



Teacher Workforce Planning Tool

Link to Shiny App: <https://mattfaiello.shinyapps.io/TWPT/>

Link to GitHub repository: <https://github.com/MatthewFaiello/twpt/tree/main>

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Intended Use

The Teacher Workforce Planning Tool (TWPT) is designed to support long-term enrollment and teacher workforce planning as part of a broader strategic effort. It provides a foundation for examining historical trends, modeling future scenarios, and helping stakeholders better understand potential teacher staffing trajectories over time.

At the same time, the tool is not intended to capture the full complexity of the teacher workforce landscape. Staffing decisions are influenced by factors that extend beyond any single model, including local labor-market conditions, school context, working conditions, compensation, and policy changes. For that reason, TWPT should be used alongside local knowledge, contextual insight, and additional data sources to support well-rounded, data-informed planning decisions.

The current version of the TWPT is available at: <https://mattfaiello.shinyapps.io/TWPT/>

Teacher Workforce Planning Tool

TWPT is an interactive web-based application designed to support Delaware’s Local Education Agencies (LEAs) in making informed, data-driven staffing decisions. By forecasting county-level population trends, school enrollment, educational service needs, and teacher workforce demand, TWPT provides a transparent and consistent platform for long-term workforce planning. The tool draws on trusted, state-managed data sources, including the Delaware Population Consortium’s (DPC) population projections and the Delaware Department of Education’s (DDOE) Student Unit Count and Educator Employment Snapshot.

Through a customizable forecasting process, LEAs can test a range of planning assumptions, including shifts in student matriculation, changes in Individualized Education Program (IEP) identification rates, adjustments to student-teacher ratios, and variation in teacher retention. This scenario-based design supports proactive planning by helping LEAs anticipate staffing needs, optimize resource allocation, and better align recruitment and retention strategies with evolving student needs and policy priorities.

Purpose and Context

The need for a tool like TWPT is grounded in a large and growing body of research on teacher staffing, workforce instability, and long-range education planning. Effective teacher staffing is essential to educational quality, continuity, and equity. Yet LEAs nationwide continue to face persistent staffing challenges shaped by changing student populations, shifting educational demands, uneven labor-market conditions, and ongoing teacher attrition (Carver-Thomas & Darling-Hammond, 2017; Franco & Patrick, 2023; Guarino et al., 2006; Ingersoll et al., 2018; Sutcher et al., 2016; Tan et al., 2024). Research consistently shows that these challenges are not driven by a single factor. Rather, teacher staffing is shaped by the interaction of demand-side conditions—such as enrollment, class-size expectations, and specialized service needs—and supply-side conditions—such as preparation pipelines, compensation, working conditions, mobility, and retention (Guarino et al., 2006; Sutcher et al., 2016).

A growing body of research further suggests that staffing challenges are best understood as localized and uneven rather than uniform across a state or district. Teacher shortages are often concentrated in particular schools, certification areas, and regions, and are shaped by local factors such as historical attrition, compensation, school working conditions, and labor-market geography (Carver-Thomas & Darling-Hammond, 2017; Edwards et al., 2023; Guarino et al., 2006; Reichardt et al., 2020). Research also shows that service-related demands matter. The teaching force has grown faster than student enrollment in part because of rising needs in areas such as special education and bilingual or English learner services, while shortages remain especially acute in fields such as special education, mathematics, science, and bilingual education (Ingersoll et al., 2018; Sutcher et al., 2016). These findings support the need for workforce planning tools that move beyond broad averages and help LEAs examine where staffing pressures are most likely to emerge.

The forecasting literature provides a clear methodological foundation for this work. Foundational studies argue that enrollment projections are necessary because schools cannot

create teachers, programs, and facilities overnight, but they also caution that projections should be treated as planning estimates rather than exact predictions (Jaffe, 1969; Webster, 1970). More recent work shows that forecasting is strongest when it combines student and teacher data, uses transparent assumptions, compares methods, and validates results against historical outcomes (Lindsay et al., 2016; Reichardt et al., 2020). National education projections reinforce the same point by showing that long-range forecasting is a standard part of education planning, while also emphasizing that projections depend on assumptions and should be interpreted with care alongside changing policy and demographic conditions (Irwin et al., 2024). In short, the research supports forecasting tools that are transparent, flexible, and designed to inform judgment rather than replace it.

