Dana Center
Mathematics
PATHWAYS

Institutional Implementation Guide

For higher education institutions taking action to implement and scale mathematics pathways based on the DCMP model

The University of Texas at Austin
Charles A. Dana Center

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Introduction

Implementing a pathways approach for college students is on the rise in higher education as institutions combat the persistent problem of low student completion. In general, a pathways approach defines an effective and intentional student experience based on data and best practice. The guided pathways movement has led many colleges to seek better definition along a student's academic trajectory from enrollment to postsecondary completion.

The same principle of defining an effective and intentional pathway can be applied to mathematics. Without clearly defined mathematics pathways, math can serve as a barrier to student completion and success. This often occurs in four ways: 1) students flounder in developmental math courses, 2) students do not pass their required math courses, 3) students delay enrolling in math courses, and 4) students enroll in mathematics courses that do not prepare them for their selected programs of study.

When used effectively, mathematics pathways address these barriers. Evidence suggests that students, including those needing developmental support, can succeed in college-level math courses with appropriate assistance. This support often is delivered through a one-semester co-requisite model or a one-year model sequencing each mathematics course in back-to-back semesters. Regardless of the model, student success relies on pathways that incorporate rigorous and relevant mathematics aligned to programs of study and informed by guidance from major professional organizations.

The Dana Center Mathematics Pathways

In 2012, the Charles A. Dana Center launched the New Mathways Project (NMP), a joint enterprise with the Texas Association of Community Colleges (TACC). Early implementation of the NMP in Texas and continued expansion in more than 13 states created many opportunities for further engagement across the nation and yielded a rich trove of lessons from which states and institutions of higher learning can benefit. These lessons are addressed in this updated implementation guide.

After reflecting on past work and looking ahead, the Dana Center reshaped the NMP and adopted a new name for the work: Dana Center Mathematics Pathways (DCMP). This change reflected the shift and progression of multiple mathematics pathways. The "New Mathways Project" was no longer new nor was it merely a project. Mathematics pathways signaled transformative change for equitable access to and opportunity for success in rigorous mathematics pathways as normative practice for all students.

The DCMP seeks to ensure that ALL students in higher education will be:

- Prepared to use mathematical and quantitative reasoning skills in their careers and personal lives,
- Enabled to make timely progress towards completion of a certificate or degree, and
- Empowered as mathematics learners.

Four principles guide the DCMP work.

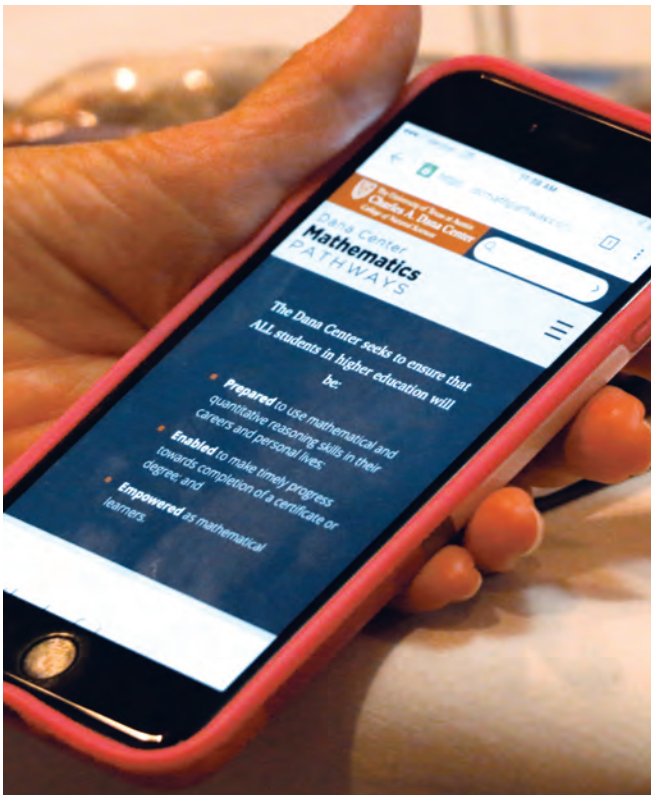
Institutions implement structural and policy changes quickly and at scale.

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.

Institutions and departments engage in a deliberate and thoughtful process of continuous improvement to ensure high-quality, effective instruction.

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.



How to Use This Guide

This guide is designed for faculty and staff at both two-year and four-year institutions that are implementing and scaling mathematics pathways based on DCMP principles. It offers a blueprint for implementation that spans four stages. The stages frame the work so that different stakeholder groups understand how to plan and prepare to implement mathematics pathways at their individual institutions and how to monitor implementation efforts for continuous improvement. As seen in the trajectory graphic on page 5, it is important to note that these stages do not exist in isolation nor is the process merely linear. Stages may overlap, and institutional circumstances may necessitate additional action to enact a stage.

The guide is comprehensive, but not all-inclusive. Here we provide the most essential information and resources to begin and monitor implementation. The DCMP resource site (dcmathpathways.org) provides a collection of resources that can be used to build a customized implementation guide that reflects an institution's specific needs.

This guide offers the following features:

- Stages of Implementation – one of several necessary operations required for successful mathematics pathways
- Essential Actions – key actions that must be completed to realize the stage of implementation
- Steps to Fulfill Actions – activities to achieve the action
- Downloadable Resources – tools and information to fulfill each action

