

The Evolution of the Rice University School Mathematics Project Summer Campus Program

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Challenges in Math Education



- ❧ The personal, occupational, and educational demands of the twenty-first century require that all citizens attain a level of mathematical proficiency that in the past was required of only a few.
- ❧ Since 2003, the average United States mathematics literacy score has consistently been lower than the average score of 34 Organization for Economic Cooperation and Development countries. (Aud et al., 2012)

Reflecting on a National Crisis



- ❧ “It is critical to realize that financial responses alone won’t ultimately safeguard our economic and social well-being, and that substantial, strategic investments in education are essential to our long-term prosperity and to our success as a democracy. We cannot just bail ourselves out of this crisis. We must teach our way out.” (Darling-Hammond, 2010, p. 3)
- ❧ Many attribute the declining mathematics achievement of American students to a lack of skilled teachers and recognize that providing high-quality professional development for mathematics teachers is critical.

University/School Partnerships



- ❧ University/school partnerships have established intensive university summer campus programs to provide opportunities for teachers to gain the mathematical and pedagogical content knowledge required to teach effectively.
- ❧ As the demand increases for high-quality professional development for mathematics teachers, there is a need to understand how university summer campus programs evolve, the factors that impact their evolution, and the components that contribute to the sustainability of these programs.

RUSMP



- ❧ The Rice University School Mathematics Project (RUSMP) was established in 1987 as a bridge between the university's mathematics research community and area mathematics teachers.
- ❧ The recognition of the RUSMP Summer Campus Program (SCP) as a model program by the National Staff Development Council and other organizations, the frequent replication of the RUSMP SCP, and “its tenure provide evidence of the success and value of the Rice University School Mathematics Project.” (Killion, 2002, p. 85)

Focus Questions



- ❧ How did the RUSMP SCP evolve to meet the demands of mathematics reform?
- ❧ What factors, including social and political factors, have impacted the evolution of the RUSMP SCP ?
- ❧ What components of the RUSMP SCP have contributed to the sustainability of this university summer campus program for K-12 mathematics teachers?

Sources of Data



- ❧ Interviews with RUSMP SCP Administrators
- ❧ Focus group with RUSMP SCP Master Teachers
- ❧ Interviews with RUSMP SCP Participants
- ❧ Archived Data
- ❧ Personal Experience
 - RUSMP SCP Participant – 1988
 - RUSMP SCP Master Teacher – 1990-present

My Evolution in RUSMP



RUSMP SCP Established - 1987



- ✧ Established with seed money provided by the National Science Foundation through its Teacher Enhancement Program
- ✧ Created an alliance between a university and the surrounding school communities
- ✧ Designed to enhance the mathematical level of teachers to improve their scholarship, broaden their understanding of mathematics as a discipline, and have a definite positive impact on their classroom interaction with students

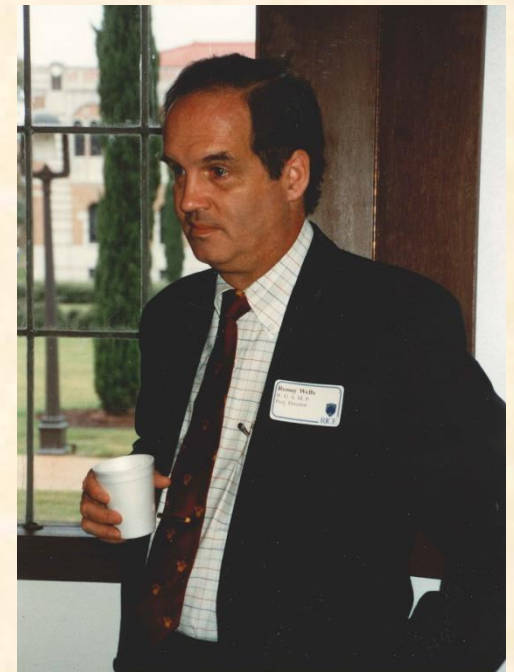
Founders of the RUSMP SCP



Joe Dan Austin



Elizabeth Herbert



Ronnie Wells

Factors Influencing the Creation of the RUSMP SCP

- ❧ Vigorous debates over mathematics curriculum
- ❧ Abundant reform movements in response to the declines in American students' performance on standardized tests
- ❧ Scientific and technological demands of society
- ❧ Acute shortage of mathematics teachers
- ❧ Critical shortcomings in mathematics instruction indicated by poor student performance on area school district's proficiency tests given in mathematics at every level
- ❧ Small percentage of American high school students completing one year of calculus

Aspects of the Original SCP



- ❧ Instruction was provided by master teachers who were selected based on their strong mathematical background and their exemplary teaching in secondary schools.
- ❧ Curriculum was developed by the master teachers and university faculty with expertise in mathematics, statistics, computer science, and mathematics education.
- ❧ Participants were potential lead teachers.
- ❧ Components included lecture workshops, seminars, colloquia, and teaching units.