In Delaware, this research base aligns with a strong state policy and planning context. Title 14 establishes the legal framework for public education oversight, educator licensure, and the provision of services aligned to student need (Delaware Code Revisors et al., 2025). Delaware also has a long-standing projection infrastructure. The Delaware Population Consortium produces a single, annually updated set of long-range population projections for the state and counties, while the University of Delaware's Center for Applied Demography and Survey Research has shown how county demographic patterns, migration, births, housing, and local enrollment behavior can be used to project district enrollment over time (Delaware Population Consortium, 2024; Laznik, 2020; Ratledge, 2004a, 2004b; Ratledge & Hickox, 2016). At the same time, Delaware's school funding assessment highlights the importance of linking staffing planning to student need, resource adequacy, transparency, and flexibility, especially for low-income students, English learners, and students with disabilities (Delaware Department of Education, 2023). Together, these sources indicate that teacher workforce planning in Delaware must be both demographically grounded and policy aware.

Against this backdrop, TWPT is designed to bridge research, policy, and practice by giving Delaware LEAs a structured way to connect population trends, enrollment projections, student service needs, staffing ratios, and retention assumptions within a single planning framework. It is grounded in foundational forecasting principles, informed by modern supply-and-demand modeling, and built on Delaware's existing demographic projection infrastructure rather than on ad hoc local estimates (Jaffe, 1969; Lindsay et al., 2016; Reichardt et al., 2020; Webster, 1970; Delaware Population Consortium, 2024). In this way, TWPT offers a research-based and policy-aligned approach to workforce planning that can support more adaptive and locally informed decision-making over time.

Significance and Implications

The adoption of TWPT presents an important opportunity to modernize and strengthen teacher workforce planning across Delaware's LEAs. By reducing the administrative burden of manual forecasting and bringing multiple data sources into one transparent framework, the tool can promote more consistent and equitable access to robust staffing projections across LEAs. Its design reflects what the literature recommends: forecasting systems should be transparent, locally interpretable, and responsive to both student demand and teacher supply conditions rather than reliant on static averages or isolated data points (Edwards et al., 2023; Lindsay et al., 2016; Reichardt et al., 2020).

TWPT is especially significant because it allows staffing decisions to be informed by demographic change, educational service needs, and retention dynamics at the same time. That matters in Delaware, where local enrollment patterns, special population trends, and funding structures all influence how staffing needs emerge and how LEAs can respond (Delaware Department of Education, 2023; Ratledge & Hickox, 2016). By helping LEAs test assumptions and examine multiple possible futures, the tool supports a more proactive approach to staffing strategy—one that is better positioned to anticipate shortages, align resources, and respond to changing student needs before staffing pressures become more severe.

More broadly, TWPT represents an important step toward a more adaptive and evidence-based statewide planning culture. Research suggests that long-term workforce stability depends not only on hiring, but also on retention, local context, and the ability to use data strategically over time (Carver-Thomas & Darling-Hammond, 2017; Edwards et al., 2023; Ingersoll et al., 2018). Continued use and refinement of TWPT can help Delaware's education system remain more responsive to changing staffing needs, support better alignment between state planning and local decision-making, and ultimately improve the likelihood that students across the state have consistent access to qualified teachers.

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Appendix I. Reflections on the Development of the TWPT

Limitations of a Purely Data-Driven Approach

The development of the TWPT highlighted both the value and the limits of data in teacher workforce planning. TWPT was designed to help Delaware LEAs use historical trends and local assumptions to explore possible future staffing needs, not to generate exact predictions. Its purpose is to support long-range planning by providing a transparent framework for examining how enrollment, student service needs, staffing ratios, and retention may shape future demand for teachers. In that sense, the tool emerged not simply as a forecasting model, but as a way to translate research, administrative data, and planning needs into a practical decision-support resource for local leaders.

At the same time, the development process made clear that historical data alone cannot fully explain or predict staffing outcomes. Indicators such as matriculation rates, IEP identification rates, student-to-teacher ratios, and retention rates are essential for planning, but they do not capture all of the local decisions and conditions that influence workforce trends. Factors such as school choice, working conditions, compensation, policy changes, and labor-market conditions may all shape how staffing patterns evolve over time.

