What are the characteristics of the CS teacher workforce?

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Part 3 of The State of Computer Science in Illinois High Schools Series

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External Review

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The State of Computer Science in Illinois High Schools Series
Part 3 - What are the characteristics of the CS teacher workforce?

The purpose of **The State of Computer Science in Illinois High Schools Series** is to analyze the landscape, structures, and pathways of computer science (CS) education in Illinois and to create a baseline by which to measure the expansion of CS education in the coming years. Beginning in the 2023-2024 school year, all districts in the state that serve grades 9-12 must offer every student the opportunity to enroll in a CS course.[1] Because not all districts in the state had CS offerings before this school year, it is imperative we measure capacity for, access to, participation in, and experiences in CS education (i.e., CAPE framework[2,3]) before and after the mandate went into effect. Analyzing trends through the lens of the CAPE framework will highlight progress while identifying existing gaps in providing equitable access and outcomes for all students. The first report of this Series provided an overview of the CS education landscape in the state by analyzing overall participation trends and details about the most enrolled CS courses.[4] The second report analyzed the CS student body, focusing on students from historically marginalized backgrounds, including trends of their participation in general and rigorous coursework and course outcomes.[5] In this third installment of the Series, we shift focus to the CS teacher workforce.

Part 3 of The Series

Because Parts 1 and 2 focused on overall trends in the CS education landscape and who enrolls in CS coursework, a report that focuses on teachers is essential to understanding if Illinois has the capacity for CS education in its high schools and if students are receiving a high-quality, equitable CS education. This report analyzes the characteristics of CS teachers in Illinois high schools, including describing the CS teacher workforce by their gender and racial make-up, what licensure and endorsements they hold, if they are appropriately assigned to CS courses based on their endorsements, if their characteristics change when disaggregated by different CS courses, and their CS workload. Similar to previous reports in this Series, we end on a Spotlight Analysis to explore the untapped teacher workforce in the state.

Background

The landscape of educators in Illinois is complex, with legislation and school code regarding CS, specifically, providing further complication. As such, we provide necessary background before moving into our analysis and findings.

Illinois School Code & CS

The Illinois Compiled Statutes (105 ILCS 5/), or the Illinois School Code, is a list of laws regarding education and schools in the state. When the legislative branch of the state proposes a new mandate, such as requiring all districts in the state that serve grades 9-12 to offer every student the opportunity to enroll in a CS course (Public Act 101-0654), they are amending the Illinois School Code. Notably, while Public Act 101-0654 detailed several mandates related to expanding CS coursework in the state, it offered no guidance

or policy on how to meet the capacity needs or how to assign teachers to these CS courses.[1] Because there were no stipulations regarding CS *teachers*, we look to the Illinois Administrative Code for such guidance.

Illinois Administrative Code – Licensure & Endorsements

The Illinois Administrative Code is created by the Illinois State Board of Education (ISBE) and is a list of rules that detail the operating procedures and regulations for schools. According to the Illinois Administrative Code[6], high school teachers are required to hold (1) a professional educator license (or an educator license with stipulations for career and technical education) and (2) the applicable teaching endorsements for the assigned course (see below for full text).[a]

> **Minimum Requirements for the Assignment of Teachers in Grades 9 through 12 Beginning July 1, 2004**
> "No teacher may be assigned to teach a particular content area in any of grades 9-12 unless that teacher holds a professional educator license in a teaching field and […] holds the applicable endorsement for the assignment (and, in the case of the educator license with stipulations endorsed for career and technical educator, an endorsement specific to the program area to be taught) …"
>
> 23 Ill. Adm Code 1.737

Licensure. There are two main types of teaching licensure in Illinois: Professional Educator License (PEL) and Educator License with Stipulations (ELS). PELs require teachers to have at least a bachelor's degree, student teaching experience (or equivalent), coursework completion, completion of an educator preparation program, and passing of licensure exams.[7] ELSs, on the other hand, are an alternative to formal licensure, with many not requiring an educator preparation program and instead accepting college-level coursework, content exams, or work experience.[8] There are nine different ELSs with endorsements available in Illinois, and each have their own requirements, limitations, and possibilities of renewal.[8,9] The most common one amongst the CS teacher workforce (detailed further below) is the ELS with the Career and Technical Educator Endorsement.[b] Requirements for this ELS include a minimum of 60 semester hours of college-level coursework and a minimum of 2,000 hours of experience in the content area. This license is valid for 5 years and is renewable with 120 hours of professional development. However, this ELS is limited to grades 5-12 and is only eligible in the specified area of the endorsement, meaning this ELS cannot be used to teach courses outside of the endorsement stipulations.[8] Teachers with PELs are also permitted to teach a CS CTE course with the needed subsequent endorsements (outlined further below). It is possible for a teacher to hold multiple licenses, such as holding an ELS before attaining a PEL. As such, this variable is not mutually exclusive in our dataset and tables showing percentages will appear to exceed 100%.

