Project Pathways

"Opening Routes to Math and Science Success for all Students"

Project Pathways, a collaboration between Arizona State University, four school districts (Chandler Unified School District, Mesa Public Schools, Tempe Union High School District, and Tolleson Union High School District), the Maricopa Community College District, and Intel, is developing research-based support for teachers and schools to ensure that K-12 students are prepared for, have access to, and are encouraged to participate and succeed in challenging mathematics. For teachers, we are creating and delivering four research-based graduate courses designed to deepen teachers' understanding of and connections between foundational mathematics and science concepts and to improve their ability to help students gain an understanding of these concepts. Teacher professional learning communities in Pathways schools will assist teachers in learning to reflect on student thinking and the process by which students acquire an understanding of foundational concepts and scientific habits of mind. They will also support teachers in providing more meaningful and challenging learning opportunities for their students. The Pathways Motivational Activities Team is developing various support strategies to motivate students to continue science and mathematics course taking. We are developing materials that clarify the prerequisites for careers in STEM fields and will be leading a summit for guidance counselors in Pathways schools. We are also providing direct support to both motivate and empower students to take challenging STEM courses by facilitating Pathways schools' participation in science fairs and other motivational projects. The Pathways ELL Team is developing research-based technology and strategies to provide English language learners equal access to foundational and challenging science and mathematics concepts.

Woods Hole Oceanographic Institution

Administrators

- Participate in monthly School Planning Team meetings
- Arrange School Board presentations
- Participate in the development of school planning tools
- Design recruitment plan and implement local recruitment activities

Estimated Impact Numbers:

- 350 teachers
- 50,000 students
- 400 ASU TAs, instructors
- 60 ASU and CC scientists, mathematicians, engineers
- 75-100 industry volunteers
- 50 guidance counselors

Teachers

- Complete four research-based graduate courses
- Participate in accompanying professional learning communities
- Make progress toward a master's degree in science or mathematics education
- Acquire a deep and connected knowledge of content and concepts
- Improve understanding of how students acquire STEM concepts and behaviors

PCA Scores:

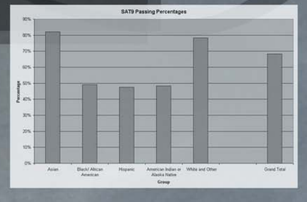
Quantile	Estimate	
100% Max	25	Mean=12.7
75% Q3	17	Median=13
50% Median	13	St. Dev. = 6.5
25% Q1	7	Teachers = 84
0% Min	0	

RESEARCH

Credit Georgia Institute of Technology; photo by Gary Meek

Students

- Experience improved STEM instruction
- Acquire understanding of foundational STEM concepts and behaviors
- Work with volunteer tutors and mentors
- Participate in science fairs and math competitions
- Compete for scholarships in STEM fields
- Use ELL Technology Supports



Guidance Counselors

- Participate in annual summit on prerequisites for STEM fields
- Assist with research on student course-taking choices
- Recruit volunteer counselors to assist students with college admissions and financial aid procedures

INTELLECTUAL MERIT

Over five years we will establish a new model of professional support for secondary STEM teachers—a model that is research- and school-developed and tested in all its components. Pathways research will produce new information about effective (and non-effective) support structures and tools for moving secondary teachers to promote STEM behaviors and conceptual learning—especially deep and connected function knowledge—in all students, of whatever background or learning level. We will gain new insights into the process by which teachers move to value and monitor the development of conceptual learning and effective STEM behaviors in their students. We will also gain new insights into the conditions that support teachers in recognizing, valuing, and supporting interdisciplinary connections in their classrooms. An added benefit, of particular interest in Arizona, will be gaining new information about effective interventions for assisting ELL students' continued STEM learning.

Teacher Workforce Outcomes include:

1. Improved teacher precalculus concept knowledge measured by performance on the Precalculus Concept Assessment (PCA)
2. Improved teacher physics concept knowledge measured by performance on Force Concept Inventory (FCI) and Mechanics Baseline Test (MBT)
3. Improved teacher performance on the Precalculus Pedagogical Content Assessment Instrument
4. Increase in teachers' ability to reflect on, monitor, and adjust their classroom practices as measured by qualitative data and RTOP scores.
5. Improved patterns in teacher test writing
6. Increased teacher quantity and diversity
7. An alternative teacher recruitment structure aimed at encouraging STEM majors to also become certified as secondary STEM teachers.
8. Improved field experience for pre-service teachers

Credit High Performance Wireless Research and Education Network (HPWREN) (http://hpwren.ucsd.edu)

Student Achievement Outcomes include:

1. Improvement on items from the state's standards-based assessment test (AIMS-Mathematics)
2. Improvement on course completion rate.
3. Improvement on the Precalculus Concepts Assessment (PCA)
4. Improvement on the Force Concept Inventory (FCI)
5. Improvement on the Chemistry Inventory (CCI1)
6. Improvement on the Geospatial test for Geology
7. Increased rates of challenging course-taking
8. Closure of the race-based achievement gap in each school by no less than 10%
9. Improvements in students' persistence in more challenging science explorations that require engineering design strategies and complex problem solving
10. Positive shifts in student views about the methods and nature of mathematics
11. Positive shifts in student views about the methods and nature of science
12. Increased numbers of students who participate in the Intel International Science and Engineering Fair and other Science Extension Activities

Credit GTEC

BROADER IMPACT

Once it is stable and disseminated, the Pathways model can contribute to ensuring that all students have teachers who are highly qualified in the science and mathematics they teach, realize significant gains in student achievement in STEM subjects, and better equip teachers to motivate minority and female students to take challenging courses in math and science. The knowledge and support tools Pathways creates can help to provide every American student with equal access to learning the foundational concepts of mathematics and science, thus opening STEM pathways for all students and encouraging more of them to become scientists, mathematicians, and engineers.

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Tempe Union High School District
Tolleson Union High School District
Maricopa Community College District

ASU Arizona State University

intel

NCAR, NASA, D. Dempsey/San Francisco State University