The research and development process also reinforced that future staffing need is not driven by enrollment alone. Rather, it emerges from the interaction of demographic change, student service needs, staffing intensity, and workforce stability. This became especially clear in the county-level analyses used to develop TWPT, where relationships between population change, enrollment, staffing, and retention were not consistent across counties (see Appendix III). These differences suggest that statewide patterns can provide useful context, but they do not apply in the same way in every local setting.

For that reason, TWPT is best understood as a decision-support tool. Its value lies not only in organizing data, but also in making planning assumptions tangible so they can be tested, discussed, and interpreted in light of local knowledge. The development of the tool ultimately reinforced a central lesson: data are a critical foundation for workforce planning, but they are most useful when combined with context, experience, and informed local decision-making.

Appendix II. Data Sources and Methods

Data Sources

Population Estimates

Population estimates and projections used in the Teacher Workforce Planning Tool are provided by the Delaware Population Consortium (DPC; January 2024). The DPC projections draw on multiple established sources, including U.S. Census Bureau data, Internal Revenue Service migration trends, and statewide birth and death records. These projections provide the demographic foundation for forecasting future school-age population change across Delaware.

Student Enrollment Unit Count

Student enrollment data are drawn from the Delaware Department of Education's (DDOE) Student Enrollment Unit Count. This dataset includes students enrolled and in attendance in public schools during the last 10 school days of September each year. Because the unit count serves as the primary basis for school funding in Delaware, it provides a consistent and policy-relevant measure of public school enrollment. The data also reflect funding allocations by educational need, as defined in Title 14 of the Delaware Code.

Educator Employment Snapshot

Teacher workforce data are drawn from the DDOE's Educator Employment Snapshot. This dataset captures educator staffing across the state each November, allowing the annual snapshot to reflect staffing adjustments related to unit count funding. For purposes of the TWPT, only full-time classroom teachers were included in the model.

Methods

Forecasting Steps

The forecasting model begins with a population estimate, which is multiplied by the matriculation rate to project total student enrollment. Enrollment is then multiplied by the IEP identification rate to estimate two student groups: students with an IEP and students without an IEP.

Next, the number of students with an IEP is divided by the students-per-teacher planning target for special education to estimate special education teacher demand. The number of students without an IEP is divided by the students-per-teacher planning target for non-special education to estimate non-special education teacher demand. These two values are then combined to calculate total teacher demand.

The model then estimates retained teachers using prior-year demand and retention targets. Prior-year special education teacher demand is multiplied by the special education teacher retention target to estimate retained special education teachers. Prior-year non-special education teacher demand is multiplied by the non-special education teacher retention target to estimate retained non-special education teachers. These values are then combined to calculate total teachers retained.

Finally, hiring need is calculated as the difference between projected demand and retained teachers. Special education hiring need is the difference between special education teacher demand and retained special education teachers. Non-special education hiring need is the difference between non-special education teacher demand and retained non-special education teachers. These values are then combined to calculate total hiring need.

Customizable Planning Targets

The forecasting model allows the user to adjust the matriculation rate, IEP identification rate, students-per-teacher planning targets for special education and non-special education, and teacher retention targets for special education and non-special education (see Appendix III for additional detail on planning targets). The year-over-year effects of changes to these planning targets are estimated using the Compound Annual Growth Factor Rate (CAGFR). CAGFR is the annual growth multiplier required to move from a current value to a target value over a specified number of years. It represents the rate at which a value would need to change each year, assuming compounded growth, in order to reach the target value.

$$\text{CAGFR} = \left(\frac{\text{Target Value}}{\text{Current Value}} \right)^{\frac{1}{\text{Target Year} - \text{Current Year}}}$$

CAGFR was selected to model future planning targets because enrollment and staffing trends are often cumulative, with each year's values building on the previous year's base. For example, as the local school-age population grows, LEAs may enroll more students each year. Most of

those students remain enrolled in subsequent years, which contributes to sustained changes in enrollment and, in turn, to changes in projected teacher demand.