Evaluation of the Original SCP



- ❧ Questionnaires given prior to and after completing the program, mathematics tests, interviews, and observations were used to evaluate the effectiveness of the RUSMP SCP program.
- ❧ Various forms of assessment consistently revealed that the participants were extremely enthusiastic about the project, felt that they had been challenged, had learned a lot, and had gained a far greater understanding of mathematics.
- ❧ The foundation for collaboration between a university and area secondary schools appeared to be based on intellectual development, hard work, and mutual respect.

SCP Expanded to Include Elementary Teachers – 1989

- ✧ Prompted by the mathematics reform movement of the time which called for improving the understanding of mathematics by all students and increasing student enrollment in mathematics at the post-elementary level.
- ✧ Assessments of area elementary students implied that these students had poor problem solving skills and school personnel indicated that lessons for upper elementary students frequently lacked technology or manipulatives.

Components of the Elementary Program

- ❧ In an effort to stress the global aspects of mathematics reform, this program was led by two teams of master teachers. Each team included an elementary teacher, a middle school teacher, and a high school teacher.
- ❧ Manipulatives, problem solving, and calculator use were integral parts of the elementary program.
- ❧ Participants explored the progression of topics from elementary school through middle school and possibly on to high school.

Focus on Middle School – 1990



- ❧ Changes in funding necessitated that the 1990 RUSMP SCP for secondary teachers be reduced to a four-week program.
- ❧ The secondary component of the RUSMP SCP focused on middle school teachers from minority groups and teachers working in predominately minority schools due to the low student achievement, especially among minority students, consistently shown on district assessments.
- ❧ Curriculum was based on the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) and the “essential elements” outlined by the state which included the concepts of algebra, functions, statistics, number theory, geometry, sequences, and series.

Summer of Many Changes – 1991



- ❧ The high school course was reinstated to meet the needs of teachers implementing district and state standards and providing instruction for honors courses and the International Baccalaureate program.
- ❧ A mathematics laboratory was added to allow participants to explore using manipulatives, calculators, and computers as methods to introduce, reinforce, and extend concepts taught in their courses.

Recruitment of Teams – 1991



- ❧ RUSMP directors recognized that the support of principals was crucial for teachers and students to successfully achieve the changes envisioned in educational reform and multiply “the impact of the program beyond the immediate nucleus of teachers who do participate in the summer programs.” (Austin & Wells, 1991a, p. 1)
- ❧ A total of 15 teams, each consisting of an administrator and two teachers from the same school, attended the RUSMP SCP.
- ❧ While participating teachers attended classes in the summer campus program, principals and administrators visited classes and attended events designed to provide them with detailed information on the curriculum and instructional objectives outlined by the mathematics reform movement and to give them an opportunity to develop activities to accomplish these objectives.

Satellite Campuses – 1992



- ❧ Originated because of the desire of Cynthia Lanius, a former RUSMP SCP participant, to create a university/school collaboration program that was similar to the RUSMP SCP on her inner-city school campus.
- ❧ Goals for the RUSMP SCP satellite campuses
 - Expand the number of mathematics teachers receiving professional development from the RUSMP SCP
 - Increase the number of participating teachers from targeted schools that had a large population of underrepresented minority students
 - Provide professional development that would address the specific needs of the various groups
 - “Create a system change with administrators, counselors, parents, business partners, and teachers designing and implementing an ongoing program” (Wells, Papakonstantinou, & Austin, 1994, p. 10)

Specific Grade Bands – 1996



- ❧ RUSMP SCP diverged from just offering three courses for elementary teachers, middle school teachers, and high school teachers to offering at least four to six different courses designed to address the specific needs of different grade bands.
- ❧ Courses were designed to support participating teachers as they enhanced their mathematical knowledge, discovered appropriate methods of mathematics instruction, discussed evaluating the mathematical learning of their students, and reflected on how they might change their mathematics instruction.
- ❧ The curriculum became more grounded in what was taught in classrooms on a day-to-day basis.

