Scaling Mathematics Pathways: What Have We Learned from Statewide Efforts

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JFF, January 30, 2019
What brings you here?

**Let your fingers do the talking:**

- 5 fingers: We’ve implemented and want to improve.
- 4 fingers: Started implementation and have challenges.
- 3 fingers: Want to know how to implement.
- 2 fingers: Deciding whether to implement.
- 1 finger: Gathering information about general concept.
Definition of *Math Pathway*

... a mathematics course or sequence of courses that students take to meet the requirements of their programs of study.

The concept of math pathways applies to college-ready and underprepared students.
Institutions implement structural and policy changes quickly and at scale.

Institutions and departments engage in continuous improvement to ensure high-quality, effective instruction.
Institutions implement structural and policy changes quickly and at scale.

Mathematics pathways are structured so that:

1) All students, regardless of college readiness, enter directly into mathematics pathways aligned to their programs of study.

2) Students complete their first college-level math requirement in their first year of college.
Dana Center Principles for Pathways

Institutions and departments engage continuous improvement to ensure high-quality, effective instruction.

Students engage in a high-quality learning experience in math pathways designed so that:

3) Strategies to support students as learners are integrated into courses and are aligned across the institution.
4) Instruction incorporates evidence-based curriculum and pedagogy.
Where we Work

Dana Center Mathematics Pathways has contributed to the implementation of math pathways in higher education systems, institutions, and campuses over 30 states.

https://dcmathpathways.org/where-we-work
Coordinated efforts across all levels of the system

Change at scale requires work at multiple levels of the system.

Systems and leaders at higher levels enable broad, large-scale action.

Local action informs and influences levels above.
The Dana Center Mathematics Pathways (DCMP) establishes:
• A model for implementing math pathways, and
• Characteristics for how the Dana Center works that inform several different projects.

Collaboration with Texas Association of Community Colleges
Building Math Pathways to Programs of Study (CCA)
Mathematics Pathways to Completion
State- or Region-Specific Work
Mathematics Pathways to Completion - MPC
System Implementation Process

Each state, region, system has a customized plan and timeline.

Phase 1: Build urgency and intrinsic motivation for change

Phase 2: Enable scale by creating the policy and practice conditions for statewide implementation

Phase 3: Enact the DCMP at institutions by building faculty and institutional

Consulting, tools, and services support each phase.
Math Pathways: a dimension of guided pathways

Guided Pathway for Metamajor

- Mathematics requirement
- Language Arts requirement
- Other Gen Ed Requirements
Math has special significance

- Has potential to be greatest obstacle for a large proportion of the student population

- Creating high quality math pathways aligned to programs can require significant changes.

→ Requires early and strategic planning.
Aligning Math with Pathways:
A Case Study - Arkansas
The Governor's Office charged Arkansas Department of Higher Education with creating a strategic plan to improve state higher education outcomes. As a part of that plan, ADHE identified the Mathematics Pathways to Completion (MPC) project as a vehicle for helping the state achieve those outcomes, charging the Arkansas Math Pathways Taskforce (AMPT) to develop expectations and processes that result in each two-year and four-year public higher education institution in the state to offer pathways in mathematics that will:
Formal Charge