A key limitation of the CAGFR approach is that it assumes a consistent rate of change over time. As a result, it may not fully capture sudden shifts in enrollment or staffing patterns, such as those associated with major housing development, school openings or closures, boundary changes, or other policy and demographic disruptions. For this reason, CAGFR-based forecasts should be interpreted as planning estimates rather than precise predictions.

For example, suppose the planning target for students per teacher (non-special education) is 19 in 2025 and the goal is to reach 17 by 2030. Over a five-year period, the CAGFR is calculated as:

$$\text{CAGFR} = \left(\frac{17}{19}\right)^{\frac{1}{2030-2025}} \approx 0.9780$$

This means the planning target is reduced by about 2.2% each year on a compounded basis. Applying that factor year by year produces the following projected values:

- SY 2026 – $19 \times 0.9780 \approx 18.5820$
- SY 2027 – $18.5820 \times 0.9780 \approx 18.1732$
- SY 2028 – $18.1732 \times 0.9780 \approx 17.7734$
- SY 2029 – $17.7734 \times 0.9780 \approx 17.3824$
- SY 2030 – $17.3824 \times 0.9780 \approx 17.0000$

In practical terms, this means the TWPT phases in the selected planning target over time, producing smoother year-to-year changes in projected staffing demand and hiring need across the forecast window.

Appendix III. Overview of Measures Used in the TWPT

Matriculation

Matriculation rate is the percentage of the school-age population enrolled in Delaware public schools.

Delaware's statewide matriculation rate increased modestly from 84.5% in 2019–20 to 86.0% in 2025–26. Growth varied across counties. Sussex showed the largest increase, rising from 81.5% to 84.5%, while Kent increased from 97.0% to 99.1%. New Castle changed only slightly, from 81.3% to 81.9%. These trends suggest that the share of school-age children attending public schools has remained relatively stable overall, but local patterns differ.

The relationship between school-age population and public school enrollment also varies substantially by county. Sussex (0.98) and Kent (0.82) show strong positive correlations, suggesting that enrollment trends in those counties more closely track population change. By contrast, New Castle's negative correlation (-0.47) suggests that enrollment patterns there are shaped less by demographics alone and more by other influences, such as school choice, policy conditions, and family preferences. With a statewide correlation of 0.65, these findings underscore the importance of planning tools that incorporate local context and policy dynamics rather than relying only on population-based projections.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 84.5% to 86.0%
- New Castle – 81.3% to 81.9%
- Kent – 97.0% to 99.1%
- Sussex – 81.5% to 84.5%

Correlation between school-age population and public school enrollment:

- Statewide – 0.65
- New Castle – -0.47
- Kent – 0.82
- Sussex – 0.98

IEP Identification

IEP identification rate is the percentage of enrolled students with Individualized Education Programs (IEPs).

Over the seven-year period from 2019–20 to 2025–26, the IEP identification rate increased across every Delaware county, rising statewide from 15.3% to 17.7%. New Castle showed the largest increase, from 15.5% to 18.5%, indicating the strongest growth in special education identification among the three counties. Kent increased from 15.7% to 17.3%, while Sussex rose from 14.5% to 16.1%.

These consistent upward trends suggest a broad-based increase in demand for special education services across the state. For planning purposes, they reinforce the importance of accounting for growth in special education identification when projecting future staffing, programming, and student support needs.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 15.3% to 17.7%
- New Castle – 15.5% to 18.5%
- Kent – 15.7% to 17.3%
- Sussex – 14.5% to 16.1%

Students per Teacher (Special Education)

Students per teacher (special education) is the number of students with an IEP per full-time special education teacher.

Over the seven-year period from 2019–20 to 2025–26, the statewide student-to-teacher ratio in special education remained relatively stable, declining slightly from 8.7 to 8.6. County trends varied more noticeably. New Castle declined modestly from 9.4 to 9.2, Kent increased from 7.8 to 9.2, and Sussex fell from 8.0 to 6.9, giving it the lowest ratio among the three counties and suggesting comparatively smaller caseloads.