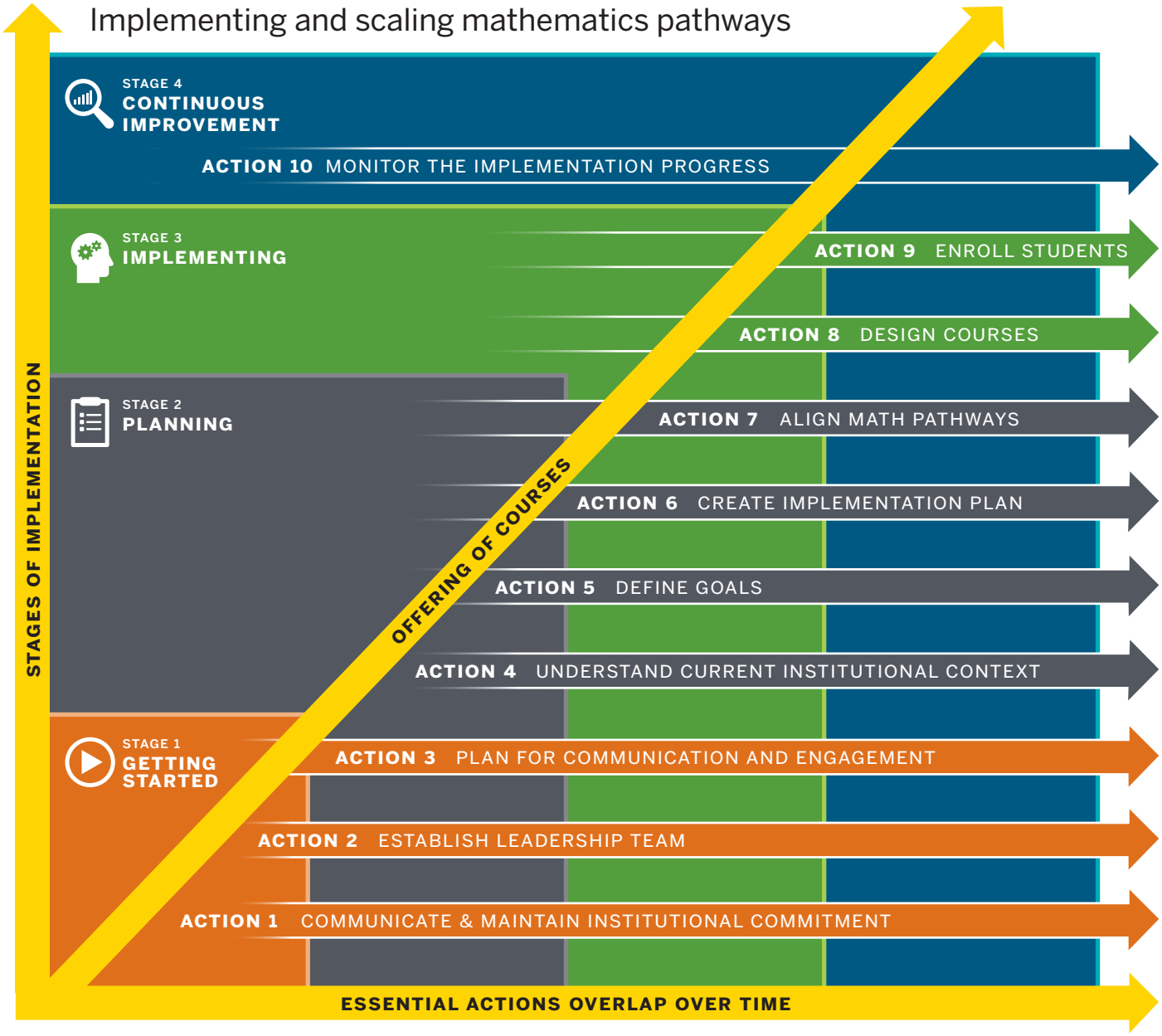
While this written guide paints a picture of the implementation process in primary colors, giving an outline of the work required and sufficient information to get started, the online version of this implementation guide offers the tints and shades of the process, elaborating on each stage and adding more nuanced information and resources.

We recommend that institutional leadership teams read this guide in its entirety before implementing mathematics pathways and also to review additional information on the DCMP resource site.

Stages of Implementation

The Dana Center recommends a four-stage process to implement mathematics pathways. To the right, we provide a brief description of each stage while its essential actions are outlined in the graphic below.

- Getting Started – leaders identify need, make commitment, and prepare to engage stakeholders through a leadership team.
- Planning – cross-functional leadership team collects and reviews data to define problem and establish goals.
- Implementing – working groups and individuals follow implementation plan under oversight of leadership team.
- Continuous Improvement – working groups and individuals follow evaluation and communications plans under oversight of leadership team.



STAGE 1: GETTING STARTED

Laying the foundation for successful implementation

Implementing mathematics pathways is a transformative process that requires work across the institution. In short, it is faculty driven, administratively supported, and policy enabled. The first stage of implementation, *Getting Started*, focuses on how leaders can identify the needs of their institution, commit to action, and prepare to engage stakeholders.

Resources to support each action are listed at the end of this document and are located on the DCMP resource site (dcmathpathways.org).

Level of Involvement from Stakeholder Groups

Stakeholder Group	Level of Involvement		
	HIGH	MEDIUM	LOW
High-Level Administrators (e.g., presidents, provosts, vice presidents)		✓	
Departmental Leadership (e.g., deans, departments heads)	✓		
Faculty (e.g., mathematics faculty, developmental education faculty, partner-discipline faculty)	✓		
Staff (e.g., advisors, institutional researchers)		✓	

ESSENTIAL ACTION 1

Communicate and maintain institutional commitment.

Steps:

Identify key administrative leaders.

Institutional leadership plays a major role in initiating a transformative change process. Key administrators include the president, provost, vice presidents, and deans.

Ensure that key administrative leaders understand the concept of mathematics pathways and how the pathways align to the institutional mission, goals, and strategic plan.

Key administrative leaders must understand the rationale for mathematics pathways, which seek to eliminate a major barrier—postsecondary mathematics—to student success. Mathematics pathways strive to align rigorous and relevant math courses to programs of study and to reduce long developmental course sequences that hamper students' ability to complete college-level mathematics in a timely fashion.

> All students benefit from mathematics pathways. Math pathways are not a secondary structure for developmental students. See *The Case for Mathematics Pathways* on the DCMP resource site.

Institutional leaders also must ensure that faculty and staff see the connection between mathematics pathways and the institution's mission, goals, and strategic plan. Leaders find ways to tie the project to the motivations of different stakeholder groups. For example, leaders continuously highlight how mathematics pathways help students succeed and can reduce the overall cost of education; leaders engage faculty and staff to an enterprise that is central to their campus community.

