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Whole-College Reforms in Community Colleges: Guided Pathways Practices and Early Academic Success in Three States

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Abstract

The guided pathways model, comprising 14 different practices, is a framework for comprehensive, whole-college reform undertaken by community colleges to help all students choose, enter, progress through, and complete a program of study that enables them to secure sustaining-wage employment or transfer with junior standing in a major. Since its introduction in 2015, it has been adopted by hundreds of community colleges across the United States. This paper asks whether guided pathways practices implemented at 62 community and technical colleges in three states—Tennessee, Ohio, and Washington—are associated with improvements in student outcomes during the first year of college. Specifically, using institutional survey and rich administrative data, we construct measures of adoption of guided pathways reforms to examine the association between guided pathways practices and fall-to-fall persistence, college credits earned, college math credits earned, and STEM credits earned.

Our study reveals substantial variation in the adoption of guided pathways reforms across the states and across community colleges within the states over time. While we cannot establish a causal relationship between guided pathways adoption and student outcomes, we find significant positive associations between the statewide adoption of guided pathways reforms and early student outcomes in Tennessee. The observed improvements in that state are likely the result of concurrent reforms—guided pathways and others—implemented simultaneously, rather than of guided pathways reforms alone. We do not find evidence of improved student outcomes in either Ohio or Washington following the launch of statewide guided pathways initiatives. Our findings suggest that complementarities among adopted practices within and across areas of practice—rather than the adoption of individual practices or the intensity of adoption—seem to drive larger improvements in early academic success across the three states. Our study is the first of its kind to explore the potential of guided pathways reforms in contributing to improved early academic success, representing a significant descriptive contribution given that whole-college reforms in higher education are understudied.

Table of Contents

1. Introduction

Community colleges play a crucial role in promoting educational equity, as they enroll a disproportionate number of low-income, racially minoritized, first-generation, immigrant, and older students. At the same time, community colleges face significant threats, such as declining enrollment numbers, intensified competition from other institutions, evolving student expectations, and a tightening labor market (Brock et al., in press). The COVID-19 pandemic further exacerbated these challenges, leading to a sharp decline in enrollments, particularly among Black and Indigenous students and male students. Community colleges also struggle with persistently low graduation rates: Only 31.9% of students earn a certificate or degree at the community college they started at; another 11.5% earn a credential from another institution. Moreover, there are troubling gaps in rates of persistence and completion by race/ethnicity within community colleges (Causey et al., 2020; National Center for Clearinghouse Research Center, 2023).

Over the last two decades, community colleges have undertaken various reforms to improve student success and educational equity (Brock et al., in press). Many colleges have adopted new approaches to developmental education and student advising, for example, and rigorous evaluations using randomized controlled trials have shown positive effects of interventions—such as multiple measures assessment, corequisite remediation, and comprehensive advising that provides academic and nonacademic supports—on college credits completed, persistence, and other outcomes (Bickerstaff et al., 2022; Karp et al., 2021). Perhaps the best-known study is of the City University of New York's Accelerated Study in Associate Programs (ASAP), a multi-faceted intervention that includes enhanced student support services, financial supports, and structured course enrollment. Rigorous evaluations of ASAP in New York and Ohio found large, positive effects on degree receipt (Miller & Weiss, 2021). These and other studies have clearly demonstrated that changes in college practices can improve student outcomes, but most of the interventions examined have affected relatively few students. An ongoing challenge for community colleges is how to undertake reforms that lead to better outcomes *at scale* for the millions of students these institutions enroll each year.

In recent years, guided pathways reforms have emerged as a widely embraced model for community colleges across the nation, with approximately 400 out of over 900 community colleges in total participating in national or statewide initiatives to implement them (CCRC, 2021). Unlike most educational interventions, guided pathways is a whole-college reform model that is intended to improve the educational experience of every student enrolled at a college throughout their time at the college. It involves changes to program design, to career and academic advising and other student supports, to course scheduling, and to teaching and learning. It is not a discrete intervention. Rather, it offers colleges a customizable framework to follow in redesigning college practice in four broad areas: (1) clarifying paths to student end goals, (2) helping students get on a path, (3) helping students stay on a path, and (4) ensuring that students are learning. Community colleges adopt guided pathways practices at their own pace and in varied sequences. Prior research by CCRC has found that it can take colleges 4–7 years to fully implement guided pathways practices at scale, which we define as affecting 80% or more of the students at a college (Jenkins et al., 2019).

Because guided pathways is a whole-college reform model, it does not lend itself to randomized controlled trials in which some students experience guided pathways and others experience business as usual. There have been a number of descriptive studies of guided pathways (Lahr et al., 2023; Jenkins et al., 2019; Jenkins et al., 2017a, 2017b; Klempin & Lahr, 2021a, 2021b; Konruff, 2020; Schanker, 2019; Schanker & Orians, 2018), and colleges' implementation has been recorded in case studies (Career Ladders Project, 2019; Michigan Center for Student Success, 2019; Waugh, 2016), but there is no causal evaluation to show that guided pathways "works." This paper stops short of a causal analysis, but it goes beyond previous studies by exploiting variation over time and across colleges and using multiple regression techniques to answer two key questions:

1. Is the adoption of guided pathways reforms associated with improvements in student outcomes during the first year of college?

2. Are there specific features of guided pathways reforms that are linked to better student outcomes?

To measure the scale of adoption, we conducted institutional surveys, phone interviews with college leaders, and comprehensive website analysis of all 62 community colleges in Tennessee, Ohio, and Washington—states that have sought to implement guided pathways across their community college systems.[1] Additionally, we integrated scale-of-adoption data with rich student administrative records from these states and Integrated Postsecondary Education Data System (IPEDS) data to thoroughly study the first-year experiences of successive fall cohorts of entering students at every community college from fall 2012 through fall 2020. Our primary outcomes of interest are first-year academic momentum metrics predictive of longer term outcomes (Belfield et al., 2019; Fink et al., 2021; Attewell & Monaghan, 2016).

We do not find evidence of improved student outcomes in either Ohio or Washington following statewide guided pathways initiatives. We do find significant positive associations between the statewide adoption of guided pathways reforms and early student outcomes in Tennessee, but the observed improvements in that state are likely the result of concurrent reforms—guided pathways and others—implemented simultaneously, rather than of guided pathways reforms alone. Our findings also suggest that complementarities among adopted guided pathways practices within and across areas of practice—rather than the adoption of individual practices or the intensity of adoption—seem to drive larger improvements in early academic success across the three states.

2. Understanding Guided Pathways Reform Practices

Guided pathways is a whole-college reform model aimed at helping students choose, enter, progress through, and complete community college programs that enable them to secure sustaining-wage employment or transfer with junior standing in a major. The model consists of multiple interconnected changes in practice undertaken in a coordinated manner across the college that are scaled to reach all students.

Guided pathways reforms address several organizational features typically found at community colleges that may create barriers to program entry and success. First, paths to associate degrees, employment, and baccalaureate transfer are generally not clearly mapped out for students, so even students who know which program they want to

[1] Tennessee launched its statewide guided pathways initiative in 2015; Ohio and Washington did so in 2016 and 2018, respectively.

complete may have difficulty figuring out which courses to take and in what sequence to achieve their goals (Scott-Clayton, 2015; Jaggars & Fletcher, 2014). Second, entering students are not consistently helped to explore career and education options (Deil-Amen & Rosenbaum, 2003; Karp, 2013) or to connect with faculty, students, alumni, and employers in fields of interest to them. Instead of being helped to explore a field of interest, most entering community college students are referred to remedial coursework, especially in math (Bailey et al., 2010; Rutschow et al., 2019), delaying their access to college-level courses that are critical for many programs. Third, many students are not helped to develop an educational plan, and their progress is not monitored (Center for Community College Student Engagement, 2018). Consequently, too many students meander through their studies, earning credits that do not count toward their intended credential or leaving college before earning a credential (Fink et al., 2018). Fourth, since many students take developmental education and general education survey courses in their early terms, they are not encountering engaging courses in topics of interest (ideally, in their intended program area), which research suggests improves student persistence, even in challenging fields such as STEM (Wang, 2020).

To reduce these barriers to student academic success, community colleges are redesigning their programs, student supports, and teaching approaches following the guided pathways model, which has four areas of practice:

1. *Clarifying paths to student end goals* by backward-mapping all programs to ensure they prepare students for direct entry into sustaining-wage employment and further education;
2. *Helping students get on a program path* by redesigning new student onboarding so that all students actively explore their options and interests, take program-relevant courses, connect with faculty and students in an academic and career community, and develop a full-program educational plan in their first term;
3. *Keeping students on path* by scheduling classes and monitoring students' progress based on their plans to ensure timely and affordable program completion; and

4. *Ensuring that students are learning across programs* by strengthening active and experiential learning to build students' confidence as learners and help them develop communication skills, problem-solving skills, and other competencies required to advance to sustaining-wage employment and further education.

Based on the guided pathways model used in a companion study of the scale of adoption of guided pathways reforms in the same three states (Jenkins et al., 2023), Table 1 provides a brief description of 14 discrete practices associated with the four practice areas of the guided pathways model. The use of these practices is intended to elicit changes in how students experience their academic programs of study, which we theorize may result in changes in a range of student behavior metrics, including to students' early momentum in credit accumulation and persistence.

Table 1. Guided Pathways Practices

Practice	Description
Practice Area 1. Clarifying paths to student end goals	
1a. Meta-majors	Programs organized by meta-major AND students' meta-major tracked
1b. Career and technical education (CTE) program maps	CTE programs mapped to related jobs/careers
1c. Transfer program maps	Transfer programs mapped to related majors
1d. Math pathways	Program-specific math sequences mapped
Practice Area 2. Helping students get on a program path	
2a. Meta-major exposure	Either mandatory orientation or mandatory first-year experience course AND either meta-major content or field-focused events
2b. Required career assessment and advising	Mandatory career assessment and mandatory initial advising
2c. Early program-related coursetaking	Students advised to take program foundation course in term 1
2d. Mandatory educational planning	Students helped to develop an educational plan in term 1 AND can see plan online
Practice Area 3. Keeping students on a path to completion	
3a. Mandatory ongoing advising	Mandatory advising for returning students
3b. Caseload advising by field	Caseload advising AND advisors assigned by meta-major
3c. Progress monitoring and feedback	Students helped to develop an educational plan in term 1 AND checkpoint advising or registration alerts
3d. Scheduling for on-time completion	Classes scheduled based on students' plans
Practice Area 4. Ensuring that students are learning across programs	
4a. Corequisite college math	Students placed in corequisite math AND corequisite support aligned with math subject
4b. Program foundation course improvement	Instructional improvement in program foundation courses other than math by meta-major

3. Launching Guided Pathways in Tennessee, Ohio, and Washington

Our study takes place in three states—Tennessee, Ohio, and Washington—that, through different paths, have engaged in statewide implementation of guided pathways reforms. The Tennessee Board of Regents (TBR) was the first to launch a statewide guided pathways reform initiative in 2015. It is important to recognize that guided pathways was one of several major initiatives Tennessee adopted over a several-year period, including the Complete College Tennessee Act (2010), an outcomes-based funding model (2011), Drive to 55 (2014), Tennessee Promise (2015), FOCUS Act governance (2016), and Tennessee Reconnect (2017). Collectively, these initiatives have motivated specific reforms to improve transfer and articulation, adopt corequisite remediation, make the first two years of community college free to state residents, and implement other high-impact practices (Meehan & Kent, 2020). During the 2015-16 and 2016-17 academic years, all 13 Tennessee community colleges scaled corequisite remediation in math, writing, and reading and embarked on guided pathways reforms (known as "Tennessee completion practices"). During the same period, colleges began accepting students through the Tennessee Promise program, a last-dollar tuition scholarship program for recent high school graduates.

In Ohio, the state's guided pathways initiative has been led by the Ohio Association of Community Colleges (OACC), a membership organization representing the state's 23 community colleges. Beginning in 2016, through its Student Success Center, OACC held a series of guided pathways institutes attended by teams from each of the colleges. OACC also offered colleges coaching on implementing guided pathways by practitioners from colleges that were earlier adopters of guided pathways reforms. Although the Ohio Department of Higher Education expressed support for these activities, OACC lacks the authority to enforce mandates on colleges and therefore relies heavily on voluntary participation from colleges in terms of time and resources committed to implementation of reforms and openness to coaching and other assistance provided by OACC.

The guided pathways initiative in Washington State was led by a state agency, the State Board for Community and Technical Colleges (SBCTC). The 2017 Washington legislature approved $3 million for the SBCTC to—over the course of two years—

support guided pathways reforms across the state's 34 community and technical colleges (Washington SBCTC, n.d.), making Washington one of two states (the other being California) where the state provided funding directly to colleges to adopt guided pathways reforms. College Spark Washington (CSW), a private philanthropy, also contributed $7 million to help individual colleges begin making reforms. The implementation of guided pathways began in 2018 with foundation funding allocated to 12 early-adopter colleges. The Washington pathways initiative also included regular in-person institutes attended by teams from all or at least most of the colleges. The SBCTC also supported coaches with expertise on guided pathways reforms to work with interested colleges.

4. Data Sources and Outcomes of Interest

In this study, we rely on institutional survey data to measure the adoption of guided pathways reforms and on student unit record data to assess changes over time in student outcomes. Each of these data sources and the outcomes we examine are explained below. Because CCRC developed the guided pathways framework and has provided assistance to states and colleges interested in adopting the associated practices, we also explain the steps we have taken to conduct an objective evaluation.

4.1 Institutional Surveys

Building on prior research assessing the implementation of guided pathways practices (Lahr, 2018), CCRC researchers developed the Guided Pathways Scale of Adoption (SOA) self-assessment survey to ask individual colleges about reform practices that we hypothesize are most critical in implementing guided pathways and most likely to be associated with improved student outcomes. The practices in the survey correspond to the 14 practices within the four broad practice areas ([1] clarifying paths to student end goals, [2] helping students get on a program path, [3] keeping students on a path to completion, and [4] ensuring students are learning across programs) shown in Table 1. Each survey item included a brief explanation of the practice and asked the college to estimate the percentage of students or percentage of academic programs affected by the practice. We define the threshold for wide-scale adoption of a practice as affecting at least 80% of programs or at least 80% of first-time-in-college (FTIC) credit students. Respondents at each college (a small group of college staff and faculty) were also asked to select the term and year in which the practice was first implemented at scale (see Brown et al., 2022 and Jenkins et al., 2023 for more information about the survey development and deployment). We exclude the 14th practice ([4b] adoption of teaching practices in program courses) from our analysis because the institutional survey did not include questions on the timing of implementation for this practice.[2]

In May 2022, we administered the survey to 69 community colleges in the three states and received completed questionnaires from 63 colleges, for an overall response rate of 91%.[3] We excluded one institution from the analysis,[4] resulting in a total of 62 colleges included in our analytic sample (all 13 in Tennessee, 19 in Ohio, and 30 in Washington).

We are interested in how the extent to which colleges adopt guided pathways practices at scale affects the early academic outcomes of their students. Based on the survey results, we thus count or score how many practices each college has adopted at scale (for all or nearly all new students or across all programs of study). This adoption or "intensity" score changes over time based on the year and term that practices reached wide-scale implementation at each college. We then categorize each college based on intensity of adoption of guided pathways practices, which we define as low if the college scaled 4 or fewer practices (about 30% of the guided pathways model), moderate if it scaled 5–8 practices, and high if it scaled 9–13 practices (at least 70% of the guided pathways model) by fall 2020.[5]

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[2] The lack of timing-related questions for the 14th practice in the survey stemmed from the need to gather information directly from faculty members, which was beyond the scope of this survey.

[3] Response rates were 100% in Tennessee, 94% in Ohio, and 95% in Washington.

[4] The college had adopted a new educational model involving online education to large numbers of students from outside the state.

[5] In the low-intensity adoption category (4 or fewer practices), it is important to note that four colleges classified as such did not adopt any practice at scale; rather, they adopted practices in more limited way. The threshold for wide-scale adoption of a practice is affecting at least 80% of programs or at least 80% of FTIC students. The survey captured scale levels, allowing colleges to specify whether a practice affected at least 80%, less than 80% but more than half, some but less than half, or none of their programs or students. For practices affecting less than 80%, the survey did not note the term and year of first adoption.

4.2 Student Unit Records

We supplement the institutional survey data with data from detailed administrative records from FTIC students who entered one of the 62 community colleges in the fall semester from academic year 2012-13 through 2020-21, excluding current and former dual enrollment and transfer students with prior college experience. Our administrative dataset captures the first-year experiences of successive cohorts of entering students at every community college from fall 2012 through fall 2020 and contains information on individual students, including college transcripts (e.g., courses taken, grades earned, awards received), basic personal and pre-college information (e.g., age, gender, race/ethnicity, high school GPA, recent high school graduate status), and financial aid received (Pell grant). We exclude from our analysis students with missing transcript data (which account for 0.4 % of FTIC students in Tennessee, 1.0% in Ohio, and 3.7% in Washington). The analytic sample has 171,825 students in Tennessee, 248,211 students in Ohio, and 411,766 students in Washington.

4.3 Outcomes of Interest

Our primary outcomes of interest are first-year academic momentum metrics predictive of longer term outcomes (Belfield et al., 2019; Fink et al., 2021; Attewell & Monaghan, 2016). We focus on four primary measures:

1. fall-to-fall persistence;
2. college-level credits earned in the first year;
3. college-level math credits earned in the first year, defined as the sum of those earned in algebra, trigonometry, statistics, pre-calculus, calculus, and other math courses;
4. college-level Science, Technology, Engineering and Math (STEM) credits earned in the first year, defined as the sum of credits indicated on transfer pathways earned in the first academic year in biology, physics, chemistry, earth science, engineering, and computer science.

4.4 Objectivity of the Study

CCRC's capacity to examine guided pathways reforms is strengthened by its familiarity with the practices (which emerged in large measure from CCRC research) and by its extensive engagement with many adopting community colleges with which CCRC has offered informational and technical support. Conversely, because of the organizations' relationship with the reforms and with colleges implementing them, it may be difficult for CCRC to be completely objective in evaluating guided pathways. We have taken several steps to ensure that we provide a full and straightforward accounting of guided pathways in the three states. First, the authors of this report were not involved in guided pathways prior to undertaking this research. Second, we pre-registered our study in the Registry of Efficacy and Effectiveness Studies (https://sreereg.icpsr.umich.edu/sreereg/index) in June 2022—before starting the analysis—to describe the outcomes we would measure and the methods we would use. Third, we engaged independent reviewers, including an evaluation advisory group and two experts in methodology, to advise us on our plans and provide feedback on our work.

As outlined in our pre-registration plan, we initially planned to use a Single Interrupted Time Series (SITS) design to compare community colleges against themselves pre- and post-reform, and a Comparative Interrupted Time Series (CITS) design to compare the outcomes of students enrolled in colleges with high or medium guided-pathways adoption with those enrolled in colleges that had not adopted guided pathways or those with a low scale of adoption. Unfortunately, once we examined the data on the adoption of guided pathways in the three states, it became clear that a SITS and CITS design was not feasible. Key challenges included difficulties in pinpointing the exact start of guided pathways implementation and the complexity of identifying suitable comparison colleges for the CITS design, given the widespread adoption of at least some guided pathways practices by colleges across the three states. Furthermore, external confounding events, like the introduction of the Tennessee College Promise program during the guided pathways adoption period, added complexity to our research. Therefore, we decided to explore alternative analytical approaches focusing on the association between guided pathways adoption and student outcomes. While our resulting analysis is not causal, it offers suggestive evidence on whether reforms may be working and which guided pathways practices, if any, may be contributing to improvements.

5. Empirical Approach

We use multiple regression techniques to understand the association between guided pathways reforms and early student outcomes. While it is difficult to pinpoint the start of guided pathways reforms in the three states, we first estimate how changes in early student outcomes correlate with the launch of statewide guided pathways initiatives in each state. Although this specification does not allow us to fully explore variation in the number of guided pathways practices adopted across colleges, it offers valuable insight into how the association between the overall adoption of guided pathways reforms and student outcomes evolves over time. We estimate separate regressions for each state of the following form:

$$(1) \qquad y_{ict} = \alpha_1 + \sum_{Gmin, g \neq -1}^{\neq Gma} \beta_g \, I(t = g) + X'_{ict}\delta + \alpha_c + \rho_{ct} + e_{ict}$$

where we regress student *i* outcomes at college *c* in year of cohort entry t, y_{ict}, on a vector of year indicators in year *t*. The summation term includes indicators for years prior to and after the launch of statewide guided pathways initiatives to identify changes in outcomes relative to 2015 for Tennessee, 2016 for Ohio, and 2018 for Washington (when each state launched its statewide initiative). We also include student demographic controls, X_{ict} (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate status) and fixed effects for colleges, α_c.[6] ρ_{ct} is the college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures (institutional support, student and academic support). These covariates reflect the institutional ability to invest in the adoption of guided pathways practices. Standard errors are clustered by college.