The relationship between students with an IEP and full-time special education teachers remained strong statewide (0.98) and in both New Castle (0.98) and Sussex (0.97), indicating that staffing in those areas has closely tracked student need over time. Kent's lower correlation (0.75), combined with its rising student-to-teacher ratio, suggests a less consistent alignment between IEP counts and special education staffing. Taken together, these patterns reinforce the importance of continued monitoring and locally responsive staffing strategies.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 8.7 to 8.6
- New Castle – 9.4 to 9.2
- Kent – 7.8 to 9.2
- Sussex – 8.0 to 6.9

Correlation between students with an IEP and full-time special education teachers:

- Statewide – 0.98
- New Castle – 0.98
- Kent – 0.75
- Sussex – 0.97

Students per Teacher (Non-Special Education)

Students per teacher (non-special education) is the number of students without an IEP per full-time non-special education teacher.

Over the seven-year period from 2019–20 to 2025–26, the statewide student-to-teacher ratio in non-special education declined slightly, from 15.8 to 15.3. New Castle also decreased from 15.2 to 14.3, giving it the lowest ratio among the three counties and suggesting comparatively smaller general education class sizes than Kent and Sussex. Kent's ratio fell modestly from 17.2 to 16.7, while Sussex increased from 16.1 to 16.7, matching Kent for the highest ratio by 2025–26.

The relationship between students without an IEP and full-time non-special education teachers varies more substantially across counties. Sussex shows a strong positive correlation (0.91), suggesting that staffing there has closely tracked student enrollment over time, while the statewide relationship is more moderate (0.72). By contrast, New Castle's negative correlation (-0.51) and Kent's weak correlation (0.25) suggest less consistent alignment between student counts and staffing levels. Taken together, these patterns highlight the importance of localized, data-informed staffing strategies rather than relying solely on broad population trends.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 15.8 to 15.3
- New Castle – 15.2 to 14.3
- Kent – 17.2 to 16.7
- Sussex – 16.1 to 16.7

Correlation between students without an IEP and full-time non-special education teachers:

- Statewide – 0.72
- New Castle – -0.51
- Kent – 0.25
- Sussex – 0.91

Teacher Retention (Special Education)

Teacher retention rate (special education) is the percentage of special education teachers who continued in the same role and LEA grouping (see note on Retention Rates) from the previous year.

Over the seven-year period from 2019–20 to 2025–26, the statewide retention rate for special education teachers remained relatively stable, shifting slightly from 88.7% to 88.5%. County trends, however, differed. New Castle improved from 88.0% to 89.5%, suggesting somewhat stronger retention over time. By contrast, Kent declined sharply from 87.2% to 82.1%, indicating the most substantial retention challenge among the three counties. Sussex also declined modestly, from 89.5% to 88.3%.

Taken together, these patterns suggest that special education teacher retention has remained broadly stable at the statewide level, but local variation is noteworthy. In particular, Kent's downward trend points to a potential area of concern and underscores the importance of targeted monitoring and locally responsive retention strategies.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 88.7% to 88.5%
- New Castle – 88.0% to 89.5%
- Kent – 87.2% to 82.1%
- Sussex – 89.5% to 88.3%

Teacher Retention (Non-Special Education)

Teacher retention rate (non-special education) is the percentage of non-special education teachers who continued in the same role and LEA grouping (see note on Retention Rates) from the previous year.

Over the seven-year period from 2019–20 to 2025–26, the statewide retention rate for non-special education teachers declined modestly, from 90.6% to 89.7%. Retention also decreased across all three counties. New Castle fell slightly from 89.9% to 89.4%, Sussex declined from 90.3% to 89.7%, and Kent dropped more noticeably from 88.5% to 86.8%.

These patterns suggest a modest statewide weakening in non-special education teacher retention over time, with the most pronounced decline occurring in Kent. Although the statewide shift is not dramatic, the county variation points to the importance of continued monitoring and locally responsive strategies to support workforce stability.

Seven-year trends (2019–20 to 2025–26):

- Statewide – 90.6% to 89.7%
- New Castle – 89.9% to 89.4%
- Kent – 88.5% to 86.8%
- Sussex – 90.3% to 89.7%

Appendix IV. Walkthrough and Layout

Walkthrough

The TWPT supports a six-step forecasting process that allows users to define the scope of analysis, select a target year, adjust planning targets, and review projected staffing outcomes.