Clarify resources available to support commitment.

Successful implementation of mathematic pathways requires time and money to support staff members who are involved. The leadership team (addressed in Essential Action 2) monitors resource use over time and relies on key administrative leaders to allocate sufficient staff, approve workload adjustments as needed, and set aside or acquire funding to ensure that implementation and monitoring continue.

Establish structures for consistent communication and engagement to and from institutional leadership.

Leaders emphasize their institutional commitment to mathematics pathways through clear and consistent communication. Visible actions, such as mentioning mathematics pathways during public meetings and highlighting progress through multiple outlets, signify the importance of this endeavor.

While senior leaders provide ongoing and public support for mathematics pathways, other leadership is responsible for campus-wide communication and engagement. It is essential to communicate specific details about the mathematics pathways and the role that pathways play in the institution's overall strategic plan and student success agenda. Additionally, leaders regularly review data demonstrating progress toward strategic goals. The president, provost, and other appropriate leaders should schedule regular updates on progress. They should also provide guidance and support when needed and periodically review resources, safeguarding the time and effort needed for broad implementation.

ESSENTIAL ACTION 2
Establish leadership team.

Steps:

Identify members for the leadership team.

The leadership team should be assembled with the purpose of representing campus stakeholder groups and with consideration for the different tasks and the challenges that the team might face. Every institution needs to consider the right composition for the leadership team.

Recommended leadership team members include:

- An administrator with the authority to support the work across the institution
- Mathematics faculty representing gateway courses and developmental programs
- Directors of advising
- Staff directly responsible for the first-year experience of students (e.g., tutoring center staff)

Additional team members to consider:

- Institutional researchers
- Registrars
- Faculty of partner disciplines

The leadership team does not have to be newly created; an existing team overseeing college-wide initiatives, such as Achieving the Dream, could take responsibility for implementing mathematics pathways. Using an existing team builds on current structures, making it more likely that the work will be coordinated with other systemic improvement efforts. Care should be taken to ensure that mathematics pathways are not absorbed or diluted by other initiatives.

Over time, members of the leadership team may change. Good planning, documentation, and communication across the institution help ensure smooth transitions and bring new members up to speed quickly.

Set a charge, and clarify roles and responsibilities for each member.

The leadership team is composed of representatives from different stakeholder groups, and individual members have specific roles and responsibilities. The team will be more efficient when all members are clear about their own responsibilities within the regular team meetings as well as what they will manage outside of meetings. Such efficiency requires that a charge must first be established, defining the purpose and authority of the team as a whole. Second, the roles and responsibilities of the team members need to be defined. Some roles are based on areas of expertise. For example, a faculty member may be asked to represent the interests and concerns of adjunct faculty. Other roles are based on the functions within the leadership team. Common roles include facilitators, managers of information, and communicators.

Facilitators provide leadership to make steady progress. They monitor work plans and timelines, and keep the work moving forward between team meetings. Facilitators develop meeting agendas and ensure that the team focuses on agenda topics.

Managers of information keep a record of what occurs during meetings, including key ideas, decisions, and assignments.

Communicators ensure that team members are following the team's communication and engagement plan. They also may manage logistics for meetings (e.g., invitations, meetings, meals).

Schedule regular meetings.

Depending on the size and reach of the institution, biweekly or monthly meetings are required. As the implementation begins and progresses through the stages, bimonthly or even quarterly meetings may suffice. Regardless of their regularity, leadership team meetings should be planned from the beginning to ensure that all members can attend all of the meetings.

Ensure that leadership team members understand mathematics pathways and how the pathways align to institutional mission, goals, and strategic plan.

Like key administrators, leadership team members must appreciate the rationale and institutional need for a transition to mathematics pathways. In communication with their different stakeholder groups, team members should convey clear connections between pathways and the institutional mission, goals, and strategic plan.

Determine processes for making and documenting decisions.

> A defined decision-making process reiterates the importance of having diverse stakeholders involved in math pathways implementation.

Clear and unambiguous guidelines for making decisions will benefit the leadership team and the institution as both engage in transformative change. An institution may have advice to the leadership team about decision making. If not, the book *Crucial Conversations: Tools for Talking When Stakes Are High* (2012) may be helpful. Patterson, Grenny, McMillan, and Switzler offer four methods of decision making:

1. Command: Decisions are made by one person without discussion.
2. Consult: Decisions are made after gaining information from others.
3. Consensus: Decisions are made after extensive involvement from all and there is agreement.
4. Vote: Every member has a vote and a predetermined threshold is reached.

Recall that the leadership team is responsible for managing information flow. Team decisions should be recorded and clearly communicated to the different stakeholder groups identified in the communication and engagement plan.

NOTES

ESSENTIAL ACTION 3

Plan for communication and engagement over time.

Steps:

Create and revisit a plan for communication and engagement.

Needs for communication and engagement evolve over time, so it is most effective to plan two to three months in advance and then to revisit the plan. A plan includes goals (what needs to be communicated), the audience (who), strategies (how), and a timeline (when).

Gather input to improve communication and engagement quality.

Responses from brief faculty and staff surveys can give the leadership team important information about communication and engagement practices. By periodically polling faculty and staff, the leadership team learns the degree to which current practices are effective, discovers how the transition to mathematics pathways affects stakeholders, and understands the adequacy of engagement strategies.

The leadership team may find it helpful to understand the Stages of Concern, one of the components of the Concerns-Based Adoption Model (CBAM) developed by researchers at The University of Texas at Austin (Hall & Hord, 2015). CBAM highlights the importance of attending to the human aspect of change. The Stages of Concern addresses the affective side of change, describing predictable concerns that stakeholders will have so that leadership teams can plan actions to address them accordingly. The seven stages of concern are described in more detail in Essential Action 6.

Build capacity for implementing and sustaining the pathways over time.