[6] The covariates used to control for student demographics varies across states based on data availability. For TN, we also include Pell Grant eligibility status; for WA, we also control for disability and being academically and economically disadvantaged at first entry.

We also estimate event-study models and compare trends in early student outcomes of moderate and high adopters with low adopters for each state. For these models, the summation term for guided pathways in equation (1) reflects the inclusion of separate indicator variables for whether community colleges adopted at least five practices at scale, leading them to become moderate or high adopters. In these models, we also include fixed effects for years of cohort entry to account for systematic differences in student outcomes across colleges and cohorts of FTIC students. The "pre" years (years before adopting at least five practices) measure pre-adoption trends, while the "post" years (years after adopting at least five practices) measure the evolution of student outcomes over time. The pre-adoption trends estimated using the pre-adoption terms in the event-study model are informative in understanding how early student outcome trajectories would have evolved for students attending low-adopter colleges.

To provide a richer description of how the adoption of specific guided pathways practices may be related to changes in early student outcomes, we measure the association between various guided pathways practices and early student academic outcomes. We present results for a variety of OLS specifications, including different sets of controls, to understand how the association changes as covariates are added (see Appendix Tables 4–15). The disadvantage of this approach is that it could result in spurious conclusions that may come from multiple measures of guided pathways practices, some of which may likely be statistically significant by chance. To address this concern and minimize both omitted variable bias and model overfit, we select a set of explanatory variables using a machine learning method implemented in a two-stage estimation approach. The advantages of this approach are related to its neutrality, as its data-driven selection of predictors provides a check on confirmation bias. First, we use the adaptive Least Absolute Shrinkage and Selection Operator (LASSO) to optimally choose guided pathways practices to include in the model. LASSO chooses a parsimonious set of practices that provide the best possible fit of the data and discards those that contribute little to the fit. LASSO's ability to work as a covariate-selection method makes it a nonstandard estimator and prevents the estimation of standard errors.[7] Therefore, we implement a second stage that predicts a given early student outcome as a function of its selected guided pathways practices. For each state and a given early student outcome in college *c* and year of cohort entry *t*, we estimate the following linear specification using OLS:

$$(2) \qquad y_{ict} = \delta_0 + \sum_{p=1}^{p=13} \delta_1^{*p} GP_{ct}^{*p} + X_{ict}' \delta_2 + \alpha_c + \rho_{ct} + T_t + \epsilon_{ict}$$

where y_{ict} represents one of the four early academic momentum metrics. The vector GP_{ct}^{*p} includes the best combination of guided pathways practices, $*p$. We use $\delta_1^{*p} GP_{ct}^{*p}$ to refer to the selected set of guided pathways practices adopted at scale and their coefficients. In addition, this analysis incorporates the same controls as specified in equation (1) and fixed effects for years of cohort entry, T_t. Standard errors are clustered at the college level. This empirical approach leverages variation arising from differences in the evolution of adoption of guided pathways practices across colleges, with fixed effects controlling for cross-sectional differences in a given year and statewide annual changes.

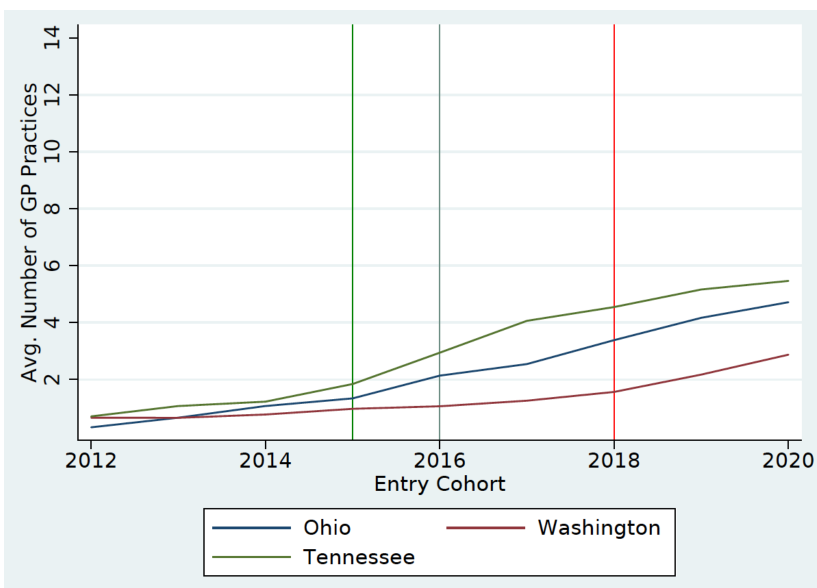
Furthermore, we anticipate that associations between guided pathways practices and early student outcomes may arise not only from the adoption of individual practices but also from synergies between them. Combinations of practices might yield greater changes in student outcomes than standalone practices. To test for the presence of complementarities, we extend the LASSO model to include all the possible interaction terms between areas of practice, defined as adopting at scale at least one practice per area. In this model, we also include the total number of adopted practices to make comparisons regarding the significance of particular combinations of practices in improving early student outcomes, in contrast to our measure of intensity of adoption (or the overall count of practices).

[7] Results from the model employing an unrestricted first-stage LASSO align closely with a model that includes controls and fixed effects in the first-stage LASSO through partialing-out. These results can be provided upon request.

6. Descriptive Statistics on Guided Pathways Reforms

Community colleges implement guided pathways reforms over several years in varied sequences and with various intensity depending on their local contexts, resources, and priorities. Figure 1 shows the average number of guided pathways practices adopted at scale in Tennessee (hereafter, TN), Ohio (OH), and Washington (WA) from fall 2012 to fall 2020. In our analysis of the survey data, most colleges adopted at least one practice at scale during that time; however, only a minority of colleges in each of the three states had adopted a fuller set of guided pathways practices at scale across the four guided pathways practice areas by the end of our study period.[8] Specifically, five community colleges adopted nine or more guided pathways practices at scale by fall 2020 (two colleges in TN, two in OH, and one in WA). On the other end of the spectrum, only four colleges (two in OH and two in WA) never adopted any guided pathways practices at scale by fall 2020.

Figure 1. Average Number of Guided Pathways Practices Adopted at Scale



Notes. Average number of practices is weighted by the number of FTIC entrants. Vertical lines indicate the years when statewide implementation of guided pathways reforms started (TN, 2015; OH, 2016; WA, 2018).

[8] We examine adoption rates up to fall 2020. Jenkins et al. (2023) focus on adoption rates up to fall 2022. The choice of fall 2020 is based on the availability of student unit records through the fall of the 2020-21 academic year, which enables us to capture the first-year experiences of successive cohorts of entering students at every community college.

While practices in Areas 1 and 2 tended to be widely adopted across colleges and states, specific practices within Area 3 were much less adopted, contributing to less overall adoption of guided pathways reforms. Correlations between our measure of intensity (the total number of practices at scale) and each specific practice reveal that, for example, in TN and OH, Practices 2a (*meta-major exposure*), 3a (*mandatory ongoing advising*), 3b (*caseload advising by field)*, and 3d (*scheduling for on-time completion*) contributed the least to the overall intensity of adoption (see Appendix Figures A1–A3). Across all states, Practice 3d (*scheduling for on-time completion*) stands out as the least likely to have been adopted at scale. This further underscores the inherent complexity of guided pathways reforms and highlights the difficulties that colleges may encounter in fully implementing the model, which requires substantial changes in college practices and culture (Jenkins et al., 2017).

Colleges in our study states made varying levels of progress in adopting guided pathways reforms. On average, TN and OH community colleges adopted the highest number of guided pathways practices at scale as of fall 2020, followed by WA. Figures 2–4 show "heat plots" indicating the number of guided pathways adopted at scale per college in each state over time. The color variation indicates the number of guided pathways practices adopted at scale in each year from 2012–2020. Yellow indicates the lowest level of adoption (0–1 practice adopted at scale); light orange, dark orange, and light purple indicate somewhat higher adoption (2–7 practices at scale); and dark purple and black indicate the highest level of adoption (8–12 practices at scale). Over time, the number of practices adopted by most colleges increased, as reflected in the darker cells on the right side of each figure.

Figure 2. Number of Practices Adopted at Each College Over Time, TN

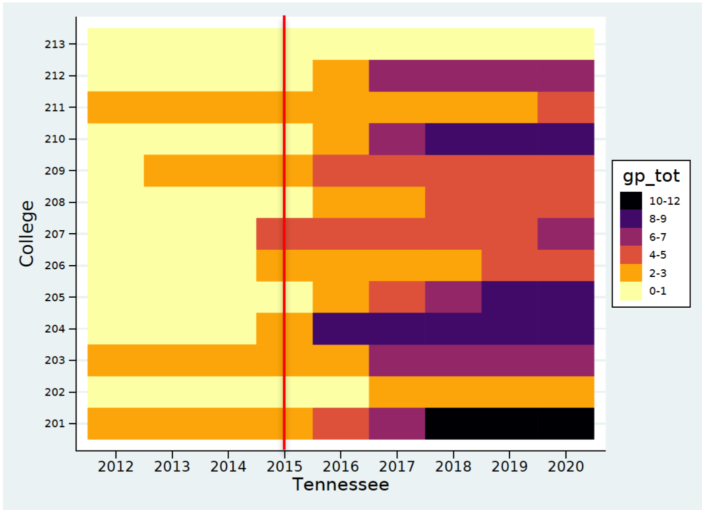


Figure 3. Number of Practices Adopted at Each College Over Time, OH

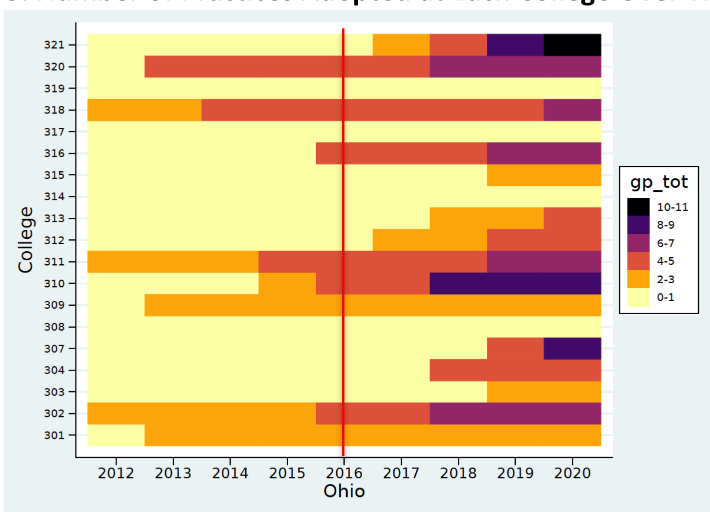
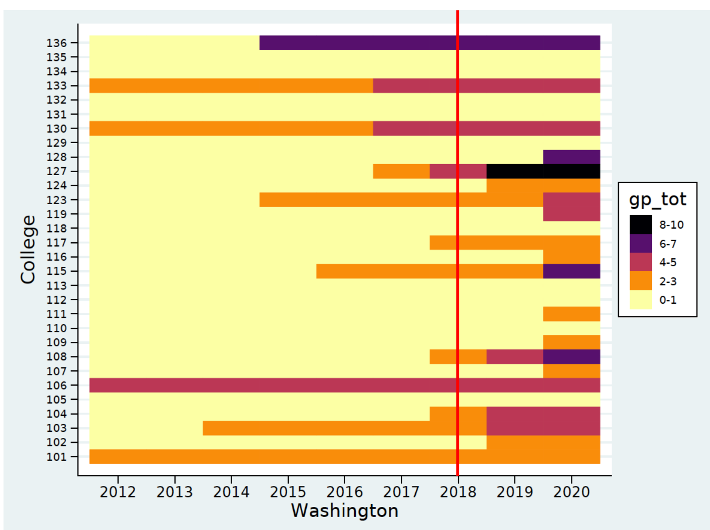


Figure 4. Number of Practices Adopted at Each College Over Time, WA



Although each state had a "launch" year (TN, 2015; OH, 2016; WA, 2018)—and, in the case of WA, dedicated funding to support guided pathways implementation at 12 colleges—our institutional survey data reveal that many colleges began implementing some guided pathways practices much earlier. In some colleges, the adoption date for some practices was earlier than 2012, so the adoption timelines in the heat plots are not fully aligned with state initiatives that aimed to promote the adoption of guided pathways reforms. In OH, for example, 15 colleges had at least two and as many as five practices in place as far back as 2012, which is well before the year that the OACC started holding regular institutes and provided coaching and other technical assistance to support adoption of guided pathways by colleges in the state. Similar patterns are observed in TN and WA.

The number of practices adopted at scale and the timing of implementation of guided pathways practices exhibit significant variation based on the intensity of adoption. Tables 2–4 present descriptive statistics on the intensity of guided pathways adoption in each state. Panel A displays college-level means of the number of guided pathways practices adopted overall and in each practice area both two years before the statewide initiative was launched ("Before") and any time (up to 2020) following the launch of the statewide initiative ("After"). After the launch of statewide guided pathways initiatives, the average intensity of adoption for moderate and high adopters substantially increased relative to low adopters. Most colleges adopted practices in Area 1 (*clarifying paths to student end goals*) as the first area of improvement, followed by Areas 2 (*helping students get on a program path)* and 3 (*keeping students on a path to completion)* after the statewide guided pathways initiatives began.

Panel B of Tables 2–4 show varying patterns in the relationship between the intensity of guided pathways adoption and financial resources (measured as revenue and expenditures per full-time-equivalent [FTE] student). Moderate and high adopters of guided pathways reforms in TN and OH exhibit higher revenues and expenditures per FTE relative to low adopters, along with some improvements in financial resources allocated to student and institutional support after the statewide implementation of guided pathways reforms. In WA, this pattern is not as pronounced but is consistent with the trends observed in TN and OH.

Table 2. College Summary Statistics by Intensity of Adoption, TN

	Low Adopters		Moderate Adopters		High Adopters	
	Before	After	Before	After	Before	After
A. Number of scaled guided pathways practices						
Overall (Areas 1–4)	1.1	3.1	1.3	6.1	1.2	10.3
Area 1	0.0	0.3	1.1	2.8	0.0	3.4
Area 2	0.2	0.8	0.0	1.5	0.0	2.3
Area 3	0.4	1.1	0.0	0.8	1.2	3.6
Area 4	0.5	1.0	0.2	1.0	0.0	1.0
B. Financial resources						
Revenue per FTE	$11,857	$14,105	$11,887	$14,399	$12,578	$15,554
Tuition	25.3%	18.3%	24.1%	17.6%	20.3%	15.5%
Expenditure per FTE	$11,199	$11,933	$11,223	$13,282	$12,110	$14,290
Student support	11.0%	10.3%	9.8%	10.0%	11.1%	13.5%
Academic support	7.9%	7.5%	9.8%	9.4%	5.6%	5.1%
Institutional support	13.3%	10.7%	12.8%	11.4%	14.9%	13.6%
Number of colleges	4		7		2	

Notes. Panel A displays institutional survey data, and panel B displays IPEDs data. "Before" refers to the years 2013–2014, and "After" refers to the years 2016–2020, following the launch of statewide adoption of guided pathways reforms in 2015. Low adopters are colleges that have scaled 4 or fewer practices (about 30% of the guided pathways model) by fall 2020; moderate adopters have scaled 5–8 practices; high adopters have scaled 9–13 practices (at least 70% of the guided pathways model. Average guided pathways adoption by intensity is measured by number of practices adopted at scale two years before statewide adoption of guided pathways reforms in each state and up to fall 2020. Revenue and expenditure per FTE have been adjusted to reflect constant prices in 2015.

Table 3. College Summary Statistics by Intensity of Adoption, OH

	Low Adopters		Moderate Adopters		High Adopters	
	Before	After	Before	After	Before	After
A. Number of scaled guided pathways practices						
Overall (Areas 1–4)	1.4	2.2	1.2	6.2	1.6	9.0
Area 1	0.5	1.0	0.6	3.9	0.4	3.0
Area 2	0.9	0.9	0.3	1.6	1.0	3.0
Area 3	0.0	0.3	0.2	0.6	0.2	2.0
Area 4	0.0	0.1	0.0	0.1	0.0	1.0
B. Financial resources						
Revenue per FTE	$ 13,188	$14,710	$ 10,619	$12,720	$14,328	$16,944
Tuition	25.9%	26.2%	26.6%	25.7%	22.6%	21.2%
Expenditure per FTE	$ 12,677	$13,003	$ 10,409	$11,580	$13,715	$15,507
Student support	10.6%	11.0%	11.6%	12.9%	7.8%	10.8%
Academic support	6.9%	7.1%	7.8%	7.6%	6.7%	8.6%
Institutional support	20.7%	24.6%	19.8%	21.3%	13.9%	17.8%
Number of colleges	10		7		2	

Notes. Panel A displays institutional survey data, and panel B displays IPEDs data. “Before” refers to the years 2014–2015, and “After” refers to the years 2017–2020, following the launch of statewide adoption of guided pathways reforms in 2016. Low adopters are colleges that have scaled 4 or fewer practices (about 30% of the guided pathways model) by fall 2020; moderate adopters have scaled 5–8 practices; high adopters have scaled 9–13 practices (at least 70% of the guided pathways model. Average guided pathways adoption by intensity is measured by number of practices adopted at scale two years before statewide adoption of guided pathways reforms in each state and up to fall 2020. Revenue and expenditure per FTE have been adjusted to reflect constant prices in 2015.

Table 4. College Summary Statistics by Intensity of Adoption, WA

	Low		Moderate		High	
	Before	After	Before	After	Before	After
A. Number of scaled guided pathways practices						
Overall (Areas 1–4)	1.0	2.0	2.3	6.1	2.8	10.0
Area 1	0.4	1.1	0.6	2.2	1.0	4.0
Area 2	0.2	0.4	0.9	1.8	1.5	4.0
Area 3	0.4	0.5	0.8	1.9	0.3	2.0
Area 4	0.0	0.0	0.0	0.2	0.0	0.0
B. Financial resources						
Revenue per FTE	$15,791	$18,383	$15,623	$19,054	$15,840	$19,432
Tuition	19.9%	23.0%	15.7%	15.6%	18.2%	15.1%
Expenditure per FTE	$14,072	$17,759	$15,119	$17,624	$15,624	$19,158
Student support	13.8%	14.0%	12.1%	10.9%	17.9%	18.6%
Academic support	8.2%	7.6%	8.8%	9.2%	7.4%	7.3%
Institutional support	11.7%	12.1%	13.7%	13.7%	15.7%	15.3%
Number of colleges	23		6		1	

Notes. Panel A displays institutional survey data, and panel B displays IPEDs data. “Before” refers to the years 2016–2017, and “After” refers to the years 2019–2020, following the launch of statewide adoption of guided pathways reforms in 2018. Low adopters are colleges that have scaled 4 or fewer practices (about 30% of the guided pathways model) by fall 2020; moderate adopters have scaled 5–8 practices; high adopters have scaled 9–13 practices (at least 70% of the guided pathways model. Average guided pathways adoption by intensity is measured by number of practices adopted at scale two years before statewide adoption of guided pathways reforms in each state and up to fall 2020. Revenue and expenditure per FTE have been adjusted to reflect constant prices in 2015.

7. Characteristics of FTIC Students and Descriptive Early Student Outcomes

As shown in Appendix Tables A1–A3, across the three states, there are variations in observable sociodemographic characteristics of FTIC students across adoption intensity levels, both before and after the start of statewide guided pathways reforms. Compared to TN and OH, WA serves a demographically distinct population of FTIC students. While in TN and OH, the average age at entry is 23 and 21 years old, respectively, in WA the age at entry is 25, making the proportion of recent high school graduates entering college much lower. WA also serves a substantially higher proportion of Asian students (about 10%) and a substantially lower proportion of Black students (5%) relative to TN and OH and TN, where the proportion of Black students is roughly 20%.