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[a] The section stipulates other circumstances under which teachers may be assigned to courses, such as meeting previous requirements before 2004, requirements for reading teachers and specialists, requirements for library information specialists, or short-term approvals; however, none of these are relevant to the context of this report.
[b] See ISBE's website for information on other types of ELSs endorsements and requirements.

Endorsements. In addition to licensure, the Illinois Administrative Code requires high school teachers to hold a subject endorsement for the courses they teach.[6] All endorsements require a minimum of 18 semester hours of college-level coursework in the content area and passing the content exam (if applicable). This is meant to ensure that, in addition to the requirements needed for general licensure, teachers have the pedagogical content knowledge[10] (PCK) to effectively teach their courses. Endorsements can be obtained by both pre-service teachers (those in training to become teachers, with no license yet) and in-service teachers (those actively teaching and already holding a license). Similar to licensure, a teacher may hold more than one endorsement. Regional offices of education (ROEs) are directed to ensure that an educator holding a particular license and endorsement is qualified for a particular teaching assignment.

The Illinois Administrative Code does not stipulate which endorsement is most appropriate for high school CS coursework. That said, it does list which endorsements are currently available (see 23 Ill. Adm Code 25.Appendix E). These endorsements coincide with the endorsements listed in ISBE's *Computer Science Courses and Assignability Recommendations* document, released in January 2023.[11] The alignment in that document between CS courses and CS endorsements was created after considering the licensure test content and content-specific coursework required to attain an endorsement. Because this document is the only guidance available on appropriate endorsements to teach CS (at the time of publication of this report), we view these recommendations as best practices for the field and thus provide analyses on these specific endorsements as those with the best opportunity to bring high quality, equitable CS education to the students of Illinois.

ISBE's Recommendations for CS-related Endorsements

Each of the CS-related endorsements have their own requirements and recommendations for ability to teach varying numbers and types of CS coursework. Table 1 below details each of the CS endorsements, their associated licensures, their associated endorsement content area exams from the Illinois Licensure Testing System (ILTS), and the number of courses (CS and CS CTE) for which each endorsement is recommended according to ISBE's *Computer Science Courses and Assignability Recommendations* document.[11]

Table 1. All recommended CS endorsements, their associated licensure and endorsement content area test, and the number of courses to which each endorsement is aligned to teach, per ISBE's *Computer Science Courses and Assignability Recommendations* document.

	CS Endorsements	ILTS content area test	How many CS courses align with this recommended endorsement? Out of 46 CS courses	How many CS courses align with this recommended endorsement? Out of 22 CS CTE courses
Professional Educator License	**Business, Marketing and Computer Education** (formerly Business Computer Programming/Systems or Information Processing)	216	29	6
	Business, Marketing and Computer Ed – Programming	216	44	17
	Computer Science	205	46	19
	Computer Applications	NA	46	14
	Technology Specialist	223	29	NA
	Technology Education (formerly Technology Education, Industrial Technology Education, and Graphic Communications)	219	18	5
Educator License with Stipulations	**Manufacturing - Computer Installation Repair**	NA	NA	2
	Information Technology (formerly Computer Systems Networking and Telecommunications, Web Page, Digital/Multimedia and Information Resources Design, Computer Programming, Specific Applications)	NA	NA	20
	Graphic Communications	NA	NA	2

As evident in the table above, not all endorsements are recommended to teach all CS courses. This is because alignment of courses and endorsements happen at the course level. For example, a teacher with an endorsement as a Technology Specialist is recommended to teach Computer Maintenance, but not Computer Programming. Similarly, while teachers with the Computer Science endorsement are recommended to teach all CS courses (as categorized by ISBE), they are not recommended to teach all CS CTE courses, such as Computer Gaming and Design.[c] As such, teachers and administrators should be aware of the differences in recommendations as CS course offerings expand and require more teachers to be endorsed.

Following ISBE's recommendations, we analyze in-field rates for CS courses. Teachers who have the appropriate CS endorsement for their respective CS course(s) would be considered *in-field*. Likewise, teachers who do not hold any CS endorsement or the appropriate one for their respective course and are assigned to teach a CS course would be considered *out-of-field*.[12] Throughout this report we refer to all the endorsements in Table 1 collectively as "CS endorsements" because they are the endorsements recommended to teach at least one CS course. Separately, we use the term "in-field CS endorsement" when referring to a specific CS course-endorsement alignment, according to ISBE's *Computer Science*

[c] See ISBE's Computer Science Courses and Assignability Recommendations for more information on course and endorsement alignment.