Professional learning is fundamental for long-term sustainability of mathematics pathways. Many institutions can provide the support needed through their centers for teaching and learning. Other institutions may choose to collaborate with neighboring campuses. Professional learning should not be limited to faculty. Administrators, advisors, tutors, and other staff may need support to prepare for their roles in mathematics pathways.

Regardless of the structure, the leadership team must plan to provide resources—both time and financial—for faculty and staff to engage in professional learning. Best practices to foster professional growth in higher education include:

- Investing in professional learning opportunities that encourage faculty and staff to learn and grow together. One-time workshops and individual conference attendance rarely contribute to systemic changes.
- Providing assistance to faculty members who are adopting new pedagogical approaches. Learning new instructional practices requires time to practice, reflect, and adjust.
- Building relationships with neighboring and like institutions, as these relationships offer faculty and staff the opportunity to learn by engaging with others. Also, making connections with math and state associations dedicated to mathematics pathways can offer opportunities for professional learning.

Build depth of leadership across multiple stakeholder groups.

Systemic changes such as using mathematics pathways require depth of understanding across numerous stakeholder groups. Having depth within each group is equally important. Personnel transitions are the norm, and the more an institution prepares for such transitions, the more prepared team members will be to weather inevitable staff changes. Depth also helps spread the work and avoid burnout and fatigue. Leaders in the implementation work should actively recruit and mentor others through shadowing, delegating tasks, and providing learning opportunities.

Over time, membership of the leadership team also will change. Scheduling routine team modifications ensures that knowledge and training are spread within the different stakeholder groups represented on the team. Good planning, documentation, and communication help to ease these team transitions and can help new members become informed and prepared to work quickly.

STAGE 2: PLANNING

Understanding the current context and mapping all that needs to be done

Planning for mathematics pathways is a multifaceted endeavor. The leadership team must collect and review existing data, identify the problems that mathematics pathways will solve, define goals, and create a plan to meet the goals.

Resources to support each action are listed at the end of this document and are located on the DCMP resource site (dcmathpathways.org).

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ESSENTIAL ACTION 4

Gather and review information on the current institutional context.

Steps:

Review institutional student data at both the gateway and developmental levels.

The data collected during this stage give the leadership team a snapshot of enrollment, retention, and completion patterns in mathematics courses. Key data points are identified in the sample Student Data spreadsheet, including number and percentage of students enrolled in developmental math and who completed an entry-level course by term and course. The team member representing the institutional research office is instrumental in leading this effort. Other team members should be assigned to collect specific data and give guidance to avoid wasted time gathering unhelpful information.

Data can help the leadership team answer relevant questions about enrollment, retention, and completion in mathematics courses. Examples of common questions include:

- What trends exist in success and failure rates in gateway and developmental mathematics courses?
- What is the distribution of student enrollment across gateway math courses?
- What progress is there through the calculus preparation sequence? How many students who begin in developmental math courses progress to calculus? How many students who begin in college algebra enroll or succeed in calculus?
- What are the transfer patterns of the institution? What institutions are students coming from (e.g., local school districts, other colleges) or going to (e.g., four-year institutions)? What programs have the highest rates of transfer in or out of the institution?
- To what extent do math courses contribute to the excessive number of transfer credits that students accumulate?

With a focus question to guide the discussion, leadership team members can consider the following:

1. What stands out to us? Does anything surprise us?
2. What trends do we see? Are there any outliers?
3. What contributes to the trends and/or outliers? Are these trends and/or outliers indicators of a problem? If so, what is the problem?
4. Do we have enough evidence to define a problem? If not, what other data do we need?

The leadership team should summarize its findings, including the data collected and observations about the data, in a brief report to be shared with the campus community. Remember: Keeping the college community informed is critical to any successful systemic improvement effort.

Define the problem.

With valuable information in hand, the leadership team can come to a common understanding about the current context, define the problem, identify drivers that contribute to the problem, and consider challenges to implementing mathematics pathways. This common

understanding helps the team to focus its efforts and better align on the actions needed to solve the problem.

When defining the problem, the leadership team needs to return to DCMP principles 1 and 2. The problem should address the degree to which students, regardless of college readiness, are directly enrolling in mathematics courses that align with their programs of study and the degree to which students complete their first college-level math course in their first year of college.

> DCMP principles 1 and 2 address the need for institutions to implement structural and policy changes quickly and broadly.

Identify enabling and limiting structures in relevant state policies and regional institutions.

The leadership team should surface questions and assumptions about state policies, and verify that they have complete and correct information. These policies may include information about K–16 alignments. For example, community colleges may want to verify math requirements at transfer institutions, and universities may want to gather information on pathways offered at feeder institutions.

Ideally, mathematics pathways are enabled by coordinated action across the state, institution, and classroom. In states working with the Dana Center Mathematics Pathways, the effort to implement mathematics pathways begins with a state-level task force that lays a foundation for institutions to implement pathways by developing a state-level vision and identifying changes needed in policy and practice. Other states have used different strategies. In any case, the leadership team should understand any state or regional work being done on math pathways or related initiatives, such as guided pathways or placement reforms.

Identify enabling and limiting structures at the institutional level.

Understanding the current context also includes understanding the structures, practices, and policies that could be affected when implementing mathematics pathways at individual institutions. For example, an institution may rely heavily on adjunct professors, requiring the team to think more creatively about how information will be shared or what structures may need to be put in place for professional learning.

Gather supporting information, including research, effective practices, and advice from experts and other practitioners.

A transition to mathematics pathways requires changes that affect curriculum, instruction, faculty credentialing, and course scheduling. Leadership team members can access a variety of resources on the DCMP resource site to increase their understanding about these and other issues.

ESSENTIAL ACTION 5
Define goals.

Steps:

Determine which pathways are needed.