Although most student demographic characteristics exhibit no striking differences across adoption intensity levels, there are a couple of noteworthy exceptions. In WA, high adopter colleges enroll a higher proportion of academically disadvantaged students compared to moderate and low adopters. In TN, both low and high adopters have a greater proportion of White students and a notably lower proportion of Black students compared to moderate adopters. There have also been notable shifts in student demographics after the launch of statewide guided pathways initiatives. Community colleges in TN experienced a twofold increase in Pell-eligible students and a rise in recent high school graduates enrolling as FTIC students, particularly among high and moderate adopters. In OH, there was a significant upswing in FTIC students enrolling within a year of high school graduation, especially among high adopters. In WA, student characteristics remained relatively stable across adoption intensity levels, except for a significant reduction in academically disadvantaged students, predominantly among low adopters, following the launch of the statewide guided pathways efforts.

Appendix Tables A1–A3 also include summary statistics for the student outcome variables. Across all states, we find that average fall-to-fall persistence rates declined after the launch of statewide guided pathways initiatives, although the decline was less pronounced in WA than in TN and OH. FTIC students in TN earned more college-level credits after the start of the statewide initiative; the increase was more notable among moderate and high adopters than among low adopters. Interestingly, prior to statewide implementation, low-adopter colleges had slightly better outcomes relative to high and moderate adopters in TN, suggesting that low adopters may have been relatively better off and potentially had fewer incentives to adopt a higher number of guided pathways practices. There were no substantial changes in the total number of credits earned across levels of adoption intensity in OH and WA, unlike the observed changes in TN.[9] These trends in early student outcomes are also illustrated graphically in Appendix Figures A4–A6.

8. Results

8.1 Estimates Based on Time of Statewide Adoption Launch

Figures 5–7 depict the evolution of early student outcomes following the statewide launch of guided pathways initiatives in each state. Vertical lines on the graphs mark the year when statewide adoption was initiated. These graphs examine changes in outcomes relative to the year preceding statewide adoption (or reference period). The y-axis measures changes in outcomes in percentage points or the number of credits earned, with each dot representing coefficient estimates for each year of statewide adoption compared to the reference period one year before adoption. The bars connected to each dot represent 95-percent confidence intervals. If a variable's bar does not cross the horizontal zero line, it indicates statistical significance at the 5-percent level.

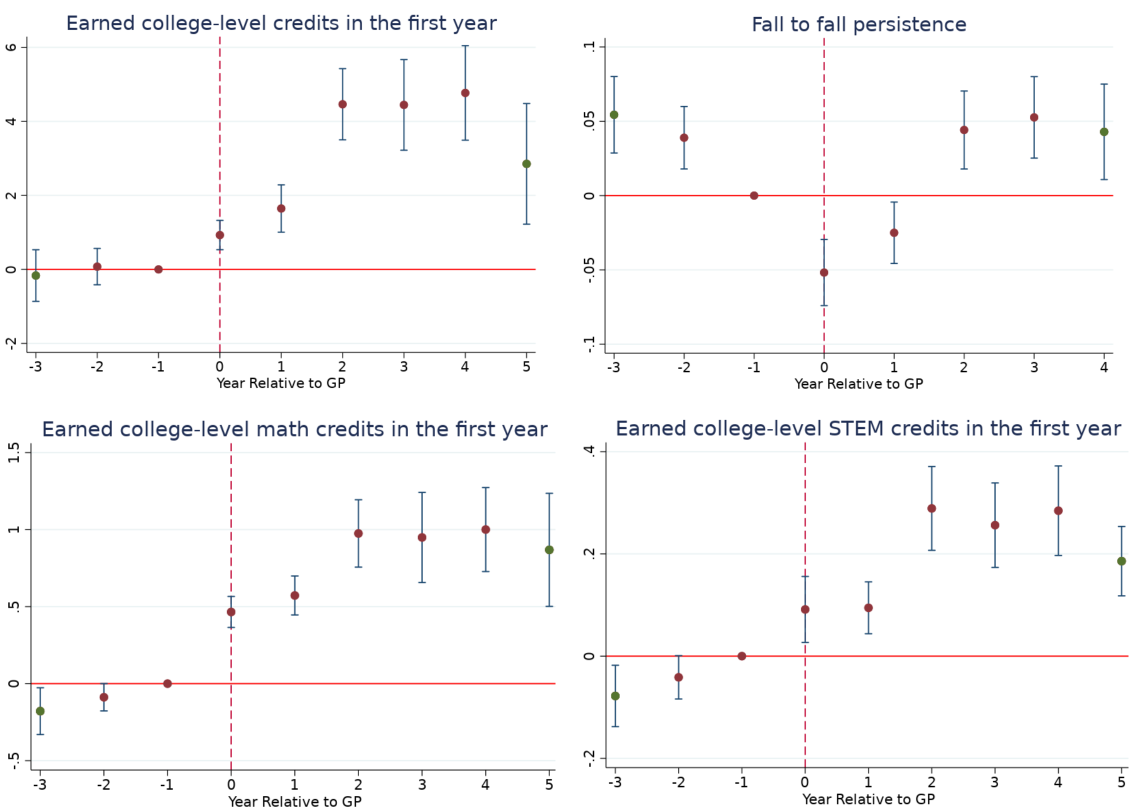
We begin with TN, which was the first state to encourage widespread adoption of guided pathways. In TN, we observe significant improvement in student outcomes on the four measures two years after the launch of statewide guided pathways initiatives: college-level credits earned in the first year, fall-to-fall persistence, college-level math credits earned in the first year, and college-level STEM credits in the first year. The coefficient estimates in the four years following statewide adoption reveal a statistically significant increase in college-level credits earned, ranging from 1.6 to 4.6 credits. In the year of the launch of statewide guided pathways initiatives, fall-to-fall persistence decreased by 5 percentage points compared to the year before adoption. One year after

[9] There were modest gains in WA, but whereas moderate and high adopters in WA saw a 5%–10% increase in college-level credits earned, in TN the increase ranged from 20%–25%.

statewide adoption, student persistence decreased by 3 percentage points compared to the year before adoption; and two years after statewide adoption, persistence rates improved relative to the reference period. The introduction of guided pathways reforms occurs in colleges that are experiencing positive trends in math and STEM credit attainment. These trends generally continue in the years after statewide adoption.

These results, though encouraging, are not causal. We cannot know whether the pre-to-post-reform change in our outcomes of interest is solely due to guided pathways reforms or other reforms that were also adopted at the same time at all the colleges. In 2015-16, for example, Tennessee's 13 public community colleges scaled other reforms such as corequisite remediation in math, writing, and reading and the Tennessee Promise program. Most likely, the observed improvements are due to a combination of factors in TN.

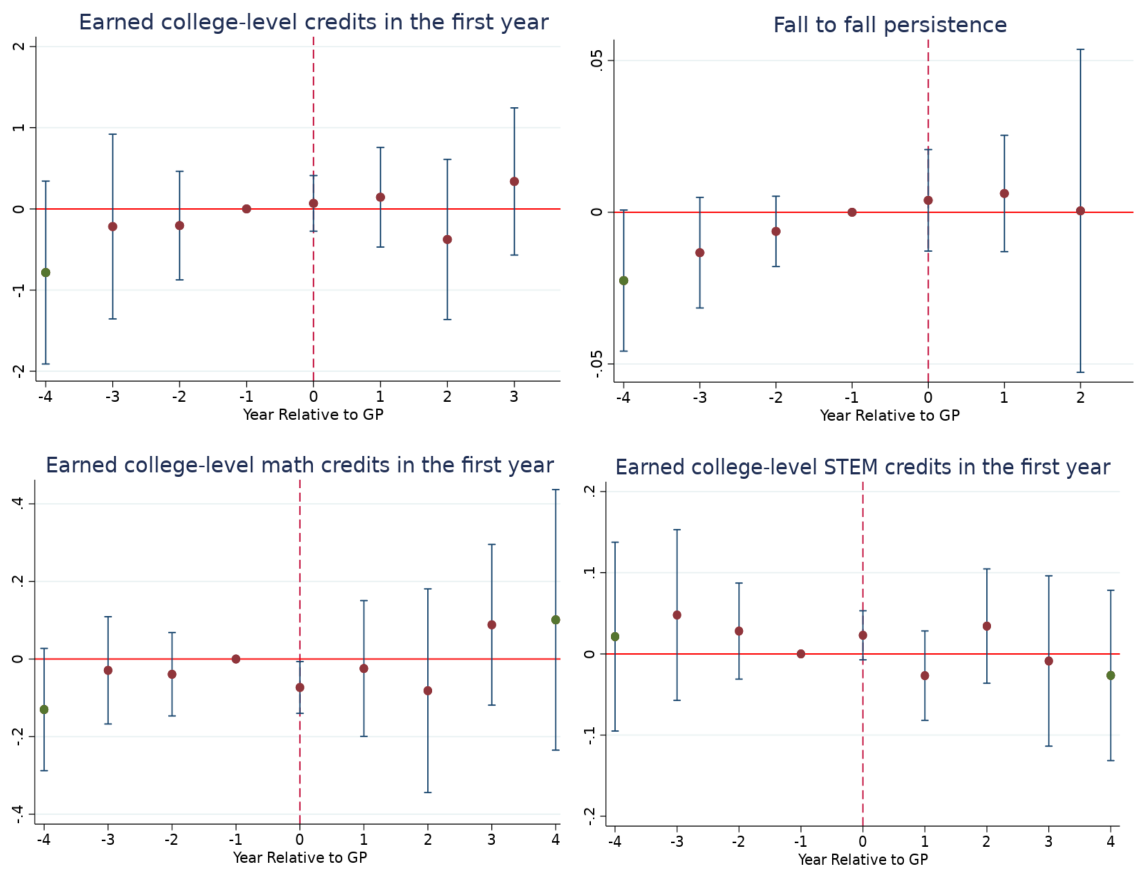
Figure 5. Trends in Early Student Outcomes, TN



Notes. Adjusted trends in early student outcomes correlated with the launch of statewide guided pathways initiatives in TN. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate status, Pell Grant eligibility status), fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in number of years relative to the year of adoption of statewide reforms in 2015. The y-axis is measured in the units of the outcome of interest.

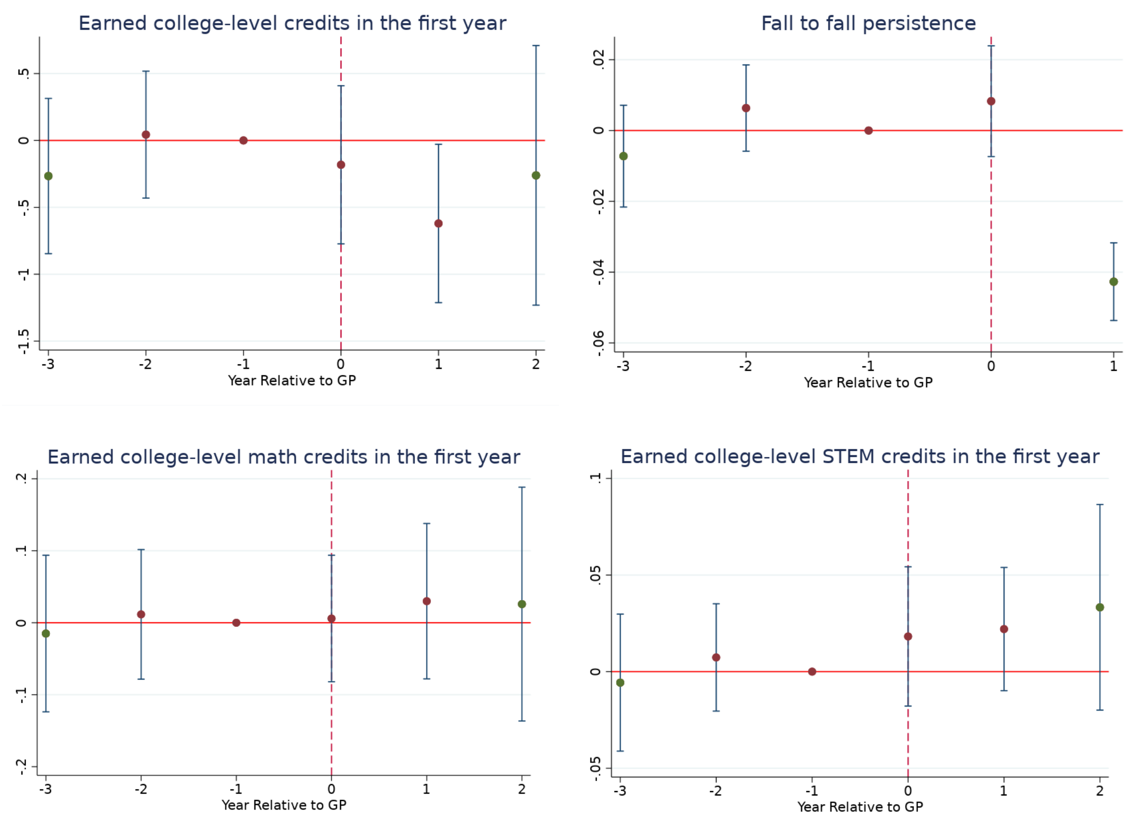
As depicted in Figures 6 and 7 for OH and WA, no significant improvements in early student outcomes are observed over the subsequent years following statewide adoption. Given that the adoption of guided pathways reforms started much later in the case of WA, it is premature to draw definitive conclusions since implementing these reforms typically takes several years.

Figure 6. Trends in Early Student Outcomes, OH



Notes. Adjusted trends in early student outcomes correlated with the launch of statewide guided pathways initiatives in OH. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate status), fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in number of years relative to the year of adoption of statewide reforms in 2016. The y-axis is measured in the units of the outcome of interest.

Figure 7. Trends in Early Student Outcomes, WA



Notes. Adjusted trends in early student outcomes correlated with the launch of statewide guided pathways initiatives in WA. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate status, disability, academically and economically disadvantaged at first entry), fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in number of years relative to the year of adoption of statewide reforms in 2018. The y-axis is measured in the units of the outcome of interest.

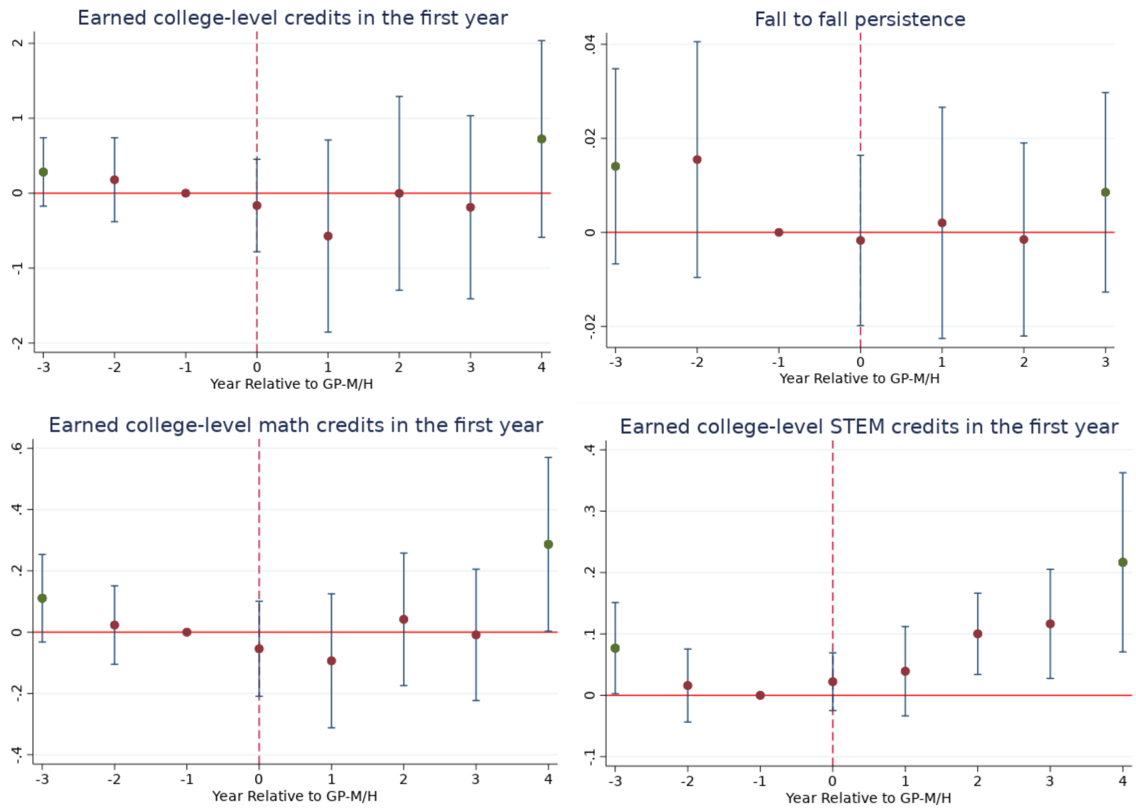
8.2 Estimates Based on Time of Adoption Intensification

To complement the findings derived from comparing outcomes “pre” and “post” the inaugural year of statewide guided pathways initiatives and to attempt to address the challenge of disentangling the effects of a combination of factors that may drive changes in outcomes following statewide reforms, we also employ an event study approach. This approach enables us to better isolate associations with other reforms occurring simultaneously by comparing changes in outcomes among moderate and high adopters with those observed in low adopters in each state.

Figures 8–10 summarize the event study for colleges before and after becoming moderate or high adopters (note that the "zero" year is thus different than in the prior set of analyses). In general, the coefficient estimates associated with the negative or positive event time terms show little evidence of problematic pre-trends. This hints that any observed changes in outcomes following an increase in guided pathways adoption intensity may be reasonably associated with the event itself rather than underlying trends that were already in motion before the event occurred. Four years after intensifying the adoption of guided pathways practices in TN (the year in which a college scaled at least five practices), there is an improvement of less than half a credit earned in college-level math and STEM. Our results for TN show little evidence to suggest that a higher intensity of adoption changes the level or trend of college-level credits earned or fall-to-fall persistence.

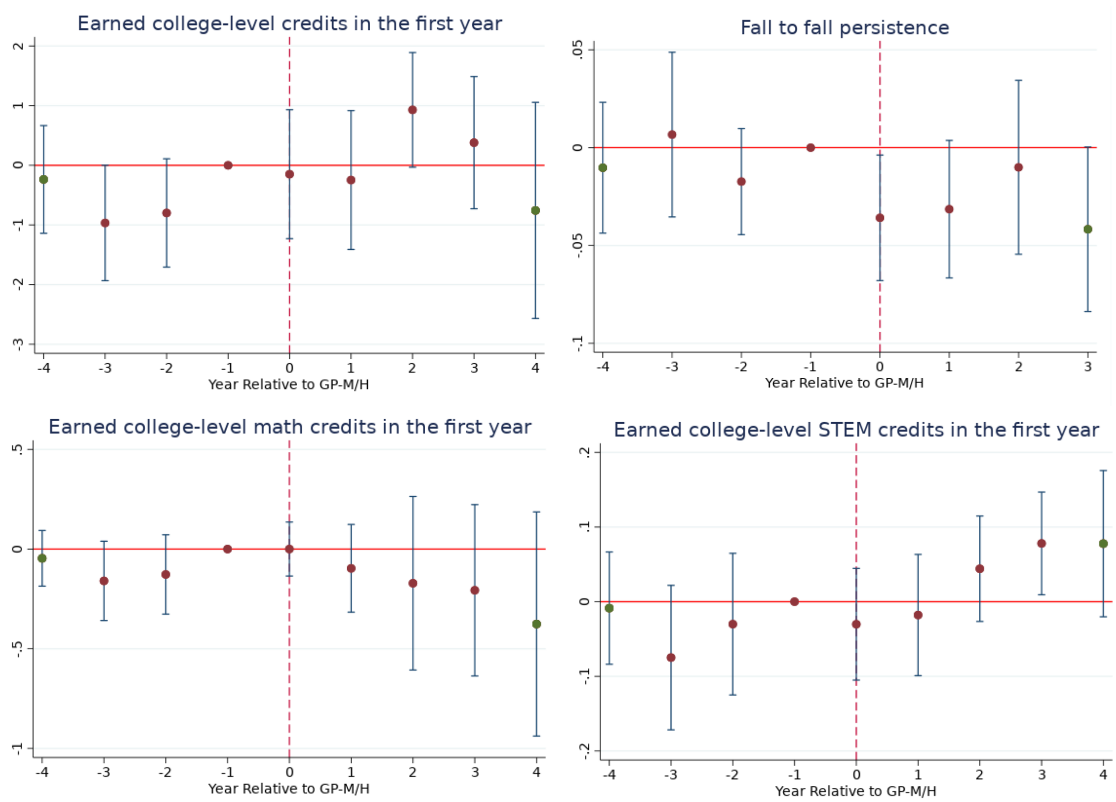
Results for OH and WA show small but statistically significant improvements in credit attainment two years after increasing the intensity of adoption (adopting at least five guided pathways practices). These improvements represent about 9% of the sample means and should be interpreted with caution. There appears to be a weakly significant upward trend in college-level credit attainment before colleges increased their adoption level in OH, and this improvement is reversed in the subsequent years. Moreover, within our analytical sample, colleges in WA had only two years since their statewide adoption, making it potentially premature to draw conclusions regarding the observed changes two years after increasing adoption intensity. Overall, event-study results for the three states provide little consistent evidence that changes in intensity of adoption are related to changes in early student outcomes.

