Streamlining Math Pathways in Florida

Presenters:
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We will discuss the following recommendations:

**Recommendation #1:** Create common mathematics pathways by aligning mathematics courses to programs, meta-majors and careers in Florida.

**Recommendation #3:** Ensure mathematics prerequisites align with mathematics pathways.

**Recommendation #5:** Encourage colleges and universities to implement instructional models (such as the co-requisite model) that place students, when appropriate, directly into college-level mathematics courses carrying general education credit.
Key Ideas

Alignment:

- Mathematics course requirements are aligned to programs of study (Recommendation #1).
- Support course content is aligned with the content of gateway courses (Recommendation #3).

Acceleration:

- Place students, when appropriate, directly into college-level mathematics courses carrying general education credit, and
- Implement co-requisite instruction to improve academic outcomes in the gateway course (Recommendation #5).
Recommendation #1: Create common mathematics pathways by aligning mathematics courses to programs, meta-majors and careers in Florida.

What is the definition of Math Pathways?
Math pathways enable students to take different paths through the math curriculum, depending on their course of study, so the math they learn is relevant and aligned to their goals (Ganga & Mazzariello, 2018).
Math Pathways...

...are more than sequences of math courses... they are also aligned to meta-majors & programs of study

Your math pathway is determined by your specific major within the Meta-Major. See a counselor or advisor for a recommendation.

FOR ARTS/HUMANITIES/COMMUNICATIONS/DESIGN AND EDUCATION IT IS RECOMMENDED TO MEET WITH A COUNSELOR OR ADVISOR REGARDING YOUR DEGREE PATHWAY.

FOR SOCIAL AND BEHAVIORAL SCIENCES AND HUMAN SERVICES

- Social Science
- Human Services

FOR BUSINESS

- Business
- Science, Technology, Engineering, and Math
- Industry, Manufacturing, and Construction

FOR HEALTH SCIENCES

- Health Sciences
- Public Safety

FOR HEALTH SCIENCES

- MAT 005C
- MAT 005C
- MAT 005C
- MAT 005C

FOR PUBLIC SAFETY

- STA 202
- STA 202
- STA 202
- STA 202

FOR HEALTH SCIENCES

- MAC 1144
- MAC 1144
- MAC 1144
- MAC 1144

FOR PUBLIC SAFETY

- STA 202
- STA 202
- STA 202
- STA 202
Create **common** math pathways in Florida
Creating common math pathways in Florida:

- Focusing on academic disciplines using a survey
  - Example: Arkansas Mathematics Task Force

- Focusing on mathematics course sequencing
  - Example: North Carolina’s Brunswick Community College
Focusing on academic disciplines

- Identify mathematics competencies needed for specific programs of study, relying on upper-division discipline-specific faculty to identify the competencies.

- Use the identified mathematics competencies to recommend common transferable mathematics course requirements for each program of study and corresponding meta-major.
Focusing on academic disciplines: ex. Arkansas

- Survey of Departmental Leadership at 2-Year and 4-Year Colleges in Arkansas to Identify Mathematics Competencies Necessary for Student Success in Non-STEM Disciplines administered using Survey Monkey.
- The survey presented a comprehensive list of mathematics skills and sub-skills asking the respondent to check the main topics or mathematical skills they felt were important for students in their majors to comprehend.

https://dcmathpathways.org/resources/forging-relevant-mathematics-pathways-arkansas
The graph shows the percentage of respondents from non-STEM degree programs who chose required topics that are traditionally associated with and taught in a College Algebra course.
The graph shows the percentage of respondents from non-STEM degree programs who chose required topics that are traditionally associated with and taught in an Introduction to Statistics course.
The graph shows the percentage of respondents from non-STEM degree programs who chose required topics that are traditionally associated with and taught in a Quantitative Literacy course.
Arkansas Math Pathways Task Force recommendations based on the survey results

- Programs of study that do not require Calculus should not require students to take College Algebra.
- Instead, students should be expected to take Quantitative Literacy or Introduction to Statistics, which are courses more relevant to their degree programs, future careers, and civic responsibilities.
Focusing on mathematics course sequencing

- **STEM**: College Algebra, Calculus and Beyond according to major
- **Business**: College Algebra, Statistics, Business Calculus according to major
  - Integration of business skills into lower-division mathematics courses for business majors.
- **Statistics/Liberal Arts Pathway**
  - Broaden access to STA2023 through new placement and prerequisite policies.
- **Liberal Arts Pathway**
- **Quantitative Reasoning/Literacy Pathway**
  - Broad learning outcomes: Argumentation/Communication, Proportional reasoning, Probability & Statistics, Modeling, Application
Brunswick Community College, NC - An Example

They have two main pathways...