Two-year Cycle for Courses – 2009



- ❧ No Child Left Behind Act (NCLB) provided a blueprint to ensure that the needs of all students were being addressed. The priorities outlined in NCLB included improving disadvantaged students' academic performance, enhancing teacher quality, increasing the English fluency of limited English proficient students, promoting innovative programs and knowledgeable parental choice, encouraging safe schools, and encouraging accountability. (Bush, 2001)
- ❧ RUSMP directors realized that in order for the SCP to adequately prepare teachers to meet these new demands, they needed to make adjustments to the curriculum to include conversations concerning national and state standards for curriculum, equitable teaching practices, assessments, and research-based strategies for effective teaching.

Two-year Cycle for Courses

2009 – Present



- ❧ The curriculum alternates between a focus on numbers, operations, quantitative reasoning, patterns, relationships, and algebraic reasoning one summer and a focus on geometry and spatial sense, measurement, data analysis, statistics, and probability the next summer.
- ❧ This allows additional time for incorporating technology, book studies, interdisciplinary activities, and class discussions on equity, assessments, and pedagogy and assisting participants in creating learning plans and locating resources that can be used with their students.
- ❧ RUSMP SCP also incorporates evening meetings during the following academic year to provide additional support for the participating teachers.

Evolution



- ❧ A real educational partnership is “never a stable or final achievement, always a work in progress.” (Stronach & McNamara, 2002, p. 155)
- ❧ “Studies must investigate the balances and tradeoffs between fidelity and adaptation, and consider which elements of a program must be preserved to ensure the integrity of its underlying goals and principles.” (Borko, 2004, p. 13)

Changes in components of the RUSMP SCP from 1987 to 2015

Components of the RUSMP SCP	1987	2015
Participants	48 mathematics teachers from (middle school and high school)	80 mathematics teachers from (kindergarten through 12 th grade)
Average years of teaching experience of participants	11 years	7 years (median – 4 years)

Participants of the Past



Participants of the Present



Changes in components of the RUSMP SCP from 1987 to 2015



Components of the RUSMP SCP	1987	2015
Length of the program	6 weeks (Monday through Friday)	3 weeks (Monday through Thursday)
Instructional focus	Mathematics related to high school mathematics courses	Mathematical knowledge for teaching (math content and pedagogy) for specific grade bands