Figure 8. Event Study of Adoption Intensification, TN



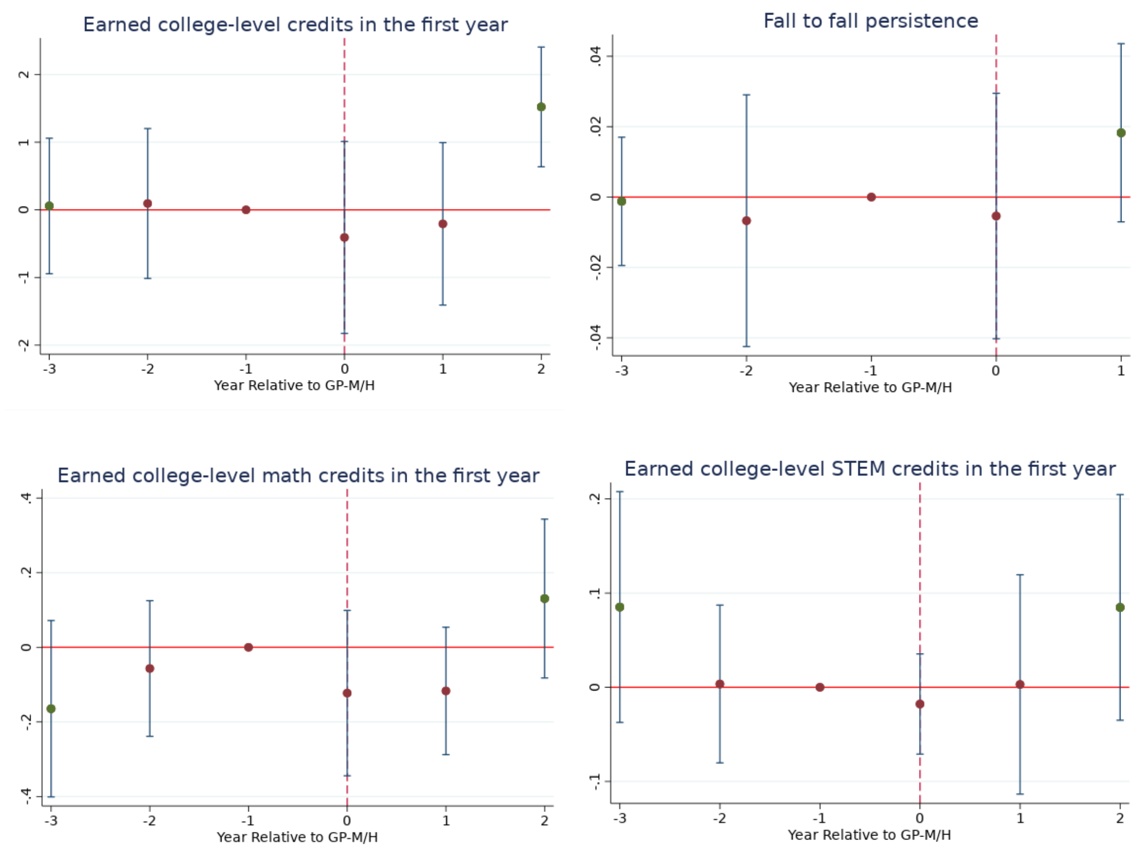
Notes. Event study estimates of the effect of moderate/high adoption of GP reforms at each college in TN. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate, Pell Grant eligibility status), fixed effects for years of cohort entry, fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in event time, or number of years relative to reaching a moderate/high adoption intensity level (scaling at least five practices). The y-axis is measured in the units of the outcome of interest.

Figure 9. Event Study of Adoption Intensification, OH



Notes. Event study estimates of the effect of moderate/high adoption of GP reforms at each college in OH. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate), fixed effects for years of cohort entry, fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in event time, or number of years relative to reaching moderate/high adoption levels. The y-axis is measured in the units of the outcome of interest.

Figure 10. Event Study of Adoption Intensification, WA



Notes. Event study estimates of the effect of moderate/high adoption of GP reforms at each college in WA. Regressions control for student demographic and pre-college controls (i.e., gender, race/ethnicity, age at first entry, high school GPA, recent high school graduate, disability, academically and economically disadvantaged at first entry), fixed effects for years of cohort entry, fixed effects for colleges, and college-level, year-specific measures of revenue and expenditure per FTE and of shares of education expenditures. The x-axis is measured in event time, or number of years relative to reaching moderate/high adoption levels. The y-axis is measured in the units of the outcome of interest.

8.3 Estimates for Particular Practices and Combinations of Practices

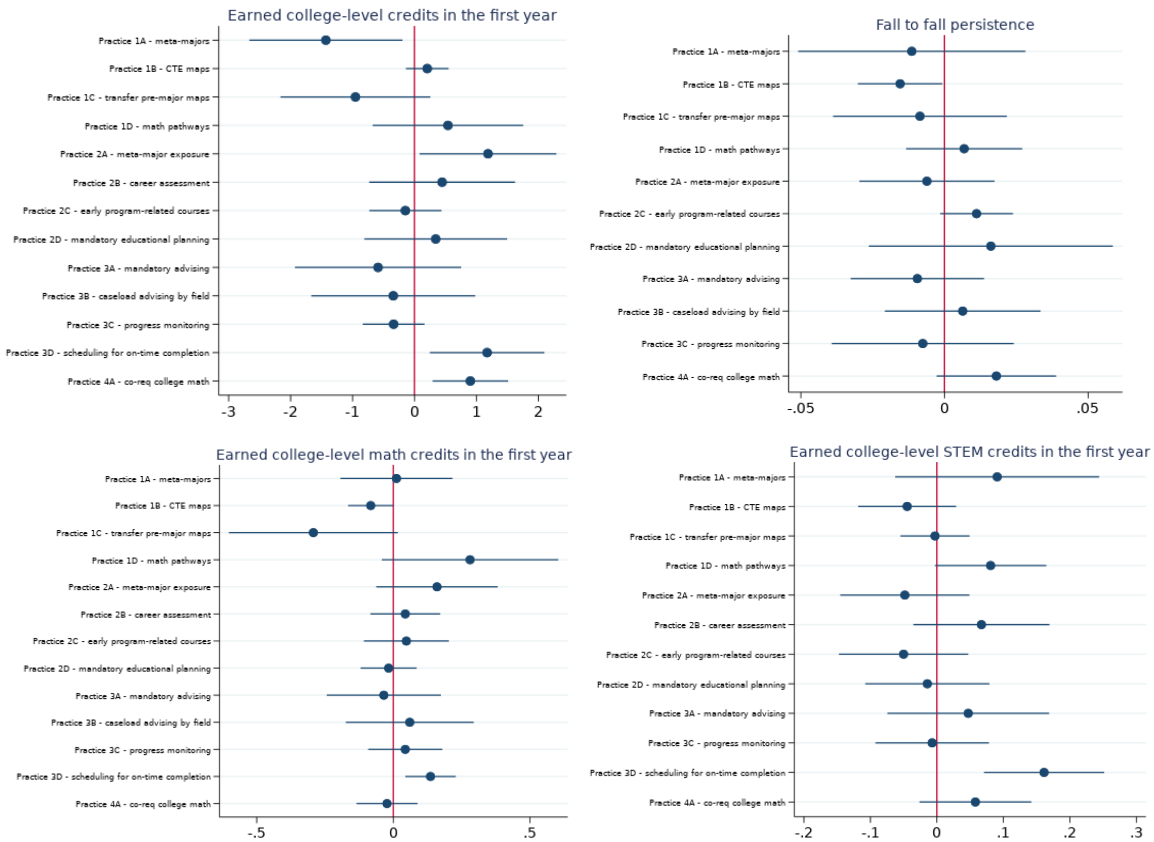
We conduct regression analyses to isolate the relationship between individual guided pathways practices included in the measure of intensity and early student outcomes. To better identify which practices best predict student outcomes, we use a feature selection model (LASSO) to select the parsimonious set of guided pathways practices that best fit student outcomes, while keeping individual and institutional controls constant. LASSO identifies a set of practices used to estimate the association between the selected practices and the outcomes of interest, while dropping practices that do not explain a significant fraction of the variance in student outcomes.

Results from the regressions are displayed in coefficient plots for the selected set of practices in Figures 11–16. In these figures, the vertical axis showcases all practices chosen by LASSO as best predictors for each outcome, while the horizontal axis is measured in the units of the outcome of interest. Each coefficient dot is accompanied by its corresponding confidence interval, allowing us to assess the statistical significance by checking if the interval overlaps with zero, indicated by a vertical red line. A confidence interval overlapping with zero indicates that the association is indistinguishable from zero at the 5% level; a confidence interval barely overlapping with zero is weakly significant at the 10% level.[10] We observe notable variations in the associations between guided pathways practices and student outcomes across the three states.

As shown in Figure 11 for TN, Practice 2c (early program-related courses) demonstrates a positive association, with a 1-percentage-point increase, in fall-to-fall persistence, while Practices 2a (meta-major exposure), 3d (scheduling for on-time completion) and 4a (corequisite college math) are each associated with additional college-level credits earned in the first year. Practice 1d (math pathways) and Practice 3d (scheduling for on-time completion) have positive associations with college-level math and STEM credits earned in the first year. Negative associations between Practice 1a (meta-majors) and first-year college-level credits and Practice 2b (CTE maps) and fall-to-fall persistence merit further investigation. One explanation may be that meta-majors are not beneficial to students without additional support services to help students make a selection and stay on a path. Yet, a negative correlation does not automatically mark a practice as undesirable. It highlights the need for further for consideration, accounting for the quality of implementation and the extent to which students effectively utilize these practices. Moreover, our estimates represent associations that might be potentially subject to selection and omitted variable bias.

[10] Omitted coefficients due to multicorrelation across areas of practice are equal to zero.

Figure 11. Associations Between Practices and Outcomes, TN

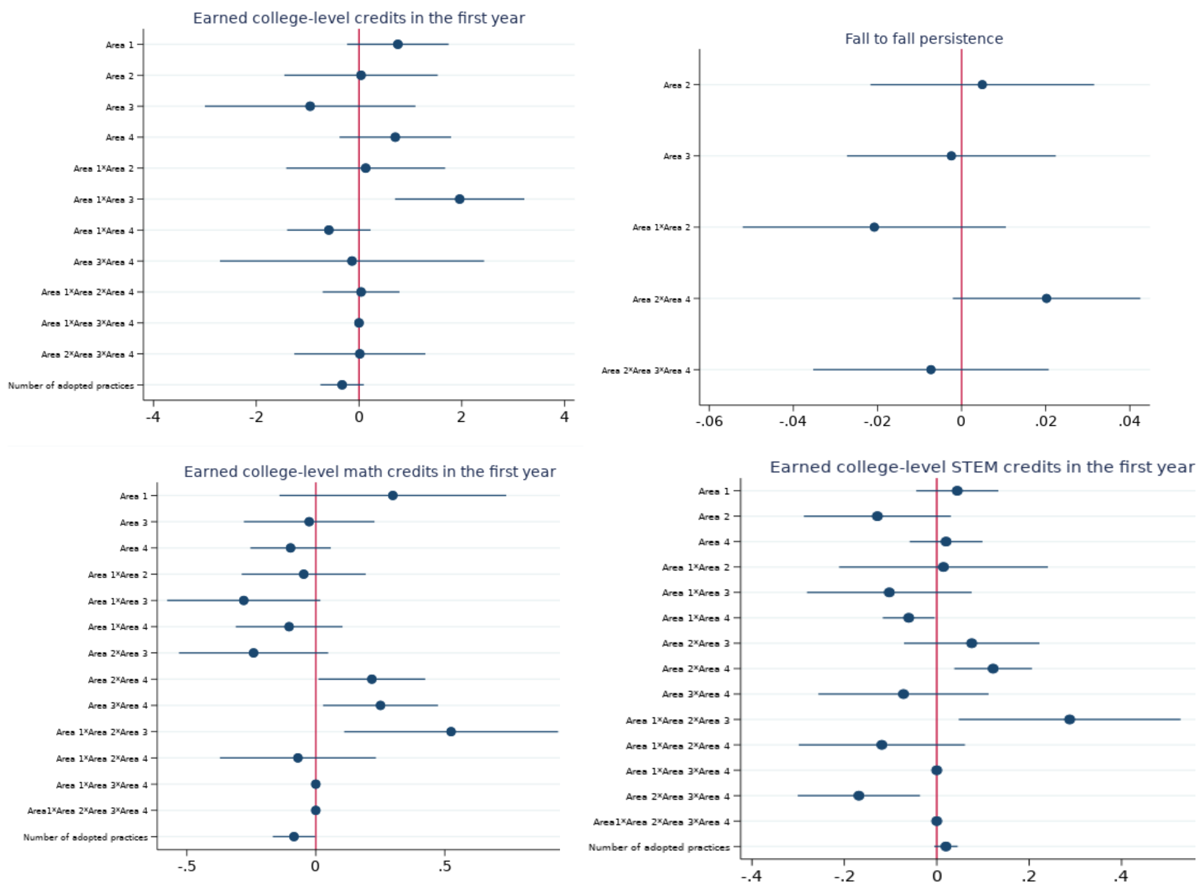


Notes. Coefficient plot of the associations between the practices selected by the LASSO procedure and outcomes in TN. Selected practices are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

Figure 12 reveals significant associations and complementarities across guided pathways practice areas in TN. Specifically, in terms of college-level credits earned in the first year, the most substantial positive association is observed when practices in Areas 1 and 3 (*clarifying paths to end goals* and *keeping students on a path)* are adopted together, resulting in a gain of 2 college-level credits earned (15% of the sample mean). This magnitude falls within the range of the improvements observed in this outcome four years following the statewide initiative launch in TN. When examining college-level math credits earned in the first year, as well as college-level STEM credits earned in the first year, positive associations are observed when practices in Areas 1, 2, and 3 and practices in Areas 2 and 4 (*helping students get on a program path* and *ensuring students are learning across programs*) are adopted together. Adoption of practices in Areas 2 and

4 positively correlates with fall-to-fall persistence, while adoption in Areas 3 and 4 (*keeping students on a path* and *ensuring students are learning across programs)* is also linked to college-level math credits earned in the first year.

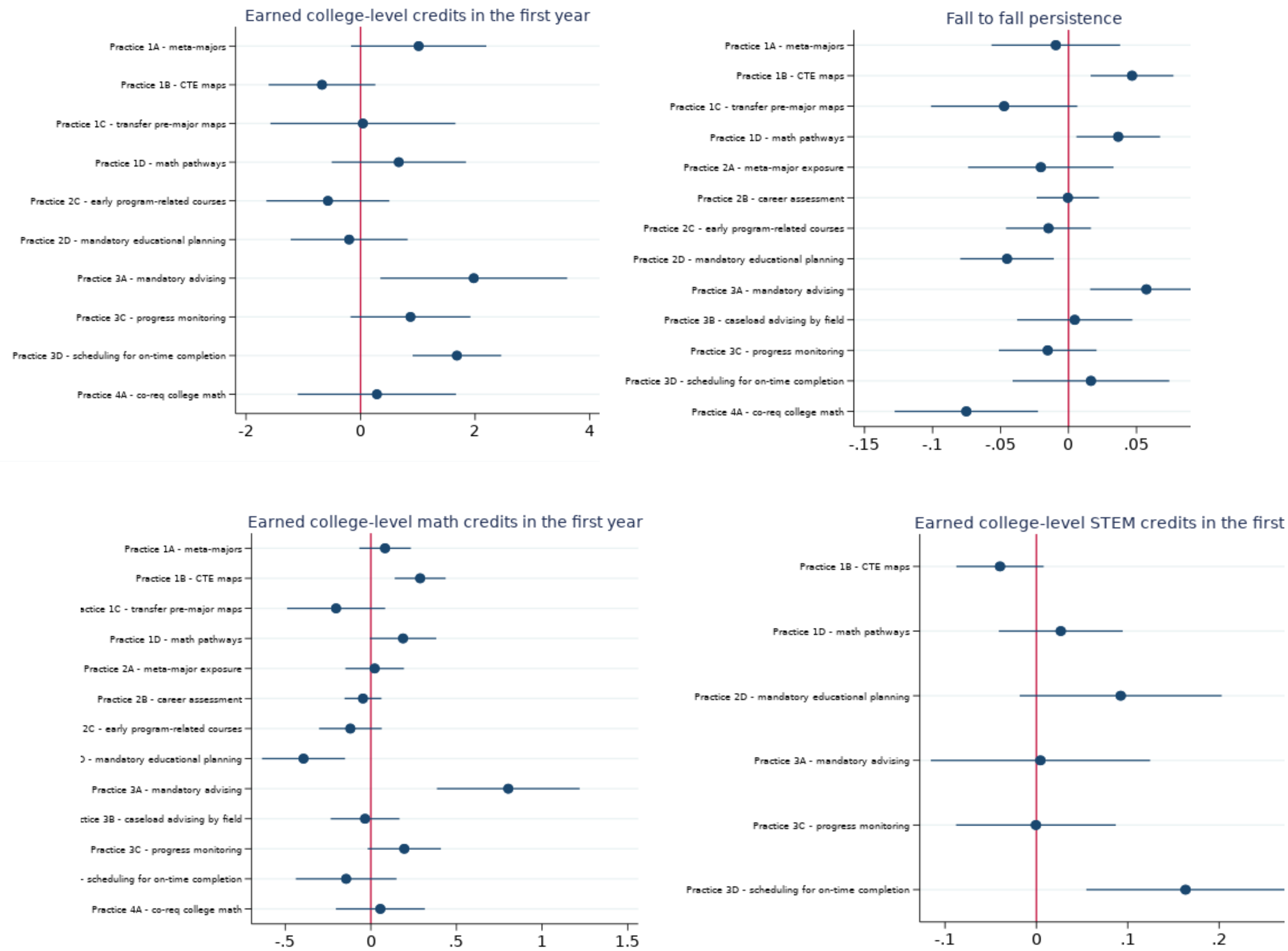
Figure 12. Associations Between Practice Areas and Outcomes, TN



Notes. Coefficient plot of the associations between the practice areas selected by the LASSO procedure and outcomes in TN. Selected practice areas are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

In OH, as presented in Figure 13, Practice 1b (*CTE maps*) is associated with a 5-percentage-point increase in fall-to-fall persistence. Three out of four practices of Area 3 (Practice 3a, *mandatory ongoing advising*; 3c, *progress monitoring* and 3d, *scheduling for on-time completion*) are each associated with between about 1 and 2 additional college-level credits earned in the first year. Practices 1b (*CTE maps*), 1d (*math pathways*), 3a (*mandatory advising*), and 3c (*progress monitoring*) have positive associations with college-level math credits earned in the first year. Finally, practice 3d (*scheduling for on-time completion*) has a positive association with college-level STEM credits earned in the first year.