- **Quant/Stat pathway**, and
- **STEM Calculus pathway** with prerequisite courses labeled “Precalculus Algebra”, rather than “Intermediate/College Algebra”:
  
  MAT 001P - Math Skills Support  
  MAT 143 - Quantitative Literacy  
  MAT 152 - Statistical Methods I  
  **MAT 171 - Precalculus Algebra**  
  MAT 172 - Precalculus Trigonometry  
  MAT 263 - Brief Calculus (Prerequisite: MAT 171)  
  MAT 271 - Calculus I (Prerequisites: MAT 171 and 172)  
  MAT 272 - Calculus II
Brunswick Community College, NC - An Example

The benefits of this system…

- “Intermediate/College Algebra” courses are labeled “Precalculus”.
- The “Precalculus Algebra” label, rather than “College Algebra”, more accurately describes for advisors, students, and program directors, the roles these courses play in the system – preparation for calculus.
- In my opinion, MAC1105 could just as well be called “High School Algebra”, since so much of it overlaps with what is being taught in Algebra 2, a high school level course.
Labels matter…

- Leaders of programs of study that do not require calculus will conclude that a “Precalculus” pathway is not best suited for them.
- Quant/Stat pathway would address more relevant real-world mathematics, including dimensional analysis, finance, modeling, problems solving, etc.
- This could help with over reliance on MAC1105:

<table>
<thead>
<tr>
<th>Course</th>
<th>2014-15</th>
<th>2015-16</th>
<th>2016-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAC1105</td>
<td>90,986</td>
<td>104,135</td>
<td>100,041</td>
</tr>
<tr>
<td>MGF1106 or MGF2106</td>
<td>25,688</td>
<td>35,446</td>
<td>35,725</td>
</tr>
<tr>
<td>MGF1107 or MGF2107</td>
<td>11,500</td>
<td>15,337</td>
<td>16,225</td>
</tr>
<tr>
<td>STA2023</td>
<td>53,344</td>
<td>69,375</td>
<td>68,883</td>
</tr>
</tbody>
</table>

~45% of students
Fitting this system into Florida’s system…

Two main pathways...
- STEM Calculus
- non-STEM with Quant/Stat/MGF

*Developmental Mathematics*
- MGF 1106 – Explorations in Mathematics I
- MGF 1107 – Explorations in Mathematics II
- MAT 11xx – Quantitative Reasoning
- STA 2023 – Statistics
- MAT 1033 – Precalculus Algebra I
- MAC 1105 – Precalculus Algebra II
- MAC 1147 – Precalculus Algebra III with Trigonometry
- MAC 2233 – Survey/Business Calculus (Prerequisite: MAC 1105)
- MAC 2311 – Calculus I (Prerequisites: MAT 1147)
Recommendation #3: Ensure mathematics prerequisites align with mathematics pathways.

Key Assumptions:

- Prerequisite course must improve students’ success rate in a gateway course.
- Prerequisite course content must align with the content of a gateway course.
Students were organized into three groups based on their first math course:

1. Developmental Education (MAT0012, 18, 19, 22, 23, 27, 28, 29, 54, 55, 56, 57, 58, 157);
2. Prerequisite Level (MAT1033, MAT1100, STA1001, MAT1032, MGF1100, or STA1021); or
3. Gateway Level (MAC1105, MGF1016, MGF2106, MGF1107, MGF2107, or STA2023).
MAT1033 Intermediate Algebra enrollment in FCS

About 92% of FCS students, who enrolled in one of the three prerequisite courses in 2016-17 school year, enrolled in MAT1033 course:

<table>
<thead>
<tr>
<th>Course</th>
<th>2014-15</th>
<th>2015-16</th>
<th>2016-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT1033</td>
<td>112,513</td>
<td>102,992</td>
<td>95,112</td>
</tr>
<tr>
<td>MAT1100</td>
<td>1,501</td>
<td>2,901</td>
<td>4,291</td>
</tr>
<tr>
<td>STA1001</td>
<td>711</td>
<td>4,101</td>
<td>4,333</td>
</tr>
</tbody>
</table>
MAT1033 as a common prerequisite in the Florida State Coursewide Numbering System

<table>
<thead>
<tr>
<th>State Math Gateway Courses</th>
<th>MAC 1105 College Algebra</th>
<th>MGF 1106 Liberal Arts Math I</th>
<th>MGF 1107 Liberal Arts Math II</th>
<th>STA 2023 Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Prerequisite as Listed in the State Coursewide Numbering System</td>
<td>MAT 1033 or Placement</td>
<td>MAT 1033 or Placement</td>
<td>MAT 1033 or Placement</td>
<td>MAT 1033</td>
</tr>
</tbody>
</table>
MAT1033 Intermediate Algebra pass rates in FCS
Examine the use of MAT1033 as a prerequisite for STA and MGF courses