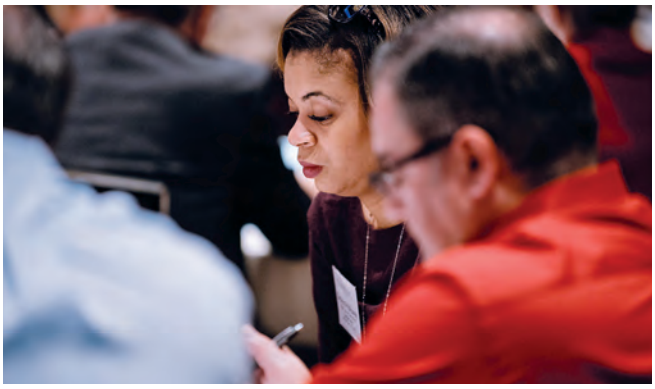
The leadership team defines what mathematics pathways are needed at its institution. If there is a statewide or regional effort to establish pathways, it is likely that the pathways have been defined.

At this point, there may still be many unknowns. Do not allow uncertainties to prevent thinking broadly. Determine what information can be obtained quickly and move forward. For example, an institution may need a pathway leading to calculus, a quantitative reasoning pathway, and a technical mathematics pathway, but there is uncertainty about getting sufficient numbers to justify a full statistics pathway. Determining the answer to this question may require learning about statistics pathways at other institutions or facilitating discussions with individual partner disciplines and transfer partners. In such a case, it is appropriate to move forward by implementing the three known math pathways and include statistics as a tentative pathway pending further research.

Set a vision and goals for scaling mathematics pathways.

Setting a vision for scaling signals a transformation and communicates an institution's collective transition to a new normative practice. The leadership team uses the information gathered and reviewed in Essential Action 4 to help the campus community develop a shared view and general understanding of what mathematics pathways means and what the institutional goals will be. Faculty and staff should start to see what the pathways will look like when implemented and have an idea about how the changes will benefit students and affect themselves. The initial goals may be based on imperfect information, especially in terms of alignment of the pathways to programs of study. At first, the leadership makes its best prediction of how programs will align over time, which will help estimate how many students will be in each pathway. These estimates will be revised as the work of alignment begins.

Although the team may wonder if it should delay setting goals for scale until there is more information about alignment, we strongly recommend not



delaying. Most faculty and staff are unfamiliar with what it means to establish a new normative practice. Explicit information about what the "new norm" will look like helps everyone understand the breadth and depth of the work and how they need to prepare.

Include occasions for stakeholders to review the vision and goals to ensure that they clearly articulate the team's intentions. Reviewers can use the questions below to guide them:

1. If applicable, are the goals meeting institutional commitments for state-level action towards mathematics pathways implementation?
2. Are the statements clear and precise?
3. Will the goals serve students well?
4. Are the goals ambitious but reasonable?

Create a high-level strategic plan to meet the scaling goals.

The final step for Essential Action 5 is to create a plan for scaling the institution's goals. We recommend making a long-term plan for 3 to 5 years with high-level action steps and milestones. A more detailed plan for each year is addressed in Essential Action 6.

When developing a strategic plan, keep in mind these critical issues:

- Design with the end in mind.
- Find ways to actively engage stakeholders.
- Use multiple avenues to communicate the plan.
- Consider implementing at full scale rather than incrementally.

ESSENTIAL ACTION 6
Create implementation plan.

Steps:

Revisit the communication and engagement plan from Essential Action 3.

It may be a good time at this point of the process to consider new goals for communication and engagement. Consider how the team will share information about the planning process up to this point, seek input on the implementation plan, and help individuals and departments understand their roles in the finalized plan. There likely will be a need to broaden communications and engagement during implementation as the work will expand to include more faculty from multiple disciplines, advisors, and other student services staff.

Identify course structures that will allow underprepared students to move to and through gateway courses as quickly as possible.

Research demonstrates the negative impact of long course sequences for students (Bailey, Jeong, & Cho, 2009). Acceleration—reducing the time it takes for students to enroll in and complete a college-level math course—underlies the DCMP model. As previously noted, promising evidence suggests that many more students can succeed in college-level courses when provided with adequate support (Complete College America, 2016).

> When using a multi-term sequence, create conditions that actively encourage students to enroll in successive semesters, which increase their likelihood of success.

The Dana Center recommends consideration of two possible structures for acceleration: a one-semester co-requisite model and a one-year aligned course sequence. The one-semester model includes a college-level mathematics course paired with learning support such as an online tutorial, additional hours of instruction, or mandatory tutorial labs to address any gaps in knowledge and skills. One-year models allow students to complete a college-level course within one year through a sequence of two courses. The first course may be designated as developmental, but it is designed to introduce students to college-level material with appropriate supports and is aligned to the second course. In any multi-term sequence, it is essential to integrate structures to support continuous enrollment to minimize attrition over the two terms.

Regardless of the structure, the leadership team should pursue acceleration models that enable students to complete a credit-bearing math course within their first year at the institution. The team should also consider how both models will affect parameters for scheduling classes.

Identify faculty and staff needs to prepare for implementation.

Full-scale implementation of mathematics pathways will depend on broad expertise and involvement of faculty and staff. The leadership team should plan strategically and build capacity for implementation. The team should seek opportunities for faculty and staff to attend training sessions or establish institution-based training in collaboration with others in the region. Additionally, the leadership team can seek counsel from institutions that are further along in their implementation.

Keep in mind that the pathways identified for specific programs of study may require a change in the types of courses that faculty will teach. For example, a greater emphasis on statistics courses may require new certification for existing faculty or indicate the need to hire new staff. The leadership team should think about the professional learning required for faculty and staff, including making appropriate provisions for adjunct faculty.

Create a detailed plan for the first year of implementation.

A detailed plan for implementation will include the following information:

- Clear Targets: What milestones are required to meet year-one goals?
- Data Collection: What data will you collect? Who will be responsible for collecting it? By when?
- Deliverables: What needs to be developed?
- Check-ins: When will you review data and note progress?
- Adjustments: How will you decide what adjustments to make?
- Communications: When will you communicate progress and celebrate success? How will this information be disseminated?

As suggested with the goals, identify stakeholders who can provide thoughtful feedback on the implementation plan.