Figure 13. Associations Between Practices and Outcomes, OH

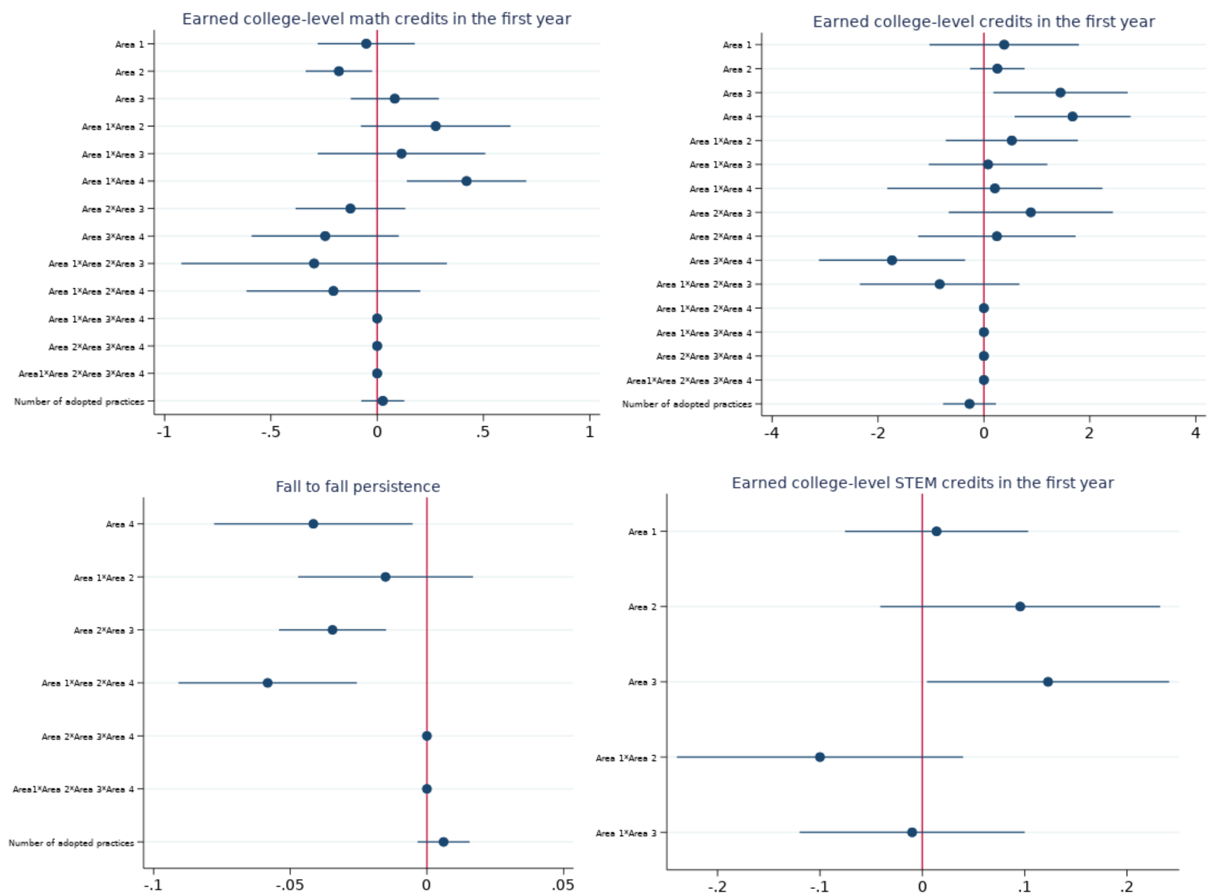


Notes. Coefficient plot of the associations between the practices selected by the LASSO procedure and outcomes in OH. Selected practices are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

On the other hand, Practices 2d (*mandatory educational planning*) and 4a (*corequisite college math*) have negative associations with some outcomes. While corequisite college math has been shown to improve student completion of math requirements (Meiselman & Schudde, 2022), poorly designed corequisite college math courses may discourage student persistence if students lack adequate support, as they may find the workload or expectations overwhelming.

We do not find a statistically significant result for complementarities across practice areas, except for the complementarity observed in the adoption of practices in Areas 1 and 4 (*clarifying paths to end goals* and *ensuring students are learning across programs*) specifically for college-level math credits earned in the first year (see Figure 14).

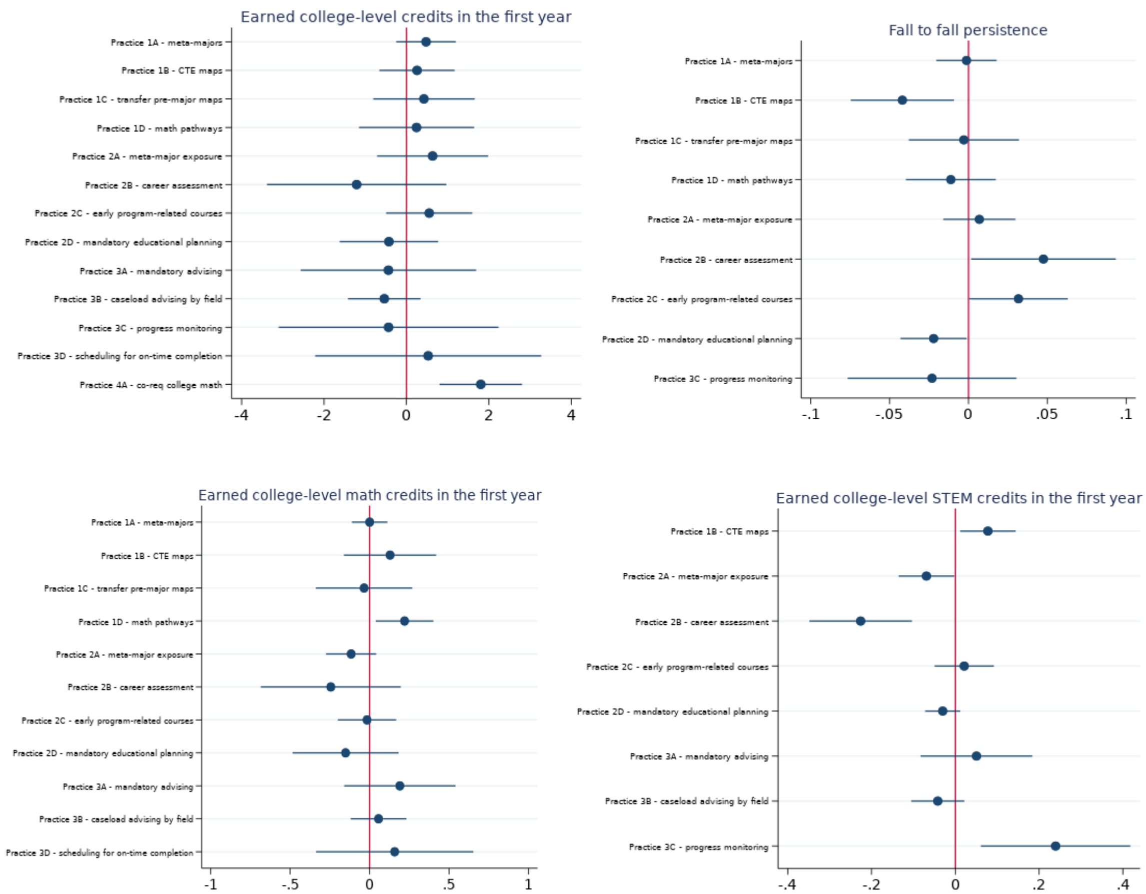
Figure 14. Associations Between Practice Areas and Outcomes, OH



Notes. Coefficient plot of the associations between the practice areas selected by the LASSO procedure and outcomes in OH. Selected practice areas are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

In WA, as illustrated in Figure 15, Practice 4a (*corequisite college math*) is associated with an increase of nearly 2 college-level credits earned in the first year. Practices 2b (*meta-major exposure*) and 2c (*early program-related courses*) are positively associated with fall-to-fall persistence. Practices 1d (*math pathways*) and 3c (*progress monitoring*) are positively associated with college-level math and STEM credits earned in the first year, respectively. While Practice 1b (*CTE maps*) has a positive association with college-level STEM credits earned in the first year, it is negatively associated with student persistence.

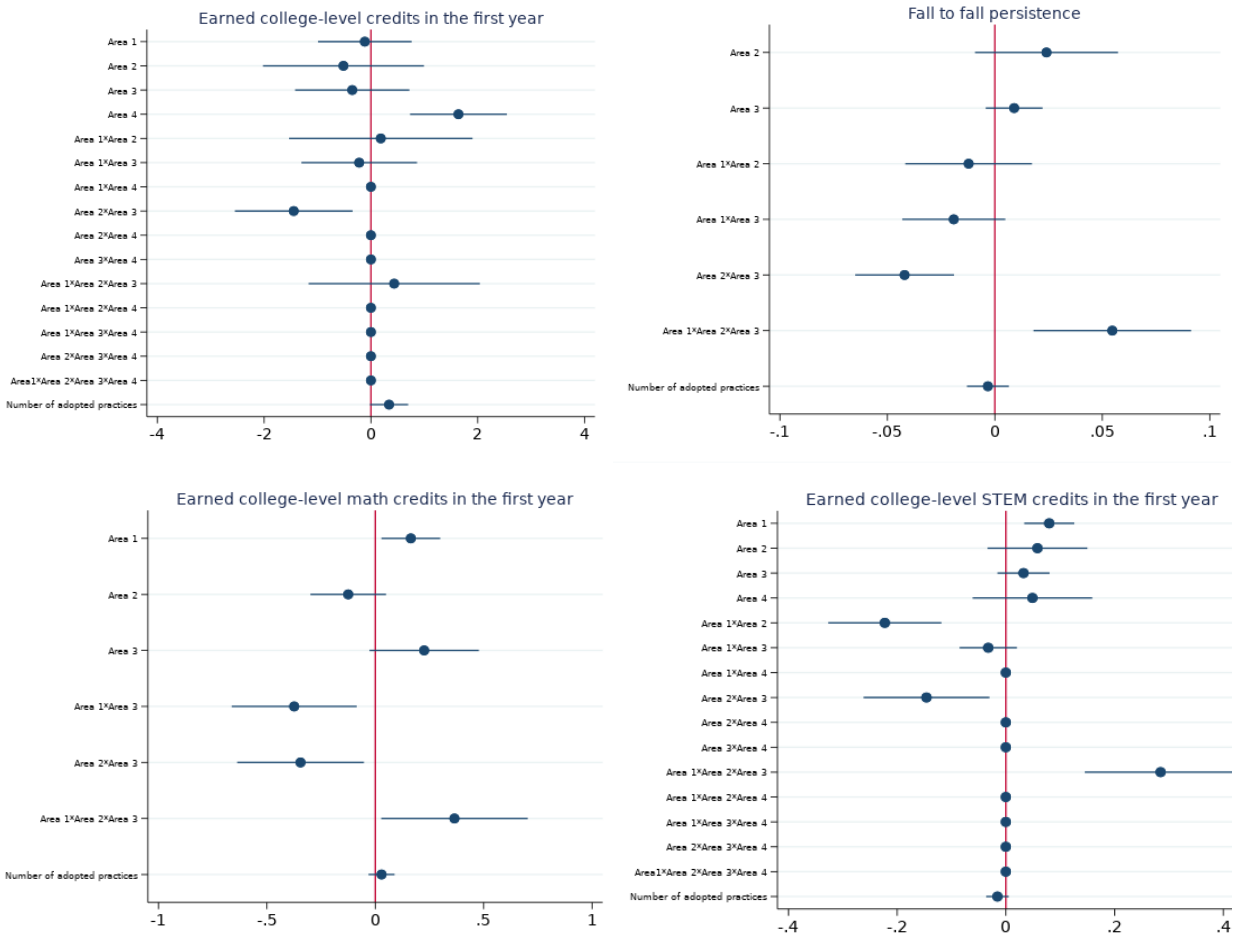
Figure 15. Associations Between Practices and Outcomes, WA



Notes. Coefficient plot of the associations between the practices selected by the LASSO procedure and outcomes in WA. Selected practices are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

We also find evidence of potential complementarities across practice areas in WA. Figure 16 shows that while not always statistically significant, adopting practices together in Areas 1, 2, and 3 has a positive association with fall-to-fall persistence, college-level credits earned and college-level math credits earned in the first year.

Figure 16. Associations Between Practice Areas and Outcomes, WA



Notes. Coefficient plot of the associations between the practice areas selected by the LASSO procedure and outcomes in WA. Selected practice areas are listed vertically. The x-axis presents point estimates and confidence intervals of the respective association, measured in the units of the outcome of interest.

9. Conclusion

This report describes a comprehensive examination of the adoption of guided pathways reforms through statewide initiatives across 62 community and technical colleges in TN, OH, and WA in order to shed light on their association with early academic success. Our analysis explores whether statewide guided pathways initiatives can effectively support students during their first year of enrollment. We also explore whether the intensity of guided pathways adoption, the adoption of single practices, or the adoption of practices in single or multiple guided pathways practice areas is associated with improved student outcomes in their first year of college. The early momentum metrics we use were determined when we pre-registered the study. Our decision to use these metrics was tied to their ability to predict later outcomes (Belfield et al., 2019; Fink et al., 2021; Attewell & Monaghan, 2016) and to the fact that we did not have enough years of data post-guided-pathways-adoption to capture any changes in long-term outcomes such as college completion.

While we do not find evidence that the launch of statewide guided pathways reforms is associated with improved student outcomes in either OH or WA, in TN we find notable improvements. There was an increase in college-level credits earned in the first year, and fall-to-fall persistence also improved. Moreover, a preexisting upward trend in math and STEM credit attainment in the first year continued after the inauguration of the state's guided pathways initiative. These positive changes are likely the result of various factors, including concurrent non-guided-pathways reforms that were implemented in the state.

In addition to using the launch year of statewide guided pathways initiatives as the basis for comparisons between cohorts arriving before and after the launch in each state, and to address the challenge of disentangling the effects of multiple factors on outcomes following the start of these reforms, we also examine associations based on the year when colleges intensified their guided pathways efforts by scaling at least five practices. Using institutional surveys to assess the timing of the scaled adoption of guided pathways reforms, we find that increasing adoption intensity to at least five practices is not strongly associated with changes in early student outcomes in TN and OH. Drawing conclusions about adoption intensity may be premature in WA, given the later initiation of reforms there, which typically require several years to adopt at scale.

Our analysis does provide evidence of a correlation between the adoption of individual practices and early student outcomes across the three states. Specifically, we find that some specific guided pathways practices may benefit early student outcomes while others may hinder them. Practice 4a (*corequisite college math*) is positively associated with college-level credits earned in the first year in TN and WA. Scaled as a percentage of the mean number of college-level credits earned, these improvements represent an increase of 7% in TN and 11% in WA. Practice 3d (*scheduling for* *completion*) is positively associated with college-level credits and college-level STEM credits earned in the first year in both TN and OH. The improvement in college-level credits earned represents a 9% and 15% increase over the sample means in each of these states, respectively. Practice 1d (*math pathways*) is associated with a nearly 20% increase in the mean number of college-level math credits earned in the first year across all three states.

A few guided pathways practices are negatively associated with early student outcomes. For example, in TN and WA, Practice 1b (*CTE maps*) is negatively associated with fall-to-fall persistence, while in OH and WA, Practice 2d (*mandatory educational planning*) is negatively associated with persistence. The magnitudes of the decreases across the three states range between 3% and 10% of the sample means. A negative relationship between a practice and an outcome does not necessarily imply that the practice is unfavorable. Nonetheless, it emphasizes the need to assess the quality of implementation of the practice and how students experience it. We also acknowledge the potential influence of selection and omitted variables in our estimates.

In terms of relationships between the four guided pathways practice areas, we find evidence that, in TN and to a lesser extent in WA, complementarities among the adoption of practices across particular practice areas are associated with larger improvements in early academic success than the adoption of practices in any single practice area or the intensity of guided pathways adoption. The most substantial positive association with college-level credits earned is observed when practices in Area 1 (*clarifying paths to student end goals*) and Area 3 (*keeping students on a path to completion*) are adopted together in TN, resulting in a nearly twofold increase compared to both the adoption of any single significant practice or to the moderate- or high-intensity adoption of practices. The combination of adopting practices in Areas 1, 2 (*helping students get on a program path*), and 3 is positively associated with improvements in math and STEM credits earned in TN and WA and with student persistence in WA. We find no evidence of the role of complementarities across practice areas in OH. OH seems to achieve more significant gains in college-level credits earned by adopting multiple practices within Area 3, as opposed to adopting practices together across different areas. These variations across states are likely due to the influence of state-specific factors—such as policies, resources, institutional contexts, and student demographics—on the effectiveness of guided pathways reforms, and they underscore the importance of tailoring the adoption of guided pathways practices to align with the characteristics and needs of individual states and colleges.

Finally, we acknowledge certain limitations in our study. Our study does not establish causal relationships, as identifying a pure comparison group and pinpointing the timing of guided pathways adoption is challenging. Additionally, we do not know the conditions under which colleges choose to adopt guided reforms at scale. Colleges tend to self-select into different levels of adoption intensity and undertake specific combinations of practices based on their unique characteristics and resources, further complicating the task of attributing estimated effects solely to guided pathways reforms. Overlapping adoption of related initiatives or programs adds complexity to isolating the specific effects of guided pathways. Finally, we have measured the intention to treat, which does not provide insights into whether students are using these practices or finding them useful.

Despite these limitations, our study is the first of its kind to explore the potential of guided pathways reforms in contributing to improved early academic success. Our findings highlight the importance of considering these results within the varied contexts of adopting guided pathways reforms, encompassing diverse institutional resources and student demographics across states. The findings lay the foundation for further research aimed at identifying the specific practices or combinations thereof, along with other relevant factors, that can optimize early academic success in community colleges. We hope our results offer valuable insights that contribute to the ongoing conversation about enhancing student success within these states and colleges and that they can be helpful to others seeking to implement whole-college reforms.

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Appendix: Supplementary Figures and Tables

Figure A1. Correlations Between Practices and Practice Areas, TN

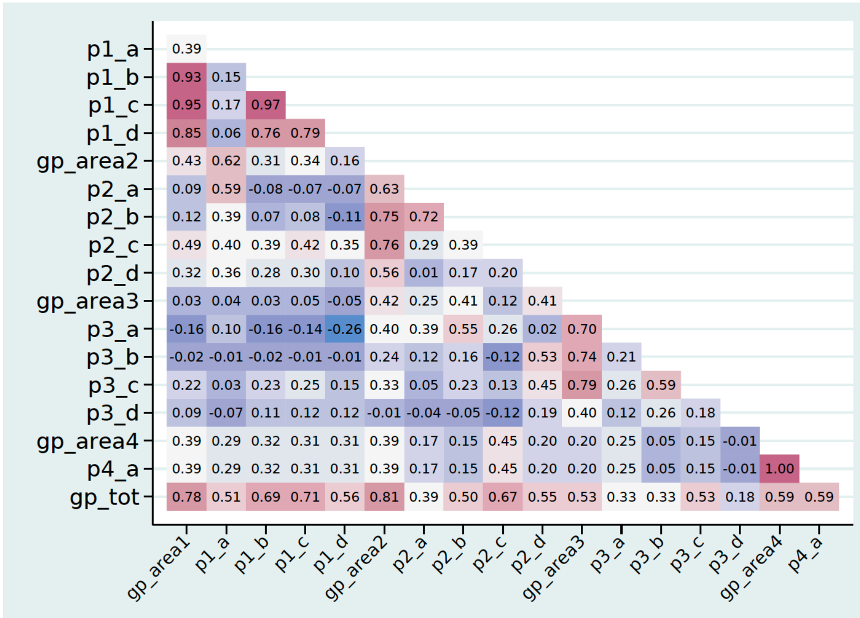
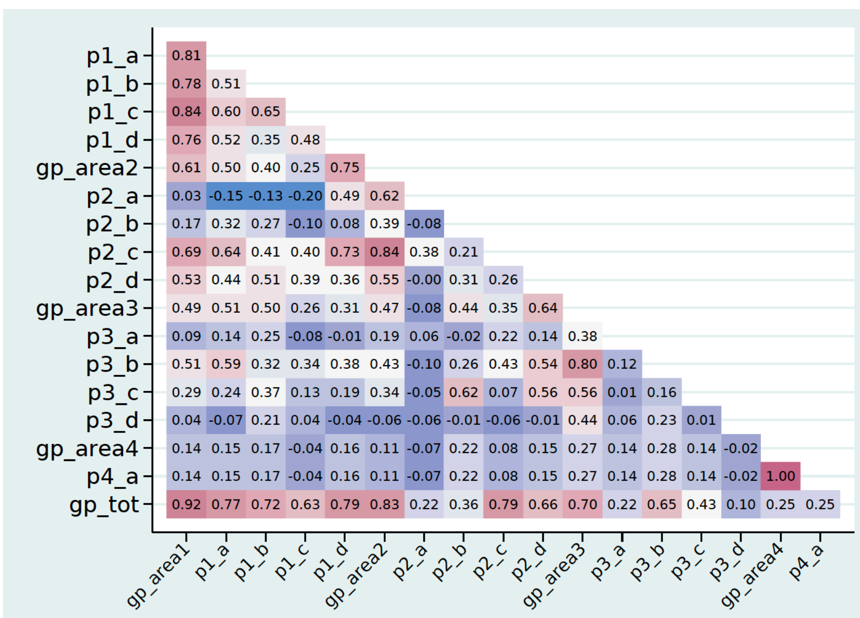
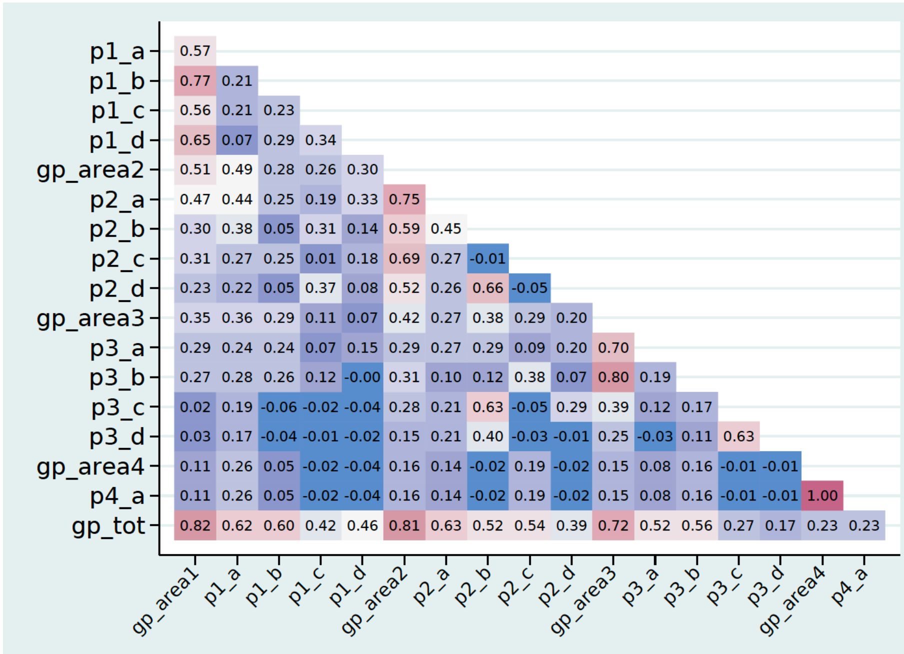


Figure A2. Correlations Between Practices and Practice Areas, OH



Notes for Figures A1 and A2. These correlation heatmaps employ color gradients to indicate the strength and direction of the relationships, with shades of red representing positive correlations, shades of blue indicating negative correlations, and shades of neutral colors (i.e., white or gray) suggesting no or weak correlations.