- “Prerequisite courses other than Intermediate Algebra can adequately prepare students for courses of study that do not lead to Calculus” (AMATYC, 2014).
  - Thus, MAT1033 may not be the best prerequisite course for STA and MGF courses.
- In the Florida Statewide Course Numbering System, we recommend to reconsider the use of MAT1033 as a prerequisite for STA and MGF courses.
## Non-MAT1033 prerequisites for **STA2023** across FCS

<table>
<thead>
<tr>
<th>None</th>
<th>Dev. Ed.</th>
<th>STA1001</th>
<th>MAT1100</th>
<th>MGF1106 or MGF1107 (2106 or 2107)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>College of Central Florida</td>
<td>Gulf Coast State College</td>
<td>Broward College</td>
<td>Florida SW State College</td>
</tr>
<tr>
<td></td>
<td>Hillsborough CC</td>
<td>State College of Florida, M-S</td>
<td>Pasco Hernando State College</td>
<td>Daytona State College</td>
</tr>
<tr>
<td></td>
<td>North Florida CC</td>
<td>Valencia College</td>
<td>Seminole State College</td>
<td>Florida State College at Jax</td>
</tr>
</tbody>
</table>

### MAT1100 -> MGF1106 -> STA

- Indian River State College
- Santa Fe College
- Lake Sumter State College
- Palm Beach State College
- Polk State College
Evidence of Success: MGF1106 & 1107 courses

In 2016-17 school year, St. Johns River State College changed the prerequisite for MGF1106 and MGF1107 courses from MAT1033 to developmental education exemption.

- Success rate for MGF1106 decreased from 76% in 2014-15 to 71% in 2016-17. However, since enrollment increased from 285 to 508, more students were successful.
- Success rate for MGF1107 increased from 61% in 2014-15 to 69% in 2016-17. Enrollment has also increased from 77 to 216.
Evidence of Success: Introductory Statistics course

Based on data from randomized controlled experiment, there is evidence to suggest that many students directed into developmental mathematics can pass the college-level statistics course without full remediation (Logue, Watanabe-Rose & Douglas, 2016).

- 56% of students assigned to the college-level statistics with a two-hour workshop support passed the course.
- 39% of students assigned to traditional developmental algebra course prior to taking statistics passed the course.
- 44% of students assigned to traditional developmental algebra course with a two-hour workshop support prior to taking statistics passed the course.
Examine the use of MAT1033 as a prerequisite for MAC1105 course

Recent study suggests that MAT1033 may not increase the likelihood of successful completion of MAC1105 (Center for Postsecondary Success, 2018).

- Within the sample of Fall 2014 FTIC, AA degree-seeking students, researchers identified a group of students with a PERT score range that would have placed them into MAT1033. Within this group, some students took MAT1033 and others enrolled into MAC1105 (possibly due to other placement measures [SAT scores, etc.])
Recommendation #5: Encourage colleges and universities to implement instructional models (such as the co-requisite model) that place students, when appropriate, directly into college-level mathematics courses carrying general education credit.

What is the definition of a Co-Requisite?  
Co-requisite developmental instruction or tutoring that supplements credit instruction while a student is concurrently enrolled in a credit-bearing course. (FL Statute 1008.02)

Working definition: ...the placement of students who have been designated as underprepared directly into college-level courses and providing additional supports. (Charles A. Dana Center 2019)
Investigation of Math Pathways in the Florida College System by the Center for Postsecondary Education (CPS) at FSU

Table 4: Predicted Probability of Earning a Degree within Two Years and Exposure to MAT1033 as a Prerequisite

<table>
<thead>
<tr>
<th>Earned Degree</th>
<th>No Pre-req.</th>
<th>Took/Passed MAT1033</th>
<th>Took/Failed MAT1033</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.67%</td>
<td>5.52%***</td>
<td>4.52%***</td>
</tr>
</tbody>
</table>

*Note. Stars indicate whether changes in MAT1033 exposure are statistically significant compared to taking no prerequisites. ***p<.001.*
Investigation of Math Pathways in the Florida College System by the Center for Postsecondary Education (CPS) at FSU