From the start, the leadership team should plan for how it will monitor progress and celebrate success. The plan to monitor progress may include questions of effect, impact based on demographic variables, completion, and persistence. The leadership team can work with the institutional research office to determine which data will answer identified questions and the appropriate analysis processes to use. Foremost, data collection and analysis should inform future decisions, which are communicated regularly through multiple channels to the different stakeholder groups.

Celebrating success is crucial—it gives the leadership team and all involved in implementation an opportunity to acknowledge wins based on data. Moreover, reflection highlights openings and barriers to success, which can be further explored or addressed as implementation continues. Sample questions to guide celebrations include:

1. What did we accomplish?
2. What helped our progress?
3. What interfered with our progress?

Anticipate and plan for the implications of change.

Many institutions have great intentions when implementing a change, particularly one designed to improve student outcomes. However well-intended the change may be, it will affect those charged with implementing that change. For many, it is not the change itself that can be unsettling; rather, it is the implications of that change on those responsible for implementing it that creates havoc. If leadership team members anticipate that some stakeholders will view mathematics pathways as a welcome change while others may be skeptical or even resist it, they can plan accordingly.

The Stages of Concern, which was introduced in Essential Action 3, refers to what someone may be thinking about or questioning about change; it does not imply that the concern is negative (Hall & Hord, 2015). There are seven stages of concern that fall into four dimensions.

Stages of Concern

DIMENSION 1

Unrelated/Unconcerned — not connected with the change

1. **Awareness:** little concern or involvement with the change

DIMENSION 2 — SELF

Concerns focus on wanting to know more about the change

2. **Informational:** general awareness about and interest in the change but not worried about self
3. **Personal:** uncertain about demands of the change and the ability to meet the demands

DIMENSION 3 — TASK

Concerns are about final preparation to engage in the change and early use

4. **Management:** attention on the processes and tasks of the change

DIMENSION 4 — IMPACT

Concerns focus on what is happening with students and how implementers can be more effective

5. **Consequence:** attention on what impact the change is having on students
6. **Collaboration:** focus on how to collaborate with others to be more effective
7. **Refocus:** focus on ways to maximize benefits

(Source: Hall & Hord, 2015)

Understand and cultivate a positive institutional culture.

Understanding the current context includes being familiar with the cultural aspects of the institution. For example, the leadership team will benefit from knowing how individuals and departments work together, what information is known by different stakeholder groups, and what the attitudes are about change. In addition, institutional culture is affected by communication, collaboration, trust, and engagement. The importance of communication and engagement has been discussed in this guide. Trust is defined as a mutual understanding about the goodwill of others and the confidence that others will do no harm, will do what they say they will do, and have the knowledge and skills to do what is asked of them (Henkin & Dee, 2001; Tschannen-Moran, 2004). Trust is essential to a positive culture. Likewise, the more that collaboration—faculty and staff working together on issues related to teaching and learning, and sharing ideas about instruction—is an institutional norm, the more positive the culture will be.

ESSENTIAL ACTION 7
Align math pathways.

Steps:

Map all programs of study to a single default math requirement that identifies clear and predictable transfer and applicability of math courses.

It is important to establish a single default or recommended pathway for each program. The most effective way to do this is to group programs into broad meta-majors that will help students make early decisions about general goals. We strongly recommend a single default rather than allow students to select from a number of general education courses. Program faculty should give explicit direction about the most appropriate course. Structures can be designed to allow students to use other options if appropriate.

> Establishing a default pathway enables students to make adequate progress. Your work setting the vision should highlight the most appropriate default pathway.

The Guide to Aligning Mathematics Pathways to Programs of Study provides the leadership team step-by-step instructions to align mathematics pathways to programs of study. This process takes time. The guide helps prioritize early actions to maximize impact. *The Sample Math Pathways List* shows how different institutions aligned mathematics pathways with programs of study and offers examples of how programs might be grouped.

NOTES

STAGE 3: IMPLEMENTING

Putting the plan into action

The next stage, *Implementing*, is about engaging in activities outlined in the implementation plan with oversight from the leadership team. The normative practices that emerge from the plan carry out the institution's goals of students' taking and completing their first college-level mathematics course for their programs of study within one year. This is no small feat, as transformative change will require myriad changes across the institution. Consistent communication is necessary for faculty, staff, and students to ensure that clear guidance is provided.

Resources to support each action are listed at the end of this document and are located on the DCMP resource site (dcmathpathways.org).

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Staff (e.g., advisors, institutional researchers)	✓		

ESSENTIAL ACTION 8
Design courses.

Steps:

Define gateway courses and learning outcomes.

Any institutional work first needs to be informed by state-level course learning outcomes or other requirements to ensure that courses are transferable. In states in which this is applicable, these state-level requirements set a broad outline for courses, which can be further defined by local faculty.

So far, faculty from major programs of study have assisted mathematics pathways implementation by: a) defining mathematics skills needed for different programs of study (Essential Action 4), which helped the institution define which math pathways were needed at the institution (Essential Action 5), and b) establishing a default mathematics course in alignment with different programs of study (Essential Action 7).

In this action, the leadership team can establish teams comprised of gateway mathematics faculty and faculty from major programs of study to review materials appropriate to a program. For example, health sciences faculty could be included in reviewing statistical reasoning courses. These teams will gather resources to define the content of math pathways courses. Sources of information may include state learning outcomes and requirements, examples of courses from other states and institutions, recommendations from math associations, and information from client disciplines.

Backward map to define mathematical and academic needs of underprepared students.

To support students who are underprepared for college-level math courses, the leadership team needs to backward map learning outcomes from the readiness

competencies of each college-level course. Gateway math faculty members should complete this work. Content for courses should be selected based on the math skills needed to be successful in the college-level course. Keep in mind that readiness competencies should not be considered prerequisite skills or a barrier to enrollment. Supplemental supports can enable students to complete these courses successfully.

> It is easy to rely on a few enthusiastic individuals to start a major change effort. However, long-term sustainability requires a broad spectrum of involvement.

Align student support services to help students in redesigned curriculum and instruction.

The leadership team should plan for how students will receive academic support, such as tutoring. Because the math courses will contain different content and use a different instructional model than traditional math courses, the resources that are traditionally available to students may need realignment. Inform and train tutors so that their understanding of math and instruction is specific to the new courses, and consider technology and other resources that may support students.