Step 1. Select a LEA or grouping

- Select the LEA grouping for the analysis.
- Options may include an individual LEA, a county-level grouping, or a statewide view.
- This selection defines the geographic and organizational scope of the forecast.
- Default planning values are loaded for the selected grouping.

Step 2. Select a projected school year

- Select the school year to which the forecast will extend.
- This year serves as the endpoint of the forecast window.
- It also determines the period over which planning targets are phased into the model.

Step 3. Enter enrollment and student service need assumptions

- Enter the following planning targets:
 - Matriculation rate
 - IEP identification rate
- The matriculation rate represents the share of the school-age population, ages 5–18, expected to enroll in public schools.
- The IEP identification rate represents the share of enrolled students expected to receive special education services.
- These values are used to estimate:
 - projected enrollment
 - students with IEPs
 - students without IEPs

Step 4. Enter teacher demand assumptions

- Enter the following planning targets:
 - Students per teacher (special education)
 - Students per teacher (non-special education)
- These ratios are applied to projected student counts.
- The model then estimates:
 - special education teacher demand
 - non-special education teacher demand
 - total teacher demand

Step 5. Enter retention assumptions

- Enter the following planning targets:
 - Teacher retention rate (special education)
 - Teacher retention rate (non-special education)
- These rates are applied to prior-year teacher demand.
- The model then estimates:
 - retained special education teachers
 - retained non-special education teachers
 - total retained teachers

Step 6. Review projected hiring need

- TWPT calculates hiring need as:
 - projected teacher demand minus projected retained teachers
- This calculation is made separately for:
 - special education teachers
 - non-special education teachers
- These values are then combined to estimate total hiring need.
- This structure allows users to examine how changes in enrollment, student need, staffing intensity, and retention affect projected workforce demand over time.

Layout

The TWPT interface is organized into three primary tabs:

- Forecasts
- Planning Target Trends
- Data Download

The Forecasts tab also includes a Past Recruitment Numbers panel.

Forecasts Tab

- Serves as the primary results view.
- Displays historical and projected teacher workforce measures based on the selected planning targets.
- Allows users to select among forecast views, including:
 - total teachers
 - special education teachers
 - non-special education teachers
- Compares:
 - projected teacher demand
 - projected retained teachers
- Defines projected hiring need as the difference between those two values.
- Includes a **Download Forecast** function that generates a ZIP file containing:
 - the forecast chart
 - the planning target values used to produce it
- Also displays intermediate projections, including:
 - population ages 5–18
 - enrollment
 - students with an IEP

Planning Target Trends Tab

- Displays historical and projected trends in key planning targets.
- Includes:
 - matriculation rate
 - IEP identification rate
 - students per teacher
 - teacher retention rate
- Helps users set assumptions with reference to observed trends.

Data Download Tab

- Provides access to the data underlying the forecast.
- Includes both:
 - historical values
 - forecasted values

- Supports review, export, and local analysis.

Past Recruitment Numbers Panel

- Provides historical information on prior teacher hiring activity.
- Reports:
 - new hires
 - transfer hires
 - total hires
- Defines:
 - new hires as teachers not employed in a Delaware public school in the prior year
 - transfer hires as teachers who moved between LEAs or between special education and non-special education roles
 - total hires as the sum of new hires and transfer hires
- Allows users to compare projected hiring need with recent recruitment patterns.

Appendix V. Notes

Notes

Years of Available Data

All figures and estimates presented in the TWPT are based on population, enrollment, and staffing data from the 2011–12 through 2025–26 school years. Reliable student enrollment data from the Delaware Department of Education’s unit count are not available prior to 2011–12; therefore, earlier years are excluded from the TWPT.

Retention Rates

To better capture workforce movement, teachers are classified as retained if they remain within the same LEA grouping and educator type (special education or non-special education) from one year to the next. LEA groupings may be defined at the state, county, or LEA level, depending on the analysis selected in the TWPT.

For example, at the state level, a special education teacher is considered retained if they remain employed in Delaware public schools as a special education teacher. As a result, movement across LEAs within the state is counted as retention in state-level analyses, even though it would not be counted as retention in an LEA-level analysis.