that will match a 6” x 14” rectangular end, rounded to the nearest whole number.

10. The pipe in the drawing is supported below a beam by hanging it with strapping. Find the length of strapping needed, rounded to the nearest $\frac{1}{8}$ inch.

11. Find the total volume of the hip roof in cubic feet, rounded to one decimal place. Hint: Think of the roof as two halves of a pyramid separated by a triangular prism.
Chapter 4: Exponential Relationships

Section 4.1: The Shape of an Exponential Equation
- x and y intercepts
- Slope of the curve

Section 4.2: Finding Exponential Equations
- Regression
- Solving for y: order of operations
- Modeling

Section 4.3: Using Exponential Equations
- Solving for x: logarithms
- Modeling

Chapter 5: Logarithmic Relationships

Section 5.1: The Shape of a Logarithmic Equation
- x and y intercepts
- Slope of the curve

Section 5.2: Finding Logarithmic Equations
- Regression
- Solving for y: order of operations
- Modeling

Section 5.3: Using Logarithmic Equations
- Solving for x: exponentials
- Modeling

Chapter 6: Choosing the Right Model

Section 6.1: Compliant Data
- Stat plot
- R-value
- Solving for x and y

Section 6.2: Resistant Data
- Creative options
- Solving for x and y
Sample Problems: Math 96

Chapter 1: Linear Models

1. The flow rate in gallons per minute (GPM) is shown in the table as a function of the horizontal discharge distance (A) in inches for various pipe diameters.

   Round slopes and y-intercepts to 3 decimal places
   a) Find the equation for the trend line using the regression feature of your graphing calculator. Consider the flow rate as a function of distance (A) for the 2 inch diameter pipe.
   b) Use your equation to predict the flow rate for a horizontal discharge of 24 inches, accurate to 1 decimal place.
   c) Use your equation to predict the horizontal distance (A) for a flow rate of 120 GPM, accurate to 1 decimal place.
   d) Find the slope between 8 and 10 inches and explain it’s meaning on context.

<table>
<thead>
<tr>
<th>Horizontal Distance (A) in Inches</th>
<th>1&quot;</th>
<th>1 1/4&quot;</th>
<th>1 1/2&quot;</th>
<th>2&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8.70</td>
<td>9.80</td>
<td>13.30</td>
<td>22.00</td>
</tr>
<tr>
<td>5</td>
<td>7.10</td>
<td>12.20</td>
<td>16.60</td>
<td>27.50</td>
</tr>
<tr>
<td>6</td>
<td>8.50</td>
<td>14.70</td>
<td>20.00</td>
<td>33.00</td>
</tr>
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<td>7</td>
<td>10.00</td>
<td>17.10</td>
<td>23.20</td>
<td>38.50</td>
</tr>
<tr>
<td>8</td>
<td>11.30</td>
<td>19.60</td>
<td>26.50</td>
<td>44.00</td>
</tr>
<tr>
<td>9</td>
<td>12.80</td>
<td>22.00</td>
<td>29.80</td>
<td>49.50</td>
</tr>
<tr>
<td>10</td>
<td>14.20</td>
<td>24.50</td>
<td>33.20</td>
<td>55.50</td>
</tr>
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<td>15.60</td>
<td>27.00</td>
<td>36.50</td>
<td>60.50</td>
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<td>18.20</td>
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<td>60.00</td>
<td>99.00</td>
<td></td>
</tr>
</tbody>
</table>

![Flow Rate-vs-Distance (2" pipe) chart]
2. The Kilowatt-hours (KWH) of electricity a home uses each month are dramatically affected by the temperature difference inside versus outside (measured in degree days). The heating degree days are listed in the table from January through December.

Round slopes and y-intercepts to 3 decimal places
a) Find the equation for the trend line using the regression feature of your graphing calculator.
b) Use your equation to predict the KHW’s used for a month with 800 HDD, accurate to 1 decimal place.
c) Use your equation to estimate the HDD for a month that used 2400 KWH, accurate to 1 decimal place.
d) Estimate the y-intercept and explain its meaning in context.