• Increase student success.
• Allow more students the opportunity to complete degree programs.
• Increase transferability of credits between institutions of higher education.
Arkansas Math Pathways Task Force
• Organized by ADHE and ACC to implement math pathways project in Arkansas.
  • Dr. Jessie Walker (ADHE)
  • Mike Leach (ACC)
  • Dr. Charles Watson (UCA)
  • Valerie Martin (NACC)
  • Dr. Linus Yu (UAFS)
Includes a least one math faculty member from every two year and four year public college in Arkansas (and several private institutions).
• Met more than ten times since February 2016.
• Issued recommendations for the state higher education system to adopt and scale math pathways.
Recommendation #1: All public institutions of higher education in Arkansas adopt multiple math pathways as needed based on the math course requirements of the programs of study offered at their institution.
Recommendation #2: Academic disciplines identify math competencies needed for specific programs of study and use competencies to recommend a common transferable math course requirement for each program of study. (Statistics, College Algebra, Quantitative Reasoning, Calculus)
Recommendation #3: All public institution of higher education adopt a co-requisite approach to preparing underprepared students for their required college-level math courses.
Recommendation #4: Provide professional development to: 1) support faculty in designing and teaching required college-level math courses and co-requisite approaches, 2) educate faculty, staff and students about the content and benefits of new math pathways, and 3) help advisors understand and be able to advise students into multiple math pathways, and help registrars implement multiple math pathways including co-requisite approaches.
• Recommendation #5: Provide technical assistance to support faculty and staff in developing multiple measures for student assessment and placement into math pathways.
• Recommendation #6: Review ACTS language related to recommended pre-requisites for college-level introductory statistics, and identify mathematics skills needed to best prepare for college-level introductory statistics.
Recommendation #7: Develop, identify and disseminate strategies and best practices for transitioning students between math pathways should students change majors and encounter a new math course requirement.
• Recommendation #8: Gather and disseminate data that indicate the impact of multiple math pathways and co-requisite approaches on student outcomes.
Quick structural change
Mathematics pathways are structured so that:
1) All students, regardless of college readiness, enter directly into mathematics pathways aligned to their programs of study.
2) Students complete their first college-level math requirement in their first year of college.

Continuous improvement
Students engage in a high-quality learning experience in math pathways designed so that:
3) Strategies to support students as learners are integrated into courses and are aligned across the institution.
4) Instruction incorporates evidence-based curriculum and pedagogy.
Continuous Faculty and Staff Professional Development
• Math Pathways Implementation Training
• Multiple Measure Workshop
• AR/OK Pathway to Calculus Convening
• Math Pathways Advisor Training with Dana Center
• QR/QL Professional Development
• Co-Req Training (SStF)
Applicability – The Elephant in the Room
Arkansas Math Pathways Task Force

Math Competency Survey Findings

College Algebra

- Linear Functions: 43.85%
- Quadratic Functions: 13.08%
- Polynomial Functions: 16.92%
- Rational Functions: 10.77%
- Absolute Values Functions: 36.54%
- Exponential Functions: 30.38%
- Logarithmic Functions: 21.15%
- Systems of Equations: 19.23%
- Difference Quotient: 28.46%
## Survey Findings

### Prob & Stat

<table>
<thead>
<tr>
<th>Topic</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categorical Data</td>
<td>59.23%</td>
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<tr>
<td>Quantitative Data</td>
<td>64.62%</td>
</tr>
<tr>
<td>Linear Regression</td>
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</tr>
<tr>
<td>Probability</td>
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<tr>
<td>Random Variables</td>
<td>31.15%</td>
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<tr>
<td>Normal Distributions</td>
<td>56.92%</td>
</tr>
<tr>
<td>Inference for Means and Proportions</td>
<td>50.23%</td>
</tr>
</tbody>
</table>
Survey Findings

Quantitative Literacy

- Personal, state and national finance: 46.54%
- Collecting and Describing Data: 74.23%
- Bivariate Data: 43.08%
- Inferential Statistics: 64.62%
- Reasoning about Probability: 45.77%
- Mathematical modeling: 28.08%
- Quantities and measurement: 57.31%
SURVEY FINDINGS

Arkansas Math Pathways Task Force

Overall

100%
75%
50%
25%
0%

College Algebra
Prob&Stat
QL

Dana Center Mathematics Pathways
Forging Relevant Mathematics Pathways in Arkansas

Deborah Korth  
Director of Fulbright Student Success, University of Arkansas

Linus Yu  
Department Head Mathematics, University of Arkansas, Fort Smith

Charles Watson  
Associate Professor of Mathematics, University of Central Arkansas

Marla Strecke  
Senior Associate Director for Academic Affairs & Research, ADHE

Valerie Martin  
Department Chair of Math, Science, and Agriculture, North Arkansas College