<table>
<thead>
<tr>
<th></th>
<th>No Pre-req.</th>
<th>Took/Passed MAT1033</th>
<th>Took/Failed MAT1033</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>62.92%</td>
<td>58.21%***</td>
<td>41.38%***</td>
</tr>
<tr>
<td>Students below gateway placement</td>
<td>53.88%</td>
<td>n/a</td>
<td>38.31%***</td>
</tr>
<tr>
<td>Students placing into MAT1033</td>
<td>62.52%</td>
<td>n/a</td>
<td>44.15%***</td>
</tr>
</tbody>
</table>

Note. Stars indicate whether changes in MAT1033 exposure are statistically significant compared to taking no prerequisites. ***p < .001.
Three Main Objectives of a College Algebra Co-Requisite Course:

1. **Remediate** - Students will learn the material that is needed for College Algebra.
2. **Reinforce** - Students will reinforce the material that is learned in College Algebra.
3. **Practice** - Students will apply the material that is learned to real life problems.
Co-RequisiteSuccesses

Georgia

- Math
  - 2 years BEFORE: 20%
  - 1 year AFTER: 63%

West Virginia

- Math
  - 2 years BEFORE: 14%
  - 1 semester AFTER: 62%
Co-Requisite Successes

Tennessee

Indiana

www.completecollege.org/spanningthedivide
Dana Center Mathematics Pathways: Co-Requisite Supports
Narrowing the Gap Between Instruction and Support

Consideration 1: Existing campus supports

- Are there other initiatives on campus, such as guided pathways work, examining content, pedagogy, alignment, enrollment, persistence, etc.? What other on-campus resources can be accessed?

Consideration 2: Co-requisite model (placement, credit hours, financing)

- **Placement:** What information is used to determine the default enrollment for students into their mathematics courses?
  - How will you determine which students are best served by a one-semester co-requisite structure or by a yearlong sequence?
  - Consider giving students information about support options and allowing them to choose.

- **Student structures**
  - **Co-mingling:** Mixing college-ready and underprepared students in the same class. Underprepared students are provided additional supports.
  - **Cohorting:** Designating certain sections of college-level courses exclusively for underprepared students. Additional supports may be embedded or separate.
Calendar structures

Just-in-time supports

- **Support courses**: Separate, structured support courses that run before, after, or on opposite days to the college-level courses; completed within one semester
- **Embedded supports**: College-level classes with the developmental content embedded
- **Mandatory tutoring**: Required attendance in a tutoring lab for a specified number of hours per week

Prerequisite supports + college-level; one semester

- **Boot camp**: First 3-5 weeks of the semester are remediation, followed by the college-level content (classes meet for extra hours each week throughout the semester in order to equal the two classes or class + lab)
- **Compressed courses**: Developmental prerequisite class is compressed into 8 weeks, and then the college-level class is compressed into 8 weeks, so that both classes are completed in one semester (classes meet for extra hours each week throughout the semester in order to equal the two classes).

Just-in-time supports; two semesters

- **Stretch courses**: College-level classes with the developmental content embedded, and stretched over two semesters (e.g., Statway model)
• **Grades**: Whether to give one grade or separate grades for the two portions
• **Staffing**: Determining whether the college-level instructor will also teach the support/developmental portion
  o If separate instructors, what mechanisms will be in place to foster coordination between instructors?
• **Credit hours and financing**
  o How many hours do students attend the college-level portion?
  o How many hours do students attend the support/developmental portion?
  o How many hours do students pay for?
  o How do the hours count in the instructor’s teaching load?

**Consideration 3: Co-requisite content**

• What are the essential foundational concepts that students need to know in order to be successful in the college-level course?

**Consideration 4: Cultural shifts**

Cultural shifts in both the college-level and the support classrooms can contribute to the narrowing of the gap between instruction and supports.

• **Collaborative work** can contribute to the formation of peer support groups.
• **Early referral** can increase success and decrease withdrawals.
• **Explicit instruction** in goal-setting, self-regulation, and the value of struggle can increase persistence.
• **Ongoing formative assessment** can result in early intervention and increased success.
Example of Schools in Florida implementing a Co-requisite Model with MAC1105

Five faculty at MDC are piloting a MAC1105 College Algebra co-requisite course in the Fall of 2019. Students who are exempt and have been placed into MAT1033 will have a choice to go directly into MAC1105 as long as they decide to enroll into a co-requisite lab that meets two hours a week. Also, students only pay for 3 credits. The extra co-requisite hour is not pass or fail.

Each professor will pilot 1 Intervention (experimental) class and 1 Control class. Students have the co-requisite part after the course where the students meet with the Learning Assistant (Not Professor) to facilitate the dialogue about the topics learned in class. The class is worksheet based/active learning.
Critical Takeaways

- Students should engage in a mathematic pathway that directly relates to their academic and career goals.
- Students should complete their first transferable mathematics course within their first year of study.