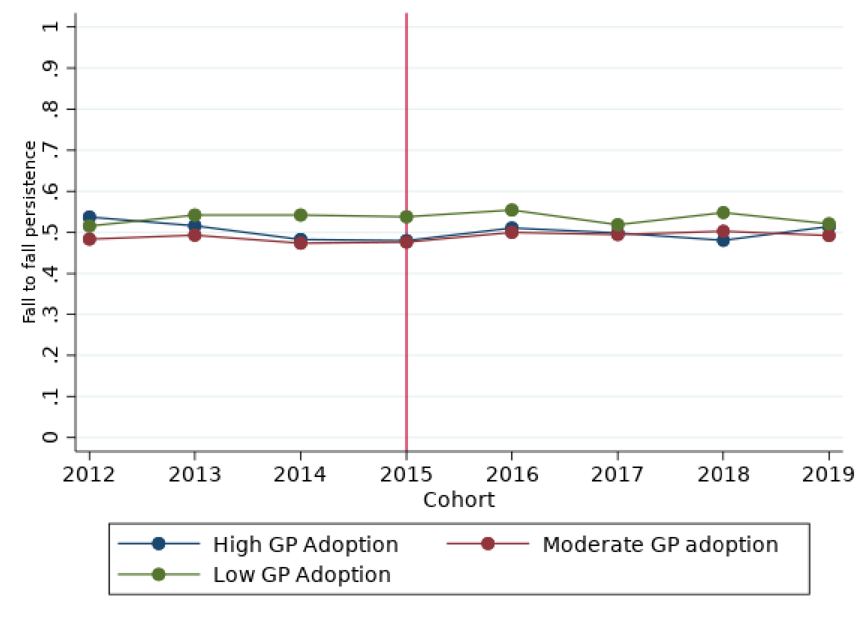
Figure A3. Correlations Between Practices and Practice Areas, WA



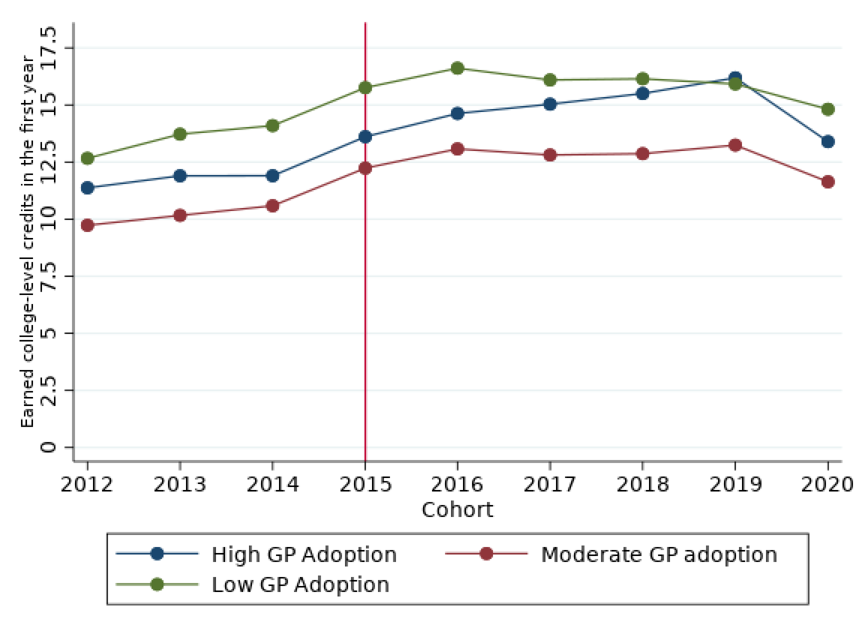
Notes. This correlation heatmap employs color gradients to indicate the strength and direction of the relationships, with shades of red representing positive correlations, shades of blue indicating negative correlations, and shades of neutral colors (i.e., white or gray) suggesting no or weak correlations.

Figure A4. Trends in Early Student Outcomes, TN

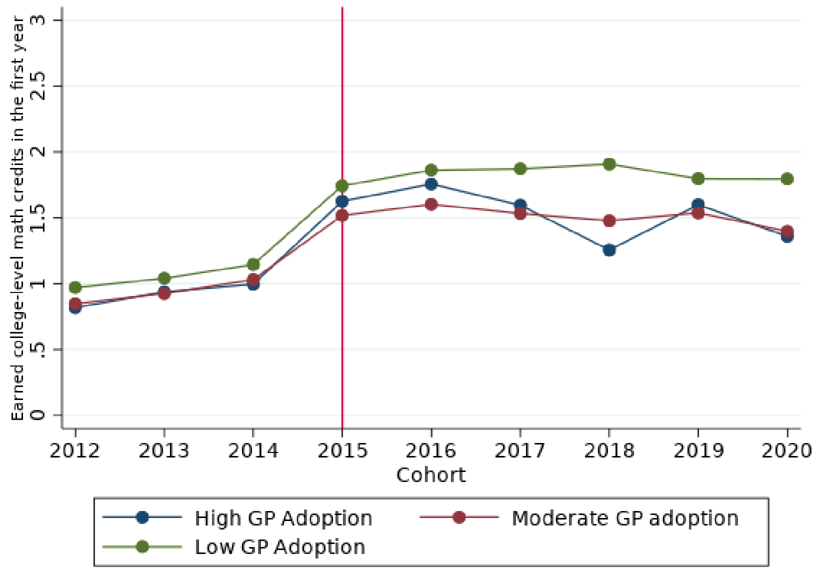
A. Fall-to-Fall Persistence



B. College-Level Credits Earned in First Year



C. College-Level Math Credits Earned in First Year



D. College-Level STEM Credits Earned in First Year

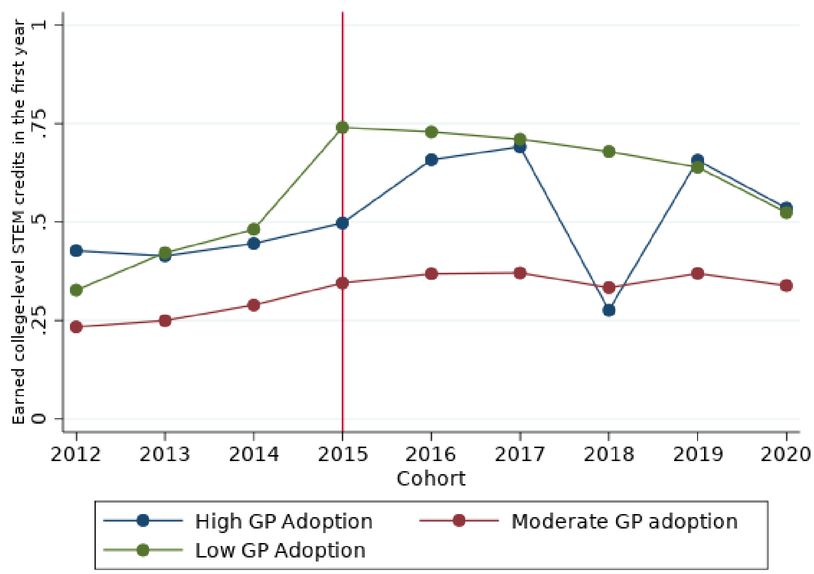
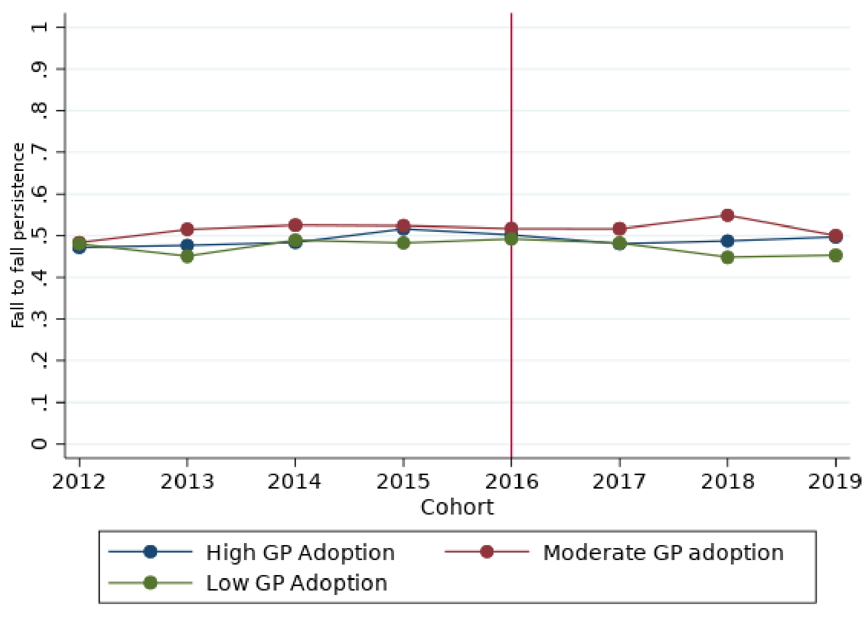
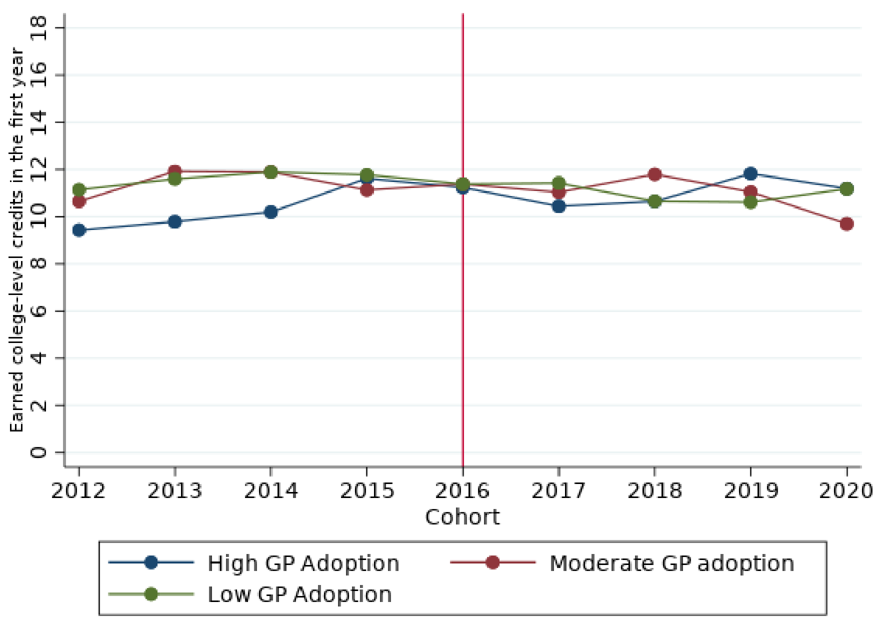


Figure A5. Trends in Early Student Outcomes, OH

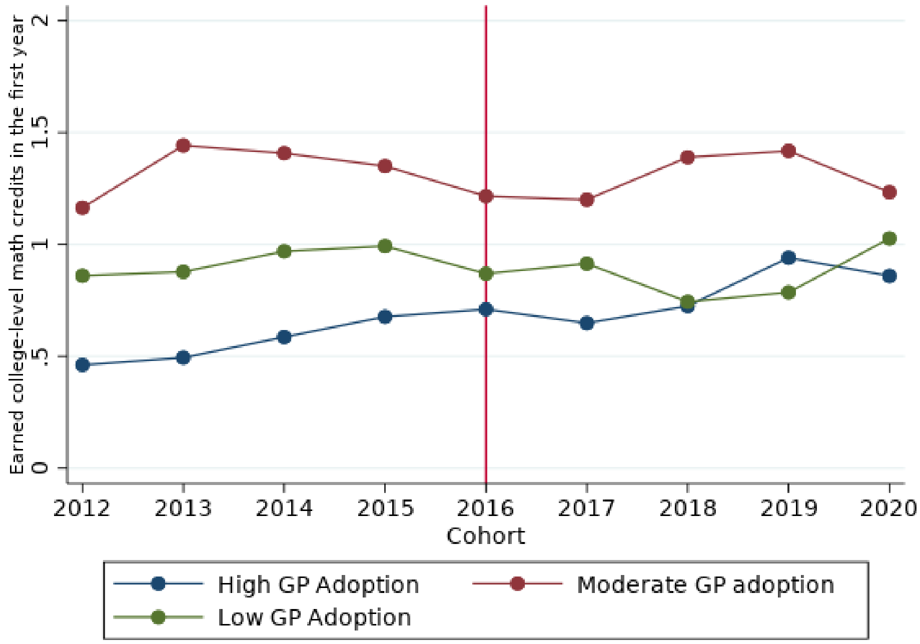
A. Fall-to-Fall Persistence



B. College-Level Credits Earned in First Year



C. College-Level Math Credits Earned in First Year



D. College-Level STEM Credits Earned in First Year

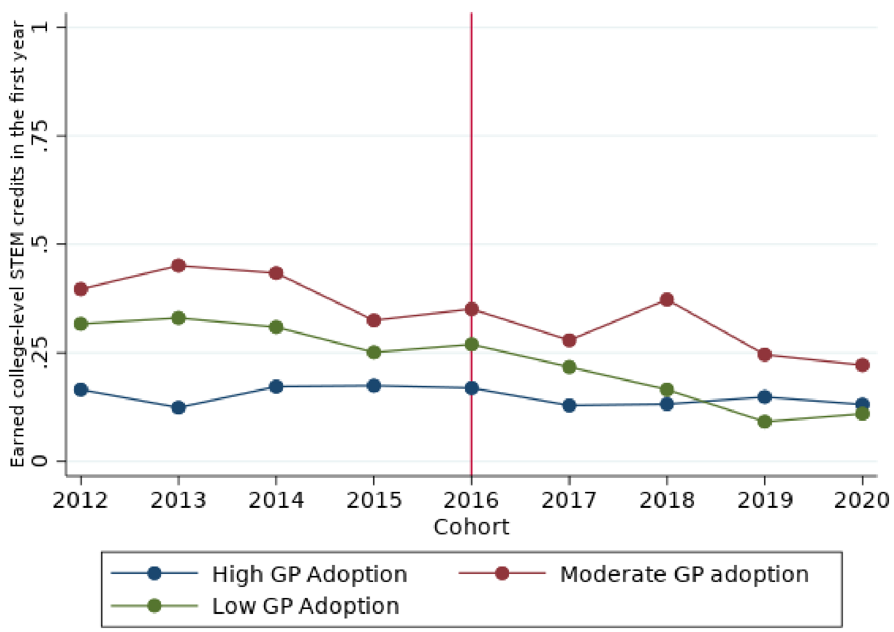
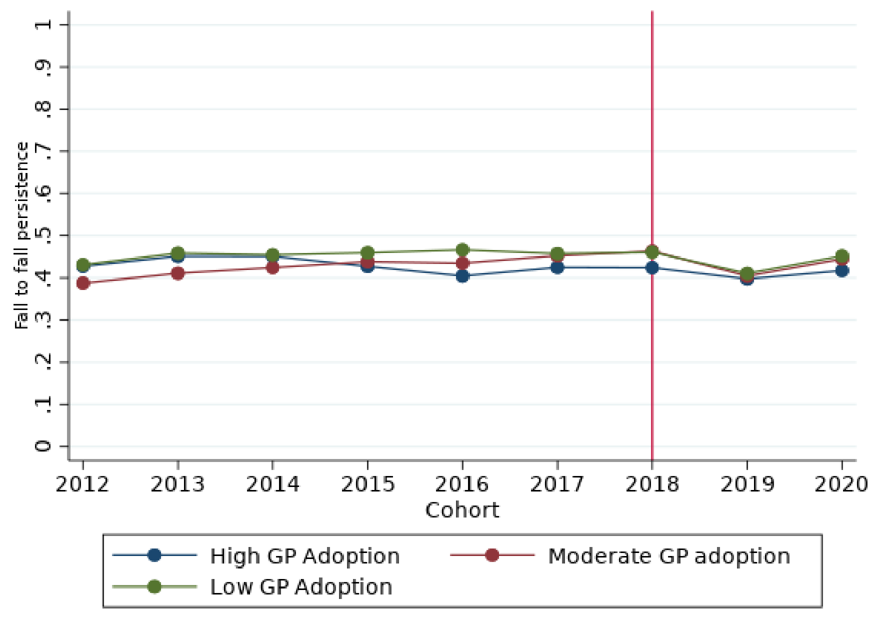
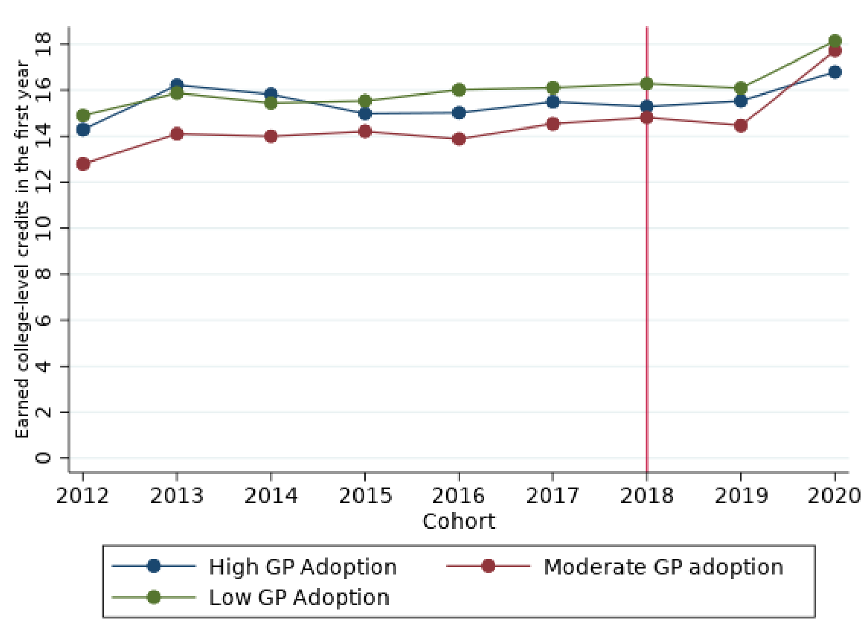