Courses and Assignability Recommendations document, where a teacher was appropriately assigned. In summary for this report:

- **CS endorsements** include any of the above-mentioned CS-related endorsements in Table 1. A teacher who holds any one of those endorsements would be a CS-endorsed teacher.
- An **in-field CS endorsed teacher** holds the appropriate CS endorsement for their assigned CS course(s) as outlined in ISBE's *Computer Science Courses and Assignability Recommendations* document.

A note on professional development

Throughout this report we discuss qualified CS teachers as those holding the recommended CS endorsement for a specific CS course and the licensure required by the Illinois Administrative Code. There is currently no way for the state of Illinois to track and standardize professional development the same way it does for endorsements (e.g., through ISBE verified content coursework at accredited colleges and universities and passing grades on a standardized content exam to earn an endorsement), which is why there is no data in this report to represent professional development in CS. This omission is not a reflection on the need for professional development or the support it provides to teachers on a regular basis. In fact, 120 hours of professional development is required to renew a teaching license (either PEL or ELS) every five years. However, the required hours of professional development to renew are not required to be in a specific content area (like CS). In short, this report does not equate professional development with an endorsement nor utilize professional development in its definition of "qualified CS teachers," but we acknowledge that professional development is an important part of the CS teacher landscape.

Data & Analysis

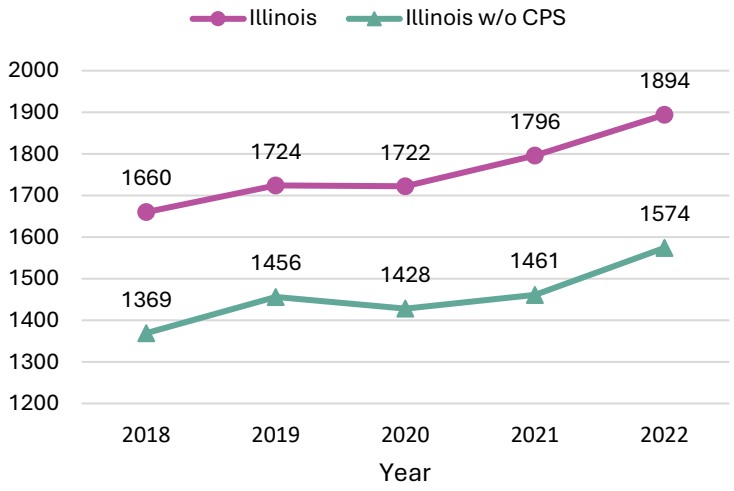
As in previous reports of this Series, we analyze student-level data provided by ISBE on every Illinois high school student who enrolled in at least one CS course[11] between the school years 2017-2018 (SY 2018) and 2021-2022 (SY 2022). Data for the teachers who were the instructors of record for each of these students in CS coursework were provided, including teacher demographic information (gender, race/ethnicity), licensure, and endorsements. Supplemental Freedom of Information Act (FOIA) requests were submitted and fulfilled by ISBE for analyses including all high school teachers in the state and employed high school teachers not actively teaching CS during our timeframe but endorsed in CS or a related field.[d] Analyses using FOIA data are noted throughout the report. This report analyzes all CS courses collectively–for information on which CS courses this includes, see the Supplemental Materials. Similar to prior reports, findings include tables or graphs for the statewide sample (labeled as Illinois) and for the sample excluding Chicago Public Schools or "CPS" (labeled as Illinois w/o CPS). We did this to provide an accurate picture of where the state is in terms of CS education outside the largest district in the state, as CPS accounts for 60.4% of the CS enrollment[4] due to their extensive CS program that includes a graduation

[d] This includes active FTE (i.e. employed) high school teachers and does not include retired or unemployed during SY 2018 – 2022. These teachers were actively teaching, but not actively teaching CS.

requirement.[e] Analyses in this report are descriptive. While not all tables and figures are included in this report for brevity, more detailed descriptive tables and calculations are included in the Series Supplemental Materials. Lastly, this dataset, and subsequent analyses, are only as accurate as what districts provide to ISBE. These data are the data of record to the state and represent the state's understanding of each district's data at the time of data finalization for reporting purposes. See the Supplementary Materials for all the state course codes included in this analysis and for more information on the data source.

Who teaches CS courses in Illinois?

Figure 1. Number of high school teachers who taught at least one CS course between SY 2018-2022 for Illinois (purple, top line) and Illinois without CPS (teal, bottom line).