Classroom of the Past



Classroom of the Present

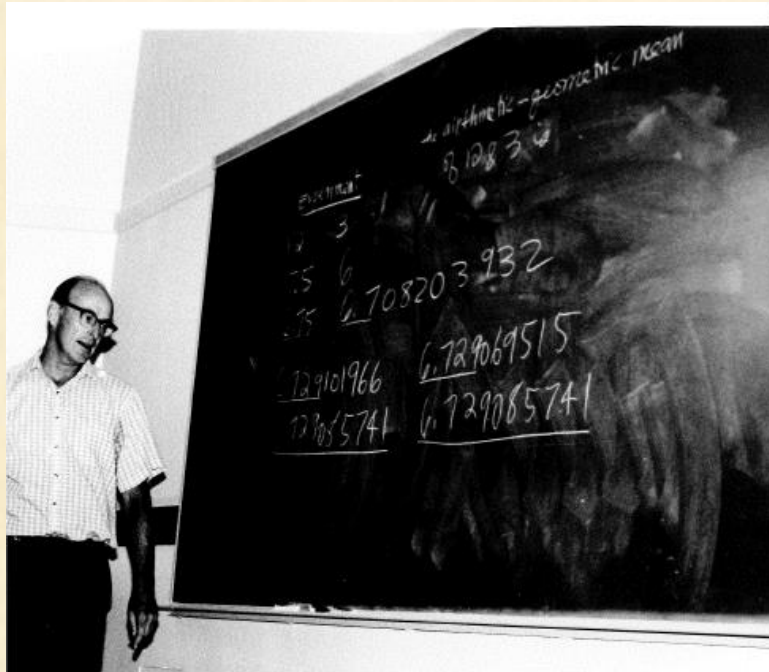


Changes in components of the RUSMP SCP from 1987 to 2015

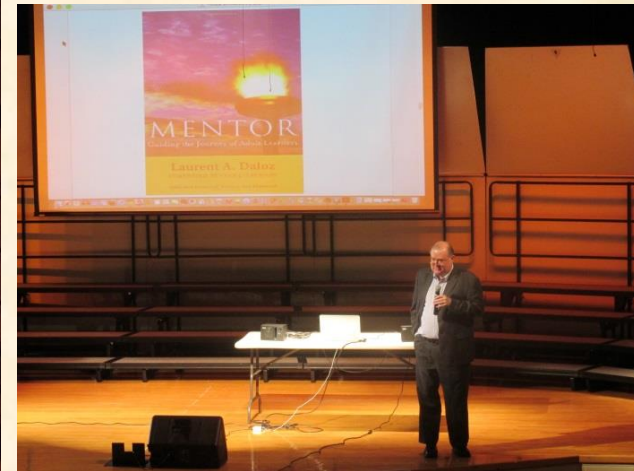


Components of the RUSMP SCP	1987	2015
Instructors	1 master teacher for each of the 6 lecture workshops on high-level mathematics which were taken by all participants	2 master teachers for each grade band course (elementary, intermediate, middle school, high school)
University faculty support	Served as colloquium speakers, planned curriculum, and provided mentoring for master teachers and participants	Served as colloquium speakers

Colloquia of the Past



Colloquia of the Present



Changes in components of the RUSMP SCP from 1987 to 2015



Components of the RUSMP SCP	1987	2015
Resources given to participants	Binders and scientific calculators	Manipulatives, resource books, iPads for K-12 teachers and graphing calculators for middle school and high school teachers
Academic year follow-up	2 networking conferences	2 networking conferences plus 4 additional academic-year follow-up sessions

Technology of the Past



Technology of the Present



Major Factors Impacting the Evolution of the RUSMP SCP

❧ Curriculum Standards

❧ Technology

❧ Accountability

❧ Equity

Curriculum Standards



- ❧ “RUSMP SCP preceded the NCTM standards . . . and when they came, out of course, we were aligned to them because the master teachers were teaching good mathematics.” (SCP Administrator)
- ❧ Once the *Curriculum and Evaluation Standards for School Mathematics* were published, they were used to guide instruction. One of the big changes impacting mathematics education in the early years of the RUSMP SCP “was the new math standards. I think pretty much everyone in the program bought into those but not everyone in the math community did.” (SCP Master Teacher)

Technology



- ❧ “Instruction changed from a handheld scientific calculator, which you learned to program, to graphing technology and learning how to use the Internet.” (SCP Administrator)
- ❧ RUSMP SCP was always “on the cutting-edge especially with technology . . . It was a challenge as a master teacher to keep up with some of the technology changes and see how to integrate these into the teaching of students.” (SCP Master Teacher)
- ❧ The current use of technology in the program “is just more grounded in the realities of the classroom and grounded on how technology has changed society.” (SCP Administrator)

Accountability



- ❧ The overwhelming largest change to the RUSMP SCP has been due to “standardized testing. When teachers’ jobs depend on how their students perform on tests, then one of the things we have to address is how can we help your students be successful on testing.”
(SCP Master Teacher)
- ❧ As a result of the focus on accountability, the RUSMP SCP “strives to help teachers build their self- and collective-efficacy so that they have the confidence to realize that by teaching student-centered mathematics, they will be adequately preparing students for assessments and, more importantly, for future mathematics learning.” (SCP Administrator)

Equity



- ❧ During the RUSMP SCP, “we do talk about testing, but the curriculum focuses on the needs of the diverse student population. We do look at equity, more than we did at the beginning. We did not talk about equity at the beginning, but we do now.” (SCP Administrator)
- ❧ The master teachers now make a more conscious effort of working with the participating “teachers to show them strategies that will work with English Language Learners or special education kids – especially the English Language Learners with vocabulary.” (SCP Master Teacher)

Components Contributing to the Sustainability of the RUSMP SCP

- ❧ Faculty and staff
- ❧ Collaboration and adaptability
- ❧ High-quality professional development
- ❧ Communities of practice

Faculty and Staff



- ❧ “We know and recognize that there has to be that connection between the teachers who come and our teaching team – our whole team. And if teachers feel that they are just a number, they are not going to open up and really get the help they need or grow the way they want to grow.” (SCP Administrator)
- ❧ “I think it’s the human capital. All of the people associated with the program . . . seemed to enjoy working for the RUSMP during the summer. And when you have that, then how can you possibly not want to give your best effort as a participant there?” (SCP Participant)