Figure A6. Trends in Early Student Outcomes, WA

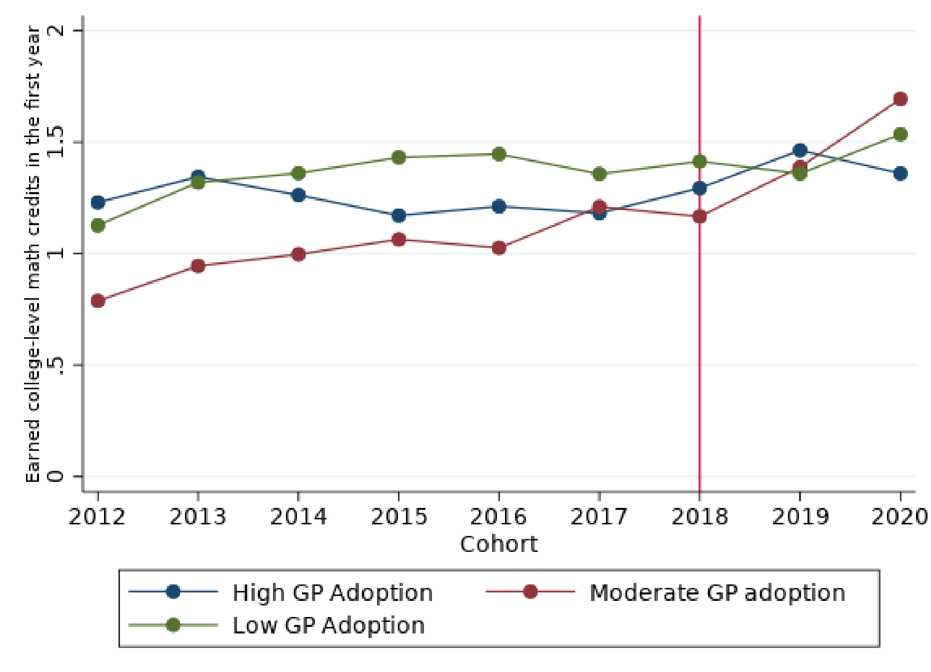
A. Fall-to-Fall Persistence



B. College-Level Credits Earned in First Year



C. College-Level Math Credits Earned in First Year



D. College-Level STEM Credits Earned in First Year

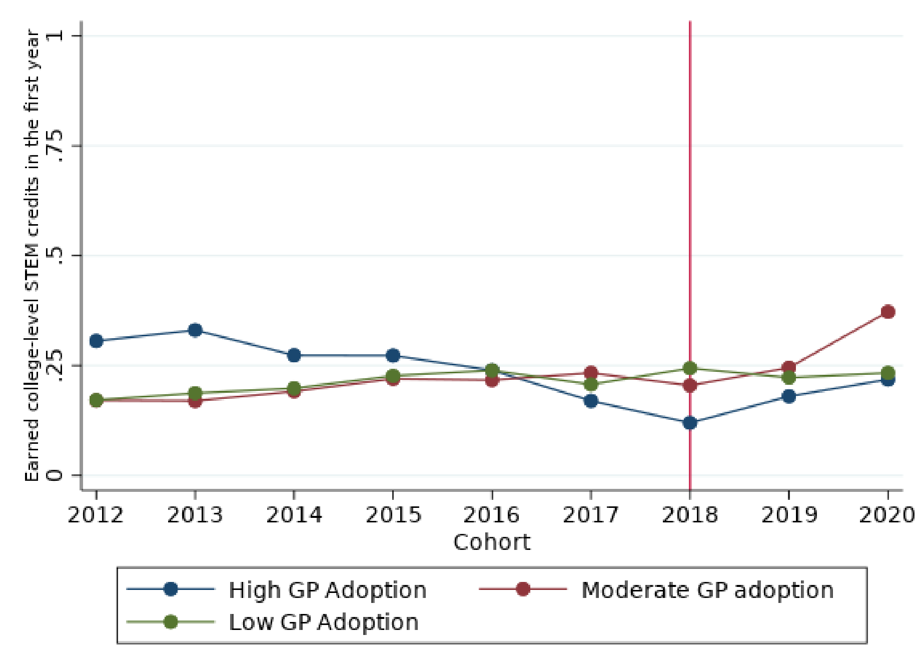


Table A1. Characteristics and Outcomes of Entering Students by Colleges' Intensity of Adoption, TN

	(1)	(2)	(3)	(4)	(5)	(6)
	Low		Moderate		High	
	Before	After	Before	After	Before	After
A. FTIC student characteristics at entry						
Age	20.06	19.76	21.24	20.42	20.95	20.33
	(4.918)	(4.746)	(6.394)	(5.805)	(6.076)	(5.699)
Female	0.57	0.57	0.55	0.55	0.57	0.57
	(0.495)	(0.495)	(0.498)	(0.497)	(0.495)	(0.495)
Asian	0.01	0.02	0.02	0.02	0.01	0.01
	(0.100)	(0.130)	(0.139)	(0.131)	(0.093)	(0.091)
Black	0.07	0.09	0.28	0.25	0.06	0.06
	(0.261)	(0.280)	(0.451)	(0.430)	(0.229)	(0.242)
Hispanic	0.05	0.09	0.05	0.08	0.04	0.06
	(0.217)	(0.292)	(0.221)	(0.270)	(0.201)	(0.240)
White	0.84	0.76	0.61	0.61	0.87	0.84
	(0.369)	(0.426)	(0.488)	(0.488)	(0.338)	(0.365)
Other race	0.04	0.06	0.05	0.06	0.03	0.03
	(0.191)	(0.232)	(0.225)	(0.238)	(0.179)	(0.180)
Recent high school graduate	0.78	0.84	0.68	0.78	0.71	0.79
	(0.411)	(0.367)	(0.466)	(0.412)	(0.452)	(0.404)
Pell eligible	0.29	0.56	0.31	0.63	0.30	0.63
	(0.452)	(0.496)	(0.464)	(0.482)	(0.459)	(0.483)
High school GPA	2.77	2.51	2.40	2.30	2.62	2.50
	(0.953)	(0.830)	(1.043)	(0.883)	(1.012)	(0.831)
B. Outcomes in first year						
College-level credits earned	13.95	15.86	10.64	12.83	11.89	14.89
	(10.57)	(11.37)	(9.707)	(10.78)	(10.16)	(11.35)
Fall-to-fall persistence	0.54	0.45	0.48	0.42	0.50	0.41
	(0.498)	(0.497)	(0.500)	(0.494)	(0.500)	(0.491)
College-level math credits earned	1.10	1.83	0.95	1.47	0.95	1.53
	(1.853)	(2.140)	(1.821)	(2.078)	(1.854)	(2.002)
College-level STEM credits earned	0.47	0.65	0.27	0.35	0.41	0.56
	(1.771)	(2.149)	(1.252)	(1.473)	(1.550)	(1.795)
Number of students	5,699	19,184	20,641	52,742	2,731	5,759

Notes. "Before" refers to the years 2013 and 2014, and "After" refers to the years 2016 through 2020, following the launch of statewide adoption of guided pathways reforms in 2015. Low adopters are colleges that, by fall 2020, scaled 4 or fewer practices (about 30% of the guided pathways model); moderate adopters scaled 5–8 practices; and high adopters scaled 9–13 practices (at least 70% of the guided pathways model). "Other race" includes multi-racial, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander. Standard errors in parentheses.

Table A2. Characteristics and Outcomes of Entering Students by Colleges' Intensity of Adoption, OH

	(1)	(2)	(3)	(4)	(5)	(6)
	Low		Moderate		High	
	Before	After	Before	After	Before	After
A. FTIC student characteristics at entry						
Age of HS entry	24.07	23.39	22.71	22.63	23.13	21.46
	(9.113)	(8.546)	(8.035)	(7.818)	(8.556)	(6.909)
Female	0.48	0.46	0.49	0.48	0.48	0.51
	(0.500)	(0.498)	(0.500)	(0.500)	(0.500)	(0.500)
Asian	0.02	0.02	0.03	0.03	0.01	0.02
	(0.137)	(0.125)	(0.161)	(0.176)	(0.119)	(0.142)
Black	0.20	0.19	0.18	0.20	0.11	0.13
	(0.403)	(0.389)	(0.385)	(0.401)	(0.315)	(0.340)
Hispanic	0.06	0.07	0.05	0.06	0.07	0.09
	(0.232)	(0.262)	(0.214)	(0.238)	(0.249)	(0.287)
White	0.64	0.60	0.64	0.58	0.69	0.68
	(0.481)	(0.490)	(0.479)	(0.494)	(0.463)	(0.466)
Other race	0.13	0.15	0.17	0.17	0.15	0.10
	(0.337)	(0.353)	(0.375)	(0.377)	(0.361)	(0.294)
Recent HS grad	0.50	0.52	0.57	0.58	0.57	0.66
	(0.500)	(0.499)	(0.495)	(0.494)	(0.496)	(0.472)
B. Outcomes in first year						
College-level credits earned	11.63	11.63	11.52	11.17	10.80	11.21
	(10.49)	(10.29)	(10.86)	(10.62)	(10.01)	(10.18)
Fall-to-fall persistence	0.48	0.39	0.51	0.38	0.49	0.39
	(0.500)	(0.487)	(0.500)	(0.485)	(0.500)	(0.487)
College-level math credits earned	0.90	0.93	1.29	1.22	0.64	0.81
	(2.053)	(1.854)	(2.609)	(2.388)	(1.698)	(1.680)
College-level STEM credits earned	0.21	0.13	0.34	0.25	0.17	0.15
	(1.392)	(1.064)	(1.802)	(1.545)	(1.112)	(1.019)
Number of students	24,298	28,920	16,112	25,014	5,639	7,242

Notes. "Before" refers to the years 2014 and 2015, and "After" refers to the years 2017 through 2020, following the launch of statewide adoption of guided pathways reforms in 2016. Low adopters are colleges that by fall 2020, have scaled 4 or fewer practices (about 30% of the guided pathways model); moderate adopters scaled 5–8 practices; and high adopters scaled 9–13 practices (at least 70% of the guided pathways model). "Other race" includes multi-racial, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander. Standard errors in parentheses.

Table A3. Characteristics and Outcomes of Entering Students by Colleges' Intensity of Adoption, WA

	(1)	(2)	(3)	(4)	(5)	(6)
	Low		Moderate		High	
	Before	After	Before	After	Before	After
A. FTIC student characteristics at entry						
Age	25.66	25.63	25.89	25.46	25.51	25.88
	(10.36)	(10.35)	(10.47)	(10.43)	(10.28)	(10.45)
Female	0.48	0.49	0.54	0.56	0.52	0.52
	(0.500)	(0.500)	(0.498)	(0.497)	(0.500)	(0.499)
Asian	0.14	0.12	0.09	0.07	0.05	0.05
	(0.350)	(0.319)	(0.291)	(0.252)	(0.225)	(0.210)
Black	0.05	0.05	0.03	0.04	0.03	0.03
	(0.221)	(0.224)	(0.181)	(0.191)	(0.159)	(0.171)
Hispanic	0.05	0.05	0.04	0.05	0.08	0.05
	(0.221)	(0.225)	(0.204)	(0.223)	(0.266)	(0.218)
White	0.52	0.53	0.53	0.52	0.65	0.61
	(0.499)	(0.499)	(0.499)	(0.500)	(0.478)	(0.488)
Other race	0.31	0.31	0.33	0.34	0.23	0.28
	(0.464)	(0.461)	(0.471)	(0.472)	(0.420)	(0.448)
Recent high school graduate	0.27	0.30	0.27	0.30	0.31	0.29
	(0.442)	(0.460)	(0.443)	(0.459)	(0.462)	(0.455)
Disability	0.06	0.05	0.06	0.06	0.06	0.07
	(0.234)	(0.214)	(0.241)	(0.228)	(0.229)	(0.248)
Economically disadvantaged	0.29	0.32	0.32	0.34	0.33	0.34
	(0.453)	(0.465)	(0.466)	(0.472)	(0.471)	(0.473)
Academically disadvantaged	0.31	0.18	0.27	0.19	0.41	0.26
	(0.462)	(0.382)	(0.443)	(0.392)	(0.493)	(0.440)
B. Outcomes in first year						
College-level credits earned	16.27	16.97	14.47	15.85	15.38	16.11
	(16.20)	(16.52)	(15.79)	(16.53)	(15.45)	(15.84)
Fall-to-fall persistence	0.46	0.43	0.44	0.42	0.42	0.41
	(0.498)	(0.495)	(0.496)	(0.494)	(0.493)	(0.491)
College-level math credits earned	1.38	1.42	1.08	1.44	1.22	1.44
	(3.226)	(3.192)	(2.699)	(2.963)	(2.761)	(2.982)
College-level STEM credits earned	0.22	0.23	0.19	0.24	0.21	0.20
	(1.511)	(1.525)	(1.220)	(1.408)	(1.518)	(1.402)
Number of students	49,261	38,519	11,096	9,106	4,103	3,233

Notes. "Before" refers to the years 2016 and 2017, and "After" refers to the years 2019 through 2020, following the launch of statewide adoption of guided pathways reforms in 2018. Low adopters are colleges that by fall 2020, have scaled 4 or fewer practices (about 30% of the guided pathways model); moderate adopters scaled 5–8 practices; and high adopters scaled 9–13 practices (at least 70% of the guided pathways model). "Other race" includes multi-racial, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander. Standard errors in parentheses.

Table A4. Association Between Guided Pathways Practices and College-Level Credits Earned in the First Year, TN

	(1) College-level credits earned in the first year	(2) College-level credits earned in the first year	(3) College-level credits earned in the first year	(4) College-level credits earned in the first year
Practice 1a - meta-majors	-2.047*** (0.600)	-1.366* (0.670)	-1.863*** (0.527)	-1.431** (0.567)
Practice 1b - CTE maps	1.106*** (0.264)	0.679*** (0.155)	0.157 (0.286)	0.207 (0.158)
Practice 1c - transfer pre-major maps	-3.261*** (0.771)	-1.570*** (0.438)	-1.590** (0.527)	-0.953 (0.555)
Practice 1d - math pathways	1.815** (0.713)	0.950* (0.495)	1.530*** (0.448)	0.541 (0.558)
Practice 2a - meta-major exposure	2.166** (0.886)	0.879 (0.538)	1.827* (0.872)	1.187** (0.507)
Practice 2b - career assessment	1.894* (0.884)	0.186 (0.597)	-0.422 (0.653)	0.446 (0.540)
Practice 2c - early program-related courses	-1.118 (0.692)	-0.191 (0.294)	-0.544** (0.241)	-0.147 (0.267)
Practice 2d - mandatory educational planning	2.310** (0.865)	0.434 (0.538)	1.250** (0.471)	0.343 (0.529)
Practice 3a - mandatory advising	-2.738*** (0.497)	-0.329 (0.610)	0.0311 (0.331)	-0.588 (0.616)
Practice 3b - caseload advising by field	0.549 (1.089)	-0.554 (0.485)	-0.542 (0.477)	-0.342 (0.608)
Practice 3c - progress monitoring	-0.367 (0.547)	-0.323 (0.298)	-0.234 (0.361)	-0.336 (0.229)
Practice 3d - scheduling for on-time completion	0.529 (0.351)	1.108** (0.399)	-0.366 (0.321)	1.173** (0.424)
Practice 4a - coreq college math	-0.124 (0.289)	0.629* (0.328)	0.855** (0.343)	0.903*** (0.280)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	139,612	139,612	139,612	139,612
R-squared	0.0358	0.219	0.218	0.220

Note. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5. Association Between Guided Pathways Practices and Fall-to-Fall Persistence, TN

	(1) Fall-to-fall persistence	(2) Fall-to-fall persistence	(3) Fall-to-fall persistence	(4) Fall-to-fall persistence
Practice 1a - meta-majors	-0.0308* (0.0142)	0.00759 (0.0217)	-0.0152 (0.0147)	-0.0103 (0.0196)
Practice 1b - CTE maps	0.0400*** (0.00565)	0.00226 (0.00739)	0.0111 (0.0108)	-0.0105 (0.00884)
Practice 1c - transfer pre-major maps	-0.0717*** (0.0111)	-0.0262*** (0.00771)	-0.0451*** (0.00902)	-0.00712 (0.0115)
Practice 1d - math Pathways	0.0247** (0.00957)	0.0112* (0.00630)	0.0332*** (0.00714)	0.00524 (0.00822)
Practice 2a - meta-major exposure	0.0303 (0.0172)	-0.0131 (0.0140)	0.0125 (0.0144)	0.0000419 (0.0114)
Practice 2b - career assessment	-0.00368 (0.0166)	-0.00877 (0.0217)	-0.0481*** (0.0139)	-0.00242 (0.0197)
Practice 2c - early program-related courses	-0.0190 (0.0148)	-0.00279 (0.00510)	-0.00421 (0.00978)	0.00668 (0.00578)
Practice 2d - mandatory educational planning	0.0535*** (0.0174)	0.0189 (0.0207)	0.0274** (0.0102)	0.0188 (0.0206)
Practice 3a - mandatory advising	-0.00942 (0.00805)	0.0202 (0.0167)	0.0493*** (0.0117)	-0.00545 (0.0148)
Practice 3b - caseload advising by field	-0.0262 (0.0175)	-0.0340*** (0.0106)	-0.0464** (0.0177)	-0.00199 (0.0115)
Practice 3c - progress monitoring	-0.00761 (0.0106)	0.000235 (0.0126)	-0.00172 (0.0132)	-0.00406 (0.0103)
Practice 3d - scheduling for on-time completion	-0.0154* (0.00785)	-0.00719 (0.0134)	-0.0271** (0.0108)	-0.0103 (0.0104)
Practice 4a - coreq college math	-0.0114 (0.0138)	0.00323 (0.0138)	0.0121 (0.0127)	0.0177* (0.00869)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	139,612	139,612	139,612	139,612
R-squared	0.0853	0.159	0.158	0.159

Note. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A6. Association Between Guided Pathways Practices and College-Level Math Credits Earned in the First Year, TN

	(1) College-level math credits earned in the first year	(2) College-level math credits earned in the first year	(3) College-level math credits earned in the first year	(4) College-level math credits earned in the first year
Practice 1a - meta-majors	0.0115 (0.0920)	-0.0307 (0.0879)	0.287*** (0.0868)	0.0116 (0.0942)
Practice 1b - CTE maps	-0.249*** (0.0659)	-0.0485 (0.0398)	-0.415*** (0.0657)	-0.0826* (0.0380)
Practice 1c - transfer pre-major maps	-0.0594 (0.241)	-0.359** (0.137)	0.0643 (0.157)	-0.293* (0.142)
Practice 1d - math pathways	0.588** (0.221)	0.362** (0.152)	0.514*** (0.141)	0.281* (0.148)
Practice 2a - meta-major exposure	0.353** (0.158)	0.102 (0.0922)	0.167 (0.145)	0.160 (0.102)
Practice 2b - career assessment	0.181 (0.180)	0.0428 (0.0942)	0.0311 (0.127)	0.0439 (0.0587)
Practice 2c - early program-related courses	-0.424** (0.159)	0.0622 (0.0819)	-0.370*** (0.0715)	0.0479 (0.0713)
Practice 2d - mandatory educational planning	0.0346 (0.0837)	0.0442 (0.0492)	-0.230*** (0.0461)	-0.0170 (0.0471)
Practice 3a - mandatory advising	-0.208** (0.0879)	-0.0393 (0.0708)	0.204** (0.0932)	-0.0347 (0.0959)
Practice 3b - caseload advising by field	0.0452 (0.115)	0.148* (0.0816)	-0.239* (0.134)	0.0603 (0.107)
Practice 3c - progress monitoring	-0.264* (0.139)	0.00169 (0.0669)	-0.0381 (0.0708)	0.0438 (0.0622)
Practice 3d - scheduling for on-time completion	0.0145 (0.130)	0.0655 (0.0562)	0.163 (0.0953)	0.136*** (0.0424)
Practice 4a - coreq college math	-0.110 (0.101)	0.00821 (0.0513)	-0.0379 (0.0830)	-0.0230 (0.0513)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	139,612	139,612	139,612	139,612
R-squared	0.0388	0.149	0.143	0.149

Note. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A7. Association between Guided Pathways Practices and College-Level STEM Credits Earned in the First Year, TN