Ensure adequate faculty capacity and provide professional learning.

Sustaining mathematics pathways at scale requires a deep pool of faculty to teach the courses and to serve as leaders and mentors. Many innovations fail or discontinue because they are dependent on a few individuals who cannot sustain or grow the work over time. By providing ongoing professional learning and other resources for faculty and staff, high-level administrators and the leadership team signal their commitment to mathematics pathways.

To build faculty capacity for teaching new courses, consider these strategies:

- Identify faculty needs through surveys, focus groups, or interviews.
- Send faculty and staff to training sessions about mathematics pathways, or establish local training or discussion forums.
- Encourage connections with faculty and advisors at other institutions, particularly those nearby with whom your institution may share transfer partners.
- Provide opportunities for staff to work together to explore relevant topics through study groups.

Faculty will benefit from release time to engage in these activities. Consider reallocating institutional resources or seeking new funding to support this learning.

ESSENTIAL ACTION 9

Establish processes and structures for student enrollment.

Steps:

Engage academic advisors and counselors.

The success of mathematics pathways depends significantly on advising. Advisors play a critical role in supporting student success and completion. They are the committed, expert ambassadors for students regarding the processes and offerings of the institution. Because students often are overwhelmed by choices and are not aware of the implications of their choices, many rely on their advisors' guidance. Therefore, ensure that advisors understand the reasons for the mathematics pathways and how pathways benefit students.

We also know that advisors work in an environment of large caseloads, diverse student needs, constant institutional redesign, and regular turnover. Include this important stakeholder group in each stage of the implementation process. This ensures that they are apprised of the rigor embedded in all of the courses, the applicability of the courses to students' programs of study, and transferability of the courses to other institutions.

The leadership team may find it helpful to work with advisors to develop scripts and other communication tools for front-line advising staff and to help describe mathematics pathways to students and parents in a way that makes sense. Advisors can create simple diagrams to define appropriate pathways for students based on their areas of interest or desired programs of study. They can also develop information for students who self-advise through the campus website or receive guidance from special programs and peers.

Ensure appropriate, transparent advising structures and practices that help students identify appropriate pathways.

> Consider a non-algebraic pathway for undeclared students.

One of the primary goals of mathematics pathways is to help students prepare for and meet their academic and career goals. It is essential that those goals be the sole determinant of which math pathway is appropriate for each student. Students who are underprepared should receive the necessary support to succeed within the pathway.

A pathways approach, however, raises the challenge of advising students who have not declared a major.

Advising departments should establish protocols for advising these students by determining their broad academic and professional interests. A full, guided pathways structure is most effective, as students can select from a small number of broad meta-majors. The default pathway for undecided students should be one of the non-algebraically intensive options, such as statistics or quantitative reasoning, because data show that more students are in programs that need these math courses (Burdman, 2015).

It is also important to give attention to the use of student-friendly language in describing the pathways both in terms of structure and content. Good advising materials and practices help students understand why they are taking certain courses and how those courses will be of value to them—this is especially true in mathematics because many students enter college with negative past experiences in math. Advising that helps students understand how a math course or sequence of courses fits into their programs and how they will be supported help build their confidence and motivation.

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STAGE 4: CONTINUOUS IMPROVEMENT

Assessing progress and making changes to ensure goal fulfillment

The last stage of the implementation process is *Continuous Improvement.* A key to successful implementation is a robust evaluation plan. When the leadership team is clear about the current status of implementation through a well-planned monitoring process, it can make adjustments for improvement and create structures that will ensure that mathematics pathways are sustained over time.

Failing to monitor and evaluate progress can lead to two problems: poor or inconsistent student outcomes and a failure to scale. A good evaluation plan and monitoring process help identify and address problems quickly. They also provide opportunities for updates and discussions that keep the work visible.

The monitoring incorporates two types of evaluation. Formative evaluation takes place regularly during an implementation cycle and creates opportunities to capture in-the-moment information about what is working well and allow for adjustments when necessary. Cumulative evaluation occurs at the end of an implementation cycle and focuses on whether key outcomes have been met. The next iteration of an implementation plan is developed as part of this process.

Communication and engagement continue to be important to keep the institutional community informed of progress and any changes as the work evolves.

Resources to support each action are listed at the end of this document and are located on the DCMP resource site (dcmathpathways.org).

Level of Involvement from Stakeholder Groups

Stakeholder Group	Level of Involvement		
	HIGH	MEDIUM	LOW
High-Level Administrators (e.g., presidents, provosts, vice presidents)		✓	
Departmental Leadership (e.g., deans, departments heads)		✓	
Faculty (e.g., mathematics faculty, developmental education faculty, partner-discipline faculty)		✓	
Staff (e.g., advisors, institutional researchers)		✓	

ESSENTIAL ACTION 10
Monitor the implementation progress.

Steps:

For formal evaluation, review the implementation plan created in Essential Action 6.

Systematic use of data-driven discussions supports the institution and its leadership team in understanding the nuances of progress with the systemic change to mathematics pathways. The team is more likely to monitor and adjust the implementation process if the team plans for it. The implementation plan includes clear targets, data collection, and scheduled check-ins.

Make decisions about needed adjustments and implement them.

With a clear picture about where a given institution is in its implementation of math pathways, the leadership team can make decisions about adjustments if the implementation is not going as planned. The following questions may assist the leadership team to reach conclusions about possible adjustments.

- What is working well and what can we learn from these successes? Do we need to modify our implementation plan?
- Do we need to provide more professional learning opportunities for faculty and staff?
- Do we need to provide more or different resources?
- Do we need to do something different to help faculty and staff manage the change?

Answers to these questions may signal to the leadership team that adjustments are necessary to enhance support for mathematics pathways implementation. For example, there may have been insufficient sections to accommodate the number of students who registered for the statistics course. The leadership team can take the actions needed to add the necessary sections; alternatively, the team might decide to share data and findings to faculty and staff to solicit their input on possible adjustments. Data may suggest that some faculty are relying on past instructional practices rather than using those recommended. In this case, the leadership team could take the information directly to faculty and staff, and ask for their guidance on how to better support them with the instructional changes.