Faculty and Staff

(continued)



- ❧ The leaders of the RUSMP SCP are “staples in maintaining high integrity in the implementation of high-quality professional development. . . . For a long time math professors were elitists and they were untouchables – but not in the RUSMP. They are brilliant, but they listen to your thinking, they encourage you to push yourself. It is the relationships that are formed with the leadership.” (SCP Participant)
- ❧ The RUSMP SCP administrator is “very talented at seeking out resources from the community and around the nation and this program would not have the success that it has if we did not have some quality people supervising that end of it.” (SCP Master Teacher)

Faculty and Staff

(continued)



- ❧ “Teachers teaching teachers has been one of the key things” in ensuring the sustainability of the RUSMP SCP.” (SCP Master Teacher)
- ❧ “The master teacher model is different than some other programs. . . . Our master teachers are classroom teachers who are authentic . . . [and] can develop that trust relationship with the participants in the class.” (SCP Administrator)
- ❧ “One strength of the RUSMP SCP is the interplay and coordination of the master teachers in the program together with the program leaders.” (SCP Master Teacher)

Collaboration and Adaptability



- ❧ In the late 1980s, the RUSMP SCP “was just a program for teachers – from the university to teachers. Now it is a collaboration.” (SCP Administrator)
- ❧ Adaptability must be “coupled with maintaining high standards and expectations. It has to be both. You can adapt and lose your focus and your quality. I think it is maintaining the high standards coupled with adaptability.” (SCP Administrator)

Collaboration and Adaptability (continued)



- ❧ RUSMP SCP's curriculum continues to evolve as the administrators collaborate with districts and address the needs of teachers and students.
- ❧ “We become more focused on what is going on in the classroom. Even though math is still the huge focus, we are doing more integration with other subjects. . . . The reality of the classroom is that math is not always taught in isolation and I think our curriculum is evolving to reflect that as time goes on.” (SCP Administrator)

High-quality Professional Development



- ❧ RUSMP SCP provides “high-quality professional development that is going to give the teachers the knowledge to get the critical thinking that the students need in order to move those students from where they are to where they need to be.” (SCP Master Teacher)
- ❧ “It would be super easy to cover material for the year, but I feel like I try to uncover material and the RUSMP SCP gives tools, techniques, and ideas to do that.” (SCP Participant)

High-quality Professional Development (Continued)



- ❧ RUSMP SCP was designed to allow “teachers to construct their knowledge as learners so that they would know what it took for students to construct their knowledge as learners.” (SCP Administrator)
- ❧ Modeling was important as “was the teacher talk and being more explicit about why we are doing the things that we are doing and why we are asking the questions we are asking.” (SCP Administrator)
- ❧ RUSMP SCP remains high-quality PD because the pedagogy used is “research-based and feedback regarding the program is solicited.” (SCP Participant)

Communities of Practice



RUSMP SCP participants are members of three communities of practice:

- ❧ The classroom community of practice in which the participating teachers “have the shared curriculum and the shared experiences because they are doing the same thing.” (SCP Administrator)
- ❧ The community of practice in which the participating teachers share the summer community of experience by attending colloquia and book studies with teachers from all grade bands.
- ❧ The community of practice in which participants of all years of the RUSMP SCP band together to attend networking conferences or share ideas.

Communities of Practice (Continued)



“Through the activities of the summer, follow-up activities, and activities such as our networking conference that bring together past participants from the past 30 years of the program, participants become part of the RUSMP family. Participants always feel comfortable contacting master teachers and directors for support and advice and are also welcoming and supportive of new members of the RUSMP family. Without these strong relationships, I do not feel that the program would have sustained itself for as long as it has.” (SCP Administrator)

Mathematics Education



- ❧ We are currently experiencing a “time of great opportunity for mathematics education in the United States. Lines of communication have been opened among policy-makers, mathematicians, and mathematics educators, and changed educational policies provide the potential for educational improvement.” (Conference Board of the Mathematical Sciences, 2012, p. 16)
- ❧ Given the critical need to develop and study programs that enhance teachers’ mathematical knowledge for teaching, the study of university summer campus programs for mathematics teachers continues to be a worthy topic of research.

Looking Towards the Future



“I believe that the more you know about the past, the better you are prepared for the future.”

Theodore Roosevelt