We believe faculty in disciplines that do not require Calculus should not require students to take College Algebra. Instead, students should be required to take Quantitative Literacy or Introduction to Statistics, which are courses more relevant to their degree programs, future careers, and civic responsibilities.
Arkansas Department of Higher Education
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Asa Hutchinson
Governor

Maria Markham, Ph.D.
Director

April 11, 2018

Dear Colleagues,

I am pleased to endorse the recommendations of the ACTS Math Review Committee regarding the applicability of Quantitative Literacy/Mathematical Reasoning toward the fields and degrees described herein. The Committee issues these recommendations after much thoughtful consideration and faculty lead debate. I ask that you, as institutional leaders, implement these recommendations in the upcoming academic year and move our state toward better alignment of mathematics pathways and stronger transfer of courses between institutions.

Sincerely,

Maria Markham, Ph.D.
Director
Recommended QL/MR Fields

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<tr>
<th>Field</th>
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<tbody>
<tr>
<td>Communication, Journalism, and Related Programs</td>
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<tr>
<td>Foreign Languages, Literatures, and Linguistics</td>
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<tr>
<td>English Languages, Literatures, and Linguistics</td>
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<tr>
<td>Liberal Arts and Sciences, General Studies, and Humanities</td>
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<tr>
<td>Homeland Security, Law Enforcement, Firefighting and Related Protective Services</td>
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<td>Public Administration and Social Services</td>
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<td>Visual and Performing Arts</td>
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<td>History</td>
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<td>Sociology, Political Science</td>
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<tr>
<td>Elementary Education K-6</td>
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<tr>
<td>Special Education</td>
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<tr>
<td>Middle Level Education (Language Arts &amp; Social Sciences)</td>
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ACTS cmte meetings with faculty from other disciplines (nursing, etc)

Tools for math faculty to meet with non-math colleagues

Regional Transfer Meetings

CAO meetings
• Recommend QL for more majors including “undecided” students
• Follow-up regional transfer meetings
• More training for faculty and staff (focus on co-req in 2019~2020)
• Work with K-12 partner to recognize Math Pathways
• Monitor and support full scale institutional implementation
• Collect evaluation data on implementation for Year 2 and Year 3
Faculty Driven – All colleges
Right Faculty/State Leadership
Constant Communication, Activity
Followed DC Strategy – Patience/Trust
Proactive Outreach to Non-Math Disciplines
Direct Attack on Applicability Issue
Co-requisite Implementation – Arkansas is Next!

In Texas, California, and several other states, DCMP facilitated co-requisite course development that will impact hundreds of thousands of college students. Stakeholders from 89 Texas campuses and 23 California State University System campuses attended meetings and workshops on co-requisite implementation.

http://www.utdanacenter.org/dc-helps-launch-co-requisites-in-cali/
http://www.utdanacenter.org/higher-education/hb2223-implementation-support/
• What are some strengths and assets you possess to support the implementation of multiple mathematics pathways?
• What are some of the challenges you face supporting students with multiple math pathways.

• Brainstorm strategies, effective practices and resources related to the challenge.
DCMP Resource Site

http://www.dcmathpathways.org/
State Mathematics Task Force Summary

Informational Brief

• Summarizes State Mathematics Task Force Progress and Accomplishments
• Highlights the Dana Center’s intentional and innovative approach to improving student success
Examples of State Progress:

- **Policy Changes:** Colorado now allows institutions to differentiate placement for multiple math pathways
- **Transfer and Alignment:** Arkansas alignment of programs to QL pathway as part of ACTS revision
- **Voluntary Commitments:** Oklahoma secured commitments from 26 out of 27 institutions to offer an entry-level course for at least one alternative pathway
Institutional Implementation Guide (Print)

Print version can be downloaded from Dana Center Mathematics Pathways Resource Site.

Concise summary of 10 Essential Actions.

Click on button at upper right on dcmathpathways.org

or use direct link:
www.dcmathpathways.org/implementat/ion-guide
Online version includes additional information and links to resources.

Click on button at upper right on dcmathpathways.org

or use direct link: www.dcmathpathways.org/im-plementation-guide
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