Stages of Implementation

As the team checks in periodically to assess implementation progress, it might be helpful to use a planning tool to align actions. The leadership team is charged with communicating expectations, monitoring progress, making suggestions about adjustments, and ensuring that implementation is supporting collaborative learning across the different stakeholder groups.

Keep in mind that meetings to review data and to make decisions about adjustments do not have to take a lot of time. A structured agenda with clear time allotments can help the team stay focused on the task at hand.

Monitor the effect of implementation on implementers.

Remember that major changes affect all involved, and implementation can be successful if the effect on faculty and staff is monitored. One strategy to consider is using a transition monitoring team (Bridges, 2009). Keeping abreast of the impact of a change is difficult to do, and this task can be especially challenging for those in leadership positions. A transition monitoring team comprised of members from the campus community who have influence with their colleagues can help improve communication to and from the leadership team.

Creating a transition monitoring team lets the community know that the leadership team is interested in receiving feedback. The transition monitoring team can also review information that the leadership team intends to share to identify any potential problems and can serve as another avenue to reduce miscommunication.

Keep in mind that a certain amount of anxiety and frustration is inevitable in a change process. Overresponding and not allowing people to work through their reactions can be counterproductive. Understanding the Stages of Concern referenced earlier can help determine if faculty and staff are progressing through normal stages or are getting stuck in unproductive patterns.

For cumulative evaluation, review goals created in Essential Action 5.

Determine if the goals are still correct. As implementation progresses and the context evolves, the leadership team may need to revise the goals. Reviewing the goals is essential to continuous improvement.

Collect and review data on outcomes.

A critical review of data will help you determine if you are making adequate progress toward your goals.

Create or refine the plan for the next implementation cycle.

Ideally, the team evaluates the first implementation cycle before planning for the next, but this may not be realistic given the lag in collecting outcome data and the demands of the academic calendar. It is very possible that the team will have to draft a plan for the upcoming cycle based on formative evaluation and then revise as necessary after reviewing outcome data.

Revisit the communication and engagement plan from Essential Action 3 to build broad understanding of the cumulative evaluation and future plans.

Transparency is critical to building a sense of ownership among stakeholders. It is not enough to simply disseminate the evaluation results. Faculty and staff should understand the process and how the evaluation results are used to refine goals and improve implementation. Find ways in which people can give meaningful input.

Celebrate success.

Systemic change can be challenging, and it is easy to become too focused on the work that we forget to stop and celebrate successes. Public celebrations highlight the commitment to mathematics pathways and the importance that the move toward this normative practice plays in the success of students. The leadership team can brainstorm on what should be celebrated and ways to celebrate throughout the implementation process.

Celebrating success and honoring those who have contributed to the success are an important part of sustaining individual commitment. They also cycle back to Essential Action 1 by communicating the institutional commitment to full implementation of mathematics pathways. Refer to steps in Essential Action 1 that connect the work to the overall mission and strategic plan of the institution.

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Downloadable Resources

The resources noted below can be found on the DCMP resource site (dcmathpathways.org), which provides an extensive overview of the Dana Center's mathematics pathways model and associated institutional and classroom activities. It offers a collection of valuable resources for faculty, institutional leadership, partner disciplines, and advisor/coordinators.

Essential Action 1
Communicate and maintain institutional commitment.

- The Case for Mathematics Pathways

Essential Action 2
Establish leadership team.

- Recommendations for Leadership Team Membership – Implementation Guide
- Effective Meeting Checklist

Essential Action 3
Plan for communication and engagement over time.

- Effective Strategies and Messaging for Communication and Engagement

Essential Action 4
Gather and review information on the current institutional context.

- Facilitating Data-Driven Discussions
- Student Data Spreadsheet – Implementation Guide

Essential Action 5
Define goals.

- A Guide for Setting Goals
- Setting Goals for Scale Tool
- Elements of Math Pathways Design

Essential Action 6
Create implementation plan.

- Institutional Action Plan

Essential Action 7
Align math pathways.

- Guide to Aligning Mathematics to Programs of Study
- Guide to Aligning Mathematics to Programs of Study – Template
- Sample Math Pathways List

Essential Action 8
Design courses.

- Mathematics Prerequisites for Success in Introductory Statistics
- Defining the Content: Content Backmapping Template

Essential Action 9
Establish processes and structures for student enrollment.

- Advising and Multiple Math Pathways Video
- Victoria College (TX), Student Math Pathways Resource

Essential Action 10
Monitor the implementation progress.

- Supporting Implementation – Implementation Guide

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About the Charles A. Dana Center at The University of Texas at Austin

The Dana Center develops and scales education innovations to support educators, administrators, and policymakers in creating seamless transitions throughout the K–14 system for all students, especially those who have historically been underserved. We focus in particular on strategies for improving student engagement, motivation, persistence, and achievement.

We help local systems adapt promising research to meet their needs, and we develop innovative resources and tools that are implemented through multiple channels, from the highly local and personal to the regional and national. We provide long-term technical assistance, collaborate with partners at all levels of the education system, and advise community colleges and states.

The Center was founded in 1991 at The University of Texas at Austin. Our staff members have expertise in leadership, literacy, research, program evaluation, mathematics and science education, policy and systemic reform, and services to high-need populations. We have worked with states and education systems throughout Texas and across the country. For more information about our programs and resources, see www.utdanacenter.org.

About the Dana Center Mathematics Pathways (DCMP)

The Dana Center Mathematics Pathways (DCMP) is a systemic approach to dramatically increasing the number of students who complete math coursework aligned with their chosen program of study and who successfully achieve their postsecondary goals. The DCMP was initially launched as the New Mathways Project (NMP) in 2012 through a joint enterprise with the Texas Association of Community Colleges.

For more information about the Dana Center Mathematics Pathways, see http://www.dcmathpathways.org.

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