<table>
<thead>
<tr>
<th>Heating Degree Days (HDD)</th>
<th>KWH Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>714</td>
<td>1799</td>
</tr>
<tr>
<td>469</td>
<td>1269</td>
</tr>
<tr>
<td>386</td>
<td>1160</td>
</tr>
<tr>
<td>266</td>
<td>860</td>
</tr>
<tr>
<td>133</td>
<td>804</td>
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<td>62</td>
<td>696</td>
</tr>
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<td>7</td>
<td>677</td>
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<td>561</td>
<td>1602</td>
</tr>
<tr>
<td>968</td>
<td>2060</td>
</tr>
</tbody>
</table>
Chapter 2: Quadratic Models

1. The chart shows the inches of drop in a bullet for different length shots for a particular type of Hornady bullet design.

   a) Use regression to find a quadratic equation to model the data, considering drop as a function of yardage. Round the numbers in your equation to 4 decimal places.
   
   b) Use your equation to predict the drop for a 170 yard shot, accurate to 1 decimal place.
   
   c) Use your equation to estimate the yardage of a shot that dropped 140 inches, accurate to 1 decimal place.
1. The table shows the gallons per minute (GPM) that various tank-less water heaters can produce based on the degree that the temperature must be raised.

a) Use regression to find a power equation for the NRC 111 Series for the GPM as a function of the temperature. Round the numbers in your equation to 2 decimal places.

b) Use your equation to predict the GPM for a 25° temperature rise, rounded to the nearest tenth.

c) Use your equation to predict temperature gain achieved at 8 GPM, rounded to the nearest tenth.
Chapter 4: Exponential Models

1. Temperature and moisture content in wood are related, in that the temperature increases the percent moisture in the wood decreases.

   a) Use regression to find an exponential equation to model the data. Round the numbers in your equation to 3 decimal places.
   b) Use your equation to accurately find the temperature, accurate to the tenth place, needed to get the moisture content to 5%.
   c) Use your equation to predict the temperature, accurate to the tenth place, that would be necessary to get the moisture content to 2%.

<table>
<thead>
<tr>
<th>Temperature (F above ambient)</th>
<th>Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.0</td>
</tr>
<tr>
<td>5</td>
<td>8.5</td>
</tr>
<tr>
<td>10</td>
<td>7.3</td>
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<tr>
<td>15</td>
<td>6.3</td>
</tr>
<tr>
<td>20</td>
<td>5.5</td>
</tr>
<tr>
<td>25</td>
<td>4.8</td>
</tr>
<tr>
<td>30</td>
<td>4.2</td>
</tr>
</tbody>
</table>
Chapter 5: Logarithmic Models

1. The Illinois River flow in cubic feet/second (CFS) is shown in the month of May as the rainy season ends and the level starts dropping.

   a) Use regression to find a logarithmic equation to model the data. Round the numbers in your equation to 2 decimal places.

   b) Use your equation to calculate the date the level will drop to 200 CFS, accurate to 1 decimal place.

   c) Use your equation to calculate the date the level was 1000 CFS, accurate to 1 decimal place.

<table>
<thead>
<tr>
<th>May</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>744</td>
</tr>
<tr>
<td>9</td>
<td>645</td>
</tr>
<tr>
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<td>558</td>
</tr>
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<td>16</td>
<td>324</td>
</tr>
<tr>
<td>17</td>
<td>302</td>
</tr>
</tbody>
</table>

![Illinois River Flow Graph]
This June, work with contextualized math curriculum based on CTE applications at RCC-SMI 2013!

- Bring a team from your district or college.
- Study and practice teaching methods used by RCC MTH63 instructors and demonstrated in CTE labs.
- No cost for SMI with lunch provided every day.
- ED607 1-3 credits available through Western Oregon University (approx. $50-$150)

WHO: High school and community college Math and CTE teachers

WHAT: Professional development Opportunity. Learn innovative approaches to teaching each chapter of the MTH63 textbook. This NSF-funded applied math course was designed specifically for high school and community college math and CTE programs at the Algebra I level (also includes some geometry and right angle trig). This curriculum can be adopted in whole or part.

CTE math applications from:
- Diesel-Automotive Construction
- Welding
- Manufacturing
- Electronics

After SMI, participants will be invited to help evaluate impact on student success at both the high school and college level. Recent results for CC-CTE math students:

<table>
<thead>
<tr>
<th>Course</th>
<th># Students</th>
<th>Pass Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 60</td>
<td>22</td>
<td>36.4</td>
</tr>
<tr>
<td>MTH 63</td>
<td>18</td>
<td>72.2</td>
</tr>
</tbody>
</table>

Conclusion: Math 63 CTE students are passing at a much higher rate than Math 60 CTE students (a difference of almost 36%).

“SMI exceeded my expectations completely. It gave me a clear vision of applying math in the real world. My eyes were opened as to the extent and complexity of things we take for granted every day”