	(1) College-level STEM credits earned in the first year	(2) College-level STEM credits earned in the first year	(3) College-level STEM credits earned in the first year	(4) College-level STEM credits earned in the first year
Practice 1a - meta-majors	-0.242^{**}	0.0582	-0.218^{*}	0.0949
	(0.0892)	(0.0645)	(0.113)	(0.0713)
Practice 1b - CTE maps	-0.105	-0.0425	-0.0945	-0.0422
	(0.0680)	(0.0403)	(0.0837)	(0.0326)
Practice 1c - transfer pre-major maps	-0.0358	-0.000899	0.0797	-0.00685
	(0.108)	(0.0273)	(0.0677)	(0.0227)
Practice 1d - math pathways	0.322^{***}	0.0672^{**}	0.275^{***}	0.0805^{**}
	(0.0901)	(0.0279)	(0.0706)	(0.0360)
Practice 2a - meta-major exposure	0.151	-0.0337	0.0855	-0.0505
	(0.118)	(0.0319)	(0.101)	(0.0445)
Practice 2b - career assessment	0.298^{*}	0.0470	0.158	0.0558
	(0.147)	(0.0445)	(0.127)	(0.0412)
Practice 2c - early program-related courses	-0.261^{**}	-0.0345	-0.281^{***}	-0.0587
	(0.111)	(0.0473)	(0.0709)	(0.0511)
Practice 2d - mandatory Educational planning	0.214^{**}	-0.00111	0.166^{**}	-0.0108
	(0.0897)	(0.0460)	(0.0703)	(0.0387)
Practice 3a - mandatory advising	-0.220^{***}	0.0493	0.0254	0.0657
	(0.0694)	(0.0464)	(0.0949)	(0.0676)
Practice 3b - caseload advising by field	-0.0477	-0.0127	-0.166	-0.0453
	(0.0535)	(0.0356)	(0.110)	(0.0504)
Practice 3c - progress monitoring	-0.0116	-0.00731	-0.0321	-0.00198
	(0.0732)	(0.0472)	(0.0531)	(0.0412)
Practice 3d - scheduling for on-time completion	0.157^{*}	0.147^{***}	0.0115	0.164^{***}
	(0.0848)	(0.0382)	(0.0865)	(0.0347)
Practice 4a - coreq college math	0.0573	0.0658	0.0780	0.0518
	(0.0930)	(0.0375)	(0.0950)	(0.0351)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	139,612	139,612	139,612	139,612
R-squared	0.0154	0.0560	0.0491	0.0561

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A8. Association Between Guided Pathways Practices and College-Level Credits Earned in the First Year, OH

	(1) College-level credits earned in the first year	(2) College-level credits earned in the first year	(3) College-level credits earned in the first year	(4) College-level credits earned in the first year
Practice 1a - meta-majors	0.770 (0.808)	0.702 (0.804)	0.997 (0.689)	0.802 (0.595)
Practice 1b - CTE maps	-0.599 (0.544)	-0.374 (0.547)	-0.706 (0.478)	-0.493 (0.396)
Practice 1c - transfer pre-major maps	-0.861 (0.698)	0.566 (1.079)	-0.808 (0.562)	0.109 (0.896)
Practice 1d - math pathways	0.292 (0.493)	0.652 (0.715)	0.631 (0.530)	0.488 (0.545)
Practice 2a - meta-major exposure	0.136 (0.571)	0.259 (0.777)	1.082** (0.487)	0.553 (0.636)
Practice 2b - career assessment	-0.270 (0.415)	-0.382 (0.339)	0.138 (0.439)	0.0708 (0.406)
Practice 2c - early program-related courses	-0.0667 (0.839)	-1.123 (0.813)	-0.237 (0.849)	-0.717 (0.570)
Practice 2d - mandatory educational planning	-0.488 (0.570)	-0.470 (0.380)	-0.709* (0.370)	-0.536 (0.371)
Practice 3a - mandatory advising	1.259* (0.601)	2.456*** (0.643)	1.680*** (0.436)	2.190*** (0.682)
Practice 3b - caseload advising by field	-0.0633 (0.724)	0.430 (0.516)	0.385 (0.390)	0.776 (0.488)
Practice 3c - progress monitoring	0.527 (0.395)	1.313* (0.630)	0.212 (0.364)	1.011* (0.565)
Practice 3d - scheduling for on-time completion	3.820** (1.435)	1.154 (0.726)	2.676*** (0.850)	1.000* (0.552)
Practice 4a - coreq college math	1.948 (1.458)	0.109 (0.629)	1.203 (1.267)	0.0341 (0.690)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
R-squared	0.00495	0.0768	0.0728	0.0776
N	179,998	179,998	179,998	179,998

Notes. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A9. Association Between Guided Pathways Practices and Fall-to-Fall Persistence, OH

	(1) Fall-to-fall persistence	(2) Fall-to-fall persistence	(3) Fall-to-fall persistence	(4) Fall-to-fall persistence
Practice 1a - meta-majors	-0.000118 (0.0232)	0.00209 (0.0278)	-0.00888 (0.0258)	-0.0205 (0.0273)
Practice 1b - CTE maps	0.0500*** (0.0147)	0.0452*** (0.0134)	0.0248 (0.0153)	0.0292* (0.0145)
Practice 1c - transfer pre-major maps	-0.0622*** (0.0206)	-0.0324 (0.0312)	-0.0705*** (0.0162)	-0.0374 (0.0258)
Practice 1d - math pathways	0.0268 (0.0177)	0.0187 (0.0168)	0.0454** (0.0160)	0.0113 (0.0139)
Practice 2a - meta-major exposure	-0.0361 (0.0354)	-0.0101 (0.0305)	0.00846 (0.0145)	0.00174 (0.0247)
Practice 2b - career assessment	0.0362* (0.0188)	-0.0203* (0.0108)	0.0363* (0.0206)	0.00397 (0.0126)
Practice 2c - early program-related courses	-0.00455 (0.0138)	-0.0273* (0.0150)	0.00276 (0.0203)	-0.00160 (0.0177)
Practice 2d - mandatory educational planning	-0.00860 (0.0157)	-0.00127 (0.0223)	-0.00118 (0.0183)	-0.00145 (0.0197)
Practice 3a - mandatory advising	-0.0727* (0.0395)	0.0121 (0.0199)	-0.0489** (0.0222)	0.0173 (0.0166)
Practice 3b - caseload advising by field	-0.0274** (0.0126)	0.0114 (0.0214)	-0.0337* (0.0161)	0.0168 (0.0204)
Practice 3c - progress monitoring	-0.0386** (0.0170)	-0.0163 (0.0221)	-0.0506*** (0.0159)	-0.0176 (0.0178)
Practice 3d - scheduling for on-time completion	0.0363* (0.0194)	0.00320 (0.0255)	0.0606** (0.0226)	-0.00371 (0.0273)
Practice 4a - coreq college math	-0.0309* (0.0157)	-0.0391* (0.0215)	-0.0391* (0.0214)	-0.0507** (0.0199)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
R-squared	0.0649	0.112	0.110	0.112
N	179,998	179,998	179,998	179,998

Notes. Standard errors in parentheses.

**p* < 0.10, ***p* < 0.05, ****p* < 0.01.

Table A10. Between Guided Pathways Practices and College-Level Math Credits Earned in the First Year, OH

	(1) College-level math credits earned in the first year	(2) College-level math credits earned in the first year	(3) College-level math credits earned in the first year	(4) College-level math credits earned in the first year
Practice 1a - meta-majors	0.318**	0.0592	0.228	0.0837
	(0.149)	(0.0930)	(0.135)	(0.0718)
Practice 1b - CTE maps	0.134	0.302***	-0.0315	0.288***
	(0.137)	(0.0887)	(0.150)	(0.0709)
Practice 1c - transfer pre-major maps	-0.333*	-0.131	-0.294*	-0.203
	(0.163)	(0.148)	(0.152)	(0.136)
Practice 1d - math pathways	0.269**	0.203*	0.248**	0.188*
	(0.124)	(0.0996)	(0.103)	(0.0924)
Practice 2a - meta-major exposure	-0.359	-0.00115	0.0424	0.0236
	(0.234)	(0.0935)	(0.127)	(0.0816)
Practice 2b - career assessment	-0.336**	-0.0937	-0.122	-0.0453
	(0.130)	(0.0586)	(0.120)	(0.0513)
Practice 2c - early program-related courses	0.0570	-0.169*	0.105	-0.120
	(0.145)	(0.0897)	(0.165)	(0.0871)
Practice 2d - mandatory educational planning	-0.269	-0.388***	-0.246	-0.393***
	(0.170)	(0.117)	(0.154)	(0.116)
Practice 3a - mandatory advising	-0.210	0.860***	-0.113	0.804***
	(0.392)	(0.189)	(0.303)	(0.197)
Practice 3b - caseload advising by field	-0.158	-0.0681	-0.102	-0.0342
	(0.132)	(0.108)	(0.187)	(0.0958)
Practice 3c - progress monitoring	-0.135	0.245**	-0.149	0.195*
	(0.124)	(0.108)	(0.0982)	(0.102)
Practice 3d - scheduling for on-time completion	0.373*	-0.133	0.420	-0.143
	(0.198)	(0.156)	(0.290)	(0.140)
Practice 4a - coreq college math	-0.0752	0.0614	-0.0579	0.0552
	(0.112)	(0.110)	(0.118)	(0.124)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
R-squared	0.00600	0.0721	0.0636	0.0723
N	179,998	179,998	179,998	179,998

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A11. Association Between Guided Pathways Practices and College-Level STEM Credits Earned in the First Year, OH

	(1) College-level STEM credits earned in the first year	(2) College-level STEM credits earned in the first year	(3) College-level STEM credits earned in the first year	(4) College-level STEM credits earned in the first year
Practice 1a - meta-majors	0.0494 (0.0849)	0.00966 (0.0626)	0.00150 (0.0822)	0.0250 (0.0432)
Practice 1b - CTE maps	-0.0844 (0.0571)	-0.0169 (0.0482)	-0.175** (0.0657)	-0.0344 (0.0339)
Practice 1c - transfer pre-major maps	-0.0461 (0.0697)	0.0613 (0.0741)	-0.00605 (0.0498)	0.0196 (0.0558)
Practice 1d - math pathways	0.118** (0.0512)	0.00744 (0.0575)	0.0834 (0.0639)	-0.0318 (0.0455)
Practice 2a - meta-major exposure	-0.0890 (0.102)	0.0552 (0.0725)	0.106 (0.0678)	0.105 (0.0645)
Practice 2b - career assessment	-0.00490 (0.0551)	-0.0138 (0.0350)	0.102** (0.0461)	0.0371 (0.0303)
Practice 2c - early program-related courses	0.0506 (0.0916)	-0.0675 (0.0884)	0.0771 (0.0933)	-0.0191 (0.0636)
Practice 2d - mandatory educational planning	0.0350 (0.0517)	0.0565 (0.0393)	0.0572 (0.0630)	0.0567 (0.0379)
Practice 3a - mandatory advising	-0.145 (0.0918)	0.0227 (0.0391)	-0.104* (0.0517)	0.00292 (0.0435)
Practice 3b - caseload advising by field	-0.0654 (0.0527)	0.0725* (0.0388)	-0.0392 (0.0729)	0.120*** (0.0415)
Practice 3c - progress monitoring	-0.0576 (0.0470)	0.0468 (0.0415)	-0.0415 (0.0632)	-0.00349 (0.0438)
Practice 3d - scheduling for on-time completion	0.0470 (0.102)	0.100 (0.0961)	0.0941 (0.0972)	0.0935 (0.0624)
Practice 4a - coreq college math	0.0236 (0.0477)	0.0450 (0.0382)	0.0487 (0.0631)	0.0449 (0.0453)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
R-squared	0.00214	0.0216	0.0191	0.0219
N	179,998	179,998	179,998	179,998

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A12. Association Between Guided Pathways Practices and College-Level Credits Earned in the First Year, WA

	(1) College-level credits earned in the first year	(2) College-level credits earned in the first year	(3) College-level credits earned in the first year	(4) College-level credits earned in the first year
Practice 1a - meta-majors	-2.972**	0.585	-1.893**	0.624
	(1.086)	(0.449)	(0.764)	(0.442)
Practice 1b - CTE maps	1.786*	1.019**	1.658***	1.020**
	(0.978)	(0.426)	(0.535)	(0.420)
Practice 1c - transfer pre-major maps	-2.254	-0.290	-1.654*	-0.0965
	(1.474)	(0.678)	(0.876)	(0.721)
Practice 1d - math pathways	0.341	0.872	-0.0591	0.723
	(1.806)	(0.633)	(0.987)	(0.735)
Practice 2a - meta-major exposure	3.131**	0.639	0.118	0.574
	(1.335)	(0.954)	(1.327)	(0.719)
Practice 2b - career assessment	-5.266***	-1.619**	-3.634**	-1.346
	(1.900)	(0.655)	(1.703)	(0.794)
Practice 2c - early program-related courses	-1.696	0.297	0.434	0.256
	(1.368)	(0.480)	(0.742)	(0.509)
Practice 2d - mandatory educational planning	1.900**	0.239	3.103***	-0.139
	(0.775)	(0.473)	(0.910)	(0.510)
Practice 3a - mandatory advising	2.141	-1.288	1.212	-1.023
	(1.621)	(0.809)	(1.229)	(0.990)
Practice 3b - caseload advising by field	-1.019	0.0198	0.151	-0.0739
	(1.488)	(0.415)	(0.876)	(0.465)
Practice 3c - progress monitoring	5.128**	0.913	2.237	0.547
	(2.002)	(0.942)	(1.657)	(1.211)
Practice 3d - scheduling for on-time completion	-1.681	-1.427	2.251	-0.958
	(2.190)	(1.199)	(1.676)	(1.322)
Practice 4a - coreq college math	-1.195	1.530**	-0.814	1.532**
	(1.249)	(0.615)	(0.946)	(0.718)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	285,706	285,706	285,706	285,706
R-squared	0.0132	0.200	0.191	0.200

Notes. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A13. Association Between Guided Pathways Practices and Fall-to-Fall Persistence, WA

	(1) Fall-to-fall persistence	(2) Fall-to-fall persistence	(3) Fall-to-fall persistence	(4) Fall-to-fall persistence
Practice 1a - meta-majors	-0.0207 (0.0182)	-0.00129 (0.00761)	-0.0203* (0.0119)	-0.000322 (0.00716)
Practice 1b - CTE maps	0.0102 (0.0247)	-0.0145 (0.0162)	0.0157 (0.0162)	-0.0149 (0.0178)
Practice 1c - transfer pre-major maps	-0.0589** (0.0275)	0.0153 (0.0224)	-0.0234 (0.0190)	0.0190 (0.0230)
Practice 1d - math pathways	0.00658 (0.0279)	-0.0178 (0.0156)	-0.000591 (0.0144)	-0.0205 (0.0159)
Practice 2a - meta-major exposure	0.0504** (0.0229)	-0.00260 (0.00855)	-0.00850 (0.0173)	-0.00424 (0.00962)
Practice 2b - career assessment	-0.0263 (0.0289)	-0.0284 (0.0179)	0.00441 (0.0246)	-0.0241 (0.0204)
Practice 2c - early program-related courses	-0.0547** (0.0267)	0.0478*** (0.0102)	0.0149 (0.0154)	0.0470*** (0.0103)
Practice 2d - mandatory educational planning	-0.0278* (0.0146)	0.0370*** (0.00985)	0.0153 (0.0138)	0.0295** (0.0108)
Practice 3a - mandatory advising	0.00508 (0.0195)	0.00218 (0.0211)	-0.000752 (0.0168)	0.00836 (0.0221)
Practice 3b - caseload advising by field	-0.00374 (0.0347)	-0.0257*** (0.00824)	-0.0130 (0.0152)	-0.0277*** (0.00851)
Practice 3c - progress monitoring	0.0415 (0.0357)	0.0592*** (0.0188)	0.0143 (0.0220)	0.0524** (0.0223)
Practice 3d - scheduling for on-time completion	-0.117*** (0.0357)	-0.0505** (0.0238)	-0.0415* (0.0221)	-0.0395 (0.0253)
Practice 4a - coreq college math	-0.0280 (0.0374)	0.00282 (0.0173)	-0.0393* (0.0231)	0.00296 (0.0197)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	285,706	285,706	285,706	285,706
R-squared	0.00358	0.0855	0.0819	0.0857

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A14. Association Between Guided Pathways Practices and College-Level Math Credits Earned in the First Year, WA

	(1) College-level math credits earned in the first year	(2) College-level math credits earned in the first year	(3) College-level math credits earned in the first year	(4) College-level math credits earned in the first year
Practice 1a - meta-majors	-0.0883 (0.142)	0.00755 (0.0655)	-0.0192 (0.128)	0.0177 (0.0625)
Practice 1b - CTE maps	0.0914 (0.164)	0.221 (0.151)	0.0518 (0.107)	0.202 (0.155)
Practice 1c - transfer pre-major maps	-0.186 (0.173)	-0.0867 (0.177)	-0.145 (0.133)	-0.0763 (0.171)
Practice 1d - math pathways	0.193 (0.153)	0.282*** (0.0988)	0.211** (0.0981)	0.278*** (0.0998)
Practice 2a - meta-major exposure	0.163 (0.183)	-0.104 (0.0928)	-0.00211 (0.189)	-0.110 (0.0977)
Practice 2b - career assessment	0.413 (0.273)	-0.534*** (0.114)	0.521* (0.284)	-0.559*** (0.134)
Practice 2c - early program-related courses	-0.481** (0.216)	-0.0144 (0.115)	-0.273 (0.198)	-0.0109 (0.113)
Practice 2d - mandatory educational planning	-0.688*** (0.158)	0.129 (0.0876)	-0.517*** (0.156)	0.118 (0.0928)
Practice 3a - mandatory advising	-0.208 (0.127)	0.0674 (0.169)	-0.216* (0.112)	0.0929 (0.207)
Practice 3b - caseload advising by field	0.0348 (0.233)	0.0841 (0.0905)	0.0987 (0.129)	0.0764 (0.0905)
Practice 3c - progress monitoring	-0.0705 (0.241)	0.632*** (0.191)	-0.320* (0.170)	0.634*** (0.182)
Practice 3d - scheduling for on-time completion	-0.681** (0.274)	-0.258 (0.188)	-0.176 (0.205)	-0.185 (0.249)
Practice 4a - coreq college math	-0.114 (0.360)	0.0933 (0.157)	-0.0931 (0.321)	0.105 (0.160)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	285,706	285,706	285,706	285,706
R-squared	0.00629	0.0914	0.0822	0.0915

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A15. Association Between Guided Pathways Practices and College-Level STEM Credits Earned in the First Year, WA

	(1) College-level STEM credits earned in the first year	(2) College-level STEM credits earned in the first year	(3) College-level STEM credits earned in the first year	(4) College-level STEM credits earned in the first year
Practice 1a - meta-majors	-0.0433 (0.0589)	-0.00705 (0.0327)	-0.0207 (0.0657)	-0.00731 (0.0319)
Practice 1b - CTE maps	-0.0284 (0.0617)	0.0995** (0.0382)	-0.0419 (0.0646)	0.0832** (0.0401)
Practice 1c - transfer pre-major maps	-0.0151 (0.110)	0.0121 (0.0537)	-0.0163 (0.0802)	0.0151 (0.0491)
Practice 1d - math pathways	-0.0202 (0.0614)	-0.0102 (0.0227)	0.0140 (0.0560)	-0.0136 (0.0241)
Practice 2a - meta-major exposure	-0.0817 (0.0535)	-0.0904** (0.0392)	-0.0803 (0.0646)	-0.0834** (0.0376)
Practice 2b - career assessment	0.273*** (0.0979)	-0.257*** (0.0649)	0.207 (0.128)	-0.273*** (0.0616)
Practice 2c - early program-related courses	-0.0257 (0.121)	-0.0177 (0.0435)	0.00638 (0.129)	-0.0114 (0.0418)
Practice 2d - mandatory educational planning	-0.222*** (0.0380)	-0.0439 (0.0285)	-0.216*** (0.0522)	-0.0366 (0.0283)
Practice 3a - mandatory advising	-0.0252 (0.0429)	0.111 (0.0817)	0.0242 (0.0606)	0.121 (0.0811)
Practice 3b - caseload advising by field	0.0245 (0.0694)	-0.0364 (0.0386)	0.0425 (0.0498)	-0.0364 (0.0354)
Practice 3c - progress monitoring	-0.266*** (0.0887)	0.154** (0.0686)	-0.336*** (0.0794)	0.146** (0.0667)
Practice 3d - scheduling for on-time completion	0.0334 (0.0693)	0.244** (0.0974)	0.234*** (0.0829)	0.273** (0.101)
Practice 4a - coreq college math	-0.0784 (0.124)	0.0264 (0.0458)	-0.0417 (0.109)	0.0294 (0.0399)
Cohort FE	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	Yes
Institutional controls	No	No	Yes	Yes
Institution FE	No	No	No	Yes
N	285,706	285,706	285,706	285,706
R-squared	0.00145	0.0231	0.0151	0.0231

Notes. Standard errors in parentheses.

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.