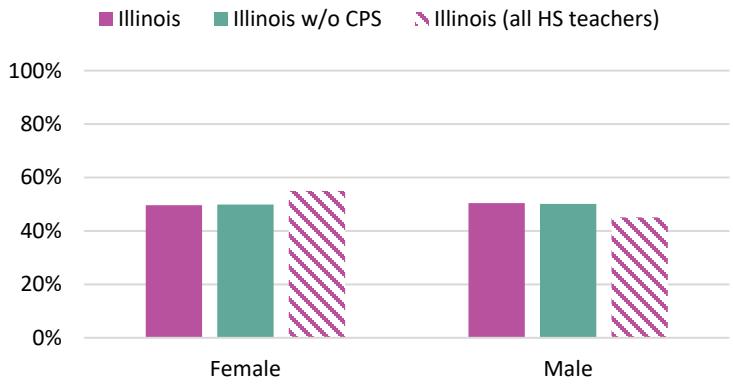
What the data tells us. As shown in Figure 1, the number of teachers teaching CS has increased steadily from 2018 until 2022, resulting in an increase of 14.1% for Illinois and 15.0% for Illinois without CPS. The rate of growth (i.e., slope of the lines) is similar between Illinois and Illinois without CPS, indicating that the number of teachers teaching CS increased mostly outside of CPS. This may be because CPS has reached their capacity of teachers teaching high school CS due to their established CS presence and graduation requirement. In Part 1, we found that CPS accounts for about 60% of the CS student body in Illinois.[4] In terms of the CS teacher workforce, CPS accounted for on average 17% of all teachers who taught a CS course in Illinois between SY 2018-2022. On average, 5.3% of all high school teachers in Illinois taught at least one CS course in these five years. This is close to what we found for students in Part 1, where, on average, 7.4% of all high school students enrolled in at least one CS course in a given year.[4]

As shown in Figure 2, the overall CS teacher workforce is nearly equally women and men for both Illinois and Illinois without CPS.[f] On average, female teachers represent a slightly higher proportion of all high

[e] The Chicago Alliance for Equity in Computer Science (CAFÉCS) reports on CPS's CS coursework. See their reports for more information on CPS district-specific findings.

[f] Data on all high school teachers in the state (including demographics) were obtained via a FOIA request and are based off Full-Time Equivalency (FTE) data and not headcounts. Because our primary data uses headcounts whereas the supplemental FOIA data uses FTE, calculations using both are conservative estimates and may be higher than stated here. Data on the number of all high school teachers in Illinois without CPS was unavailable and thus findings for Illinois are only shown.

Figure 2. Average percent representation of high school CS teachers by binary gender for SY 2018-2022 in Illinois (purple), Illinois without CPS (teal), and Illinois for all high school teachers (purple striped).

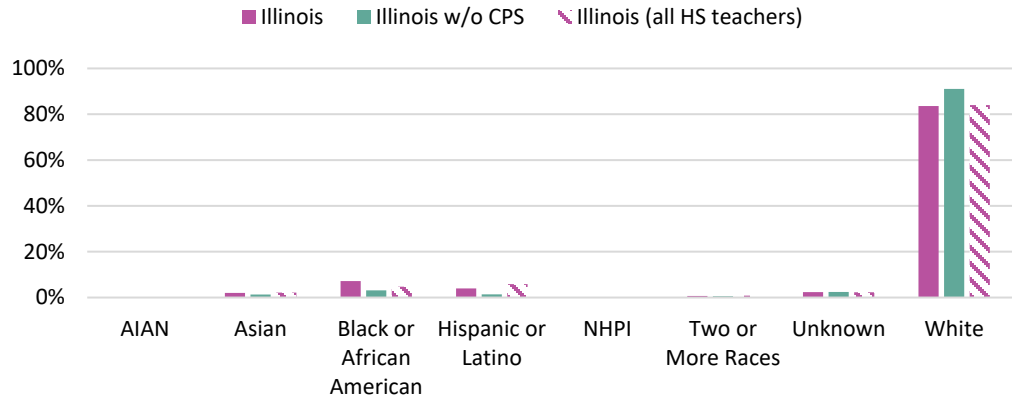


school teachers in the state, meaning female teachers are slightly underrepresented in CS compared to the total high school workforce for Illinois (purple striped bar). Gender representation of the CS teacher workforce changed minimally between SY 2018-2022.[g] It is important to note that the high school CS teacher workforce looks very different than the post-secondary teacher workforce. Only 30% of post-secondary teaching professors in CS are women[13], indicating the higher representation of women in secondary CS teaching may be an artifact of the K-12 teaching profession skewing slightly more female.

Figure 3 highlights the CS teacher workforce by race. Notably, the CS teacher workforce is almost entirely White for Illinois and Illinois without CPS (83.6% and 91.1%, respectively), with very little representation of Asian, Black/African American, Hispanic/Latino, or Indigenous teachers.[h] The CS teacher workforce does not differ much from the teacher workforce of all high school teachers (purple striped bar). Representation of Black/African American and Hispanic/Latino CS teachers is better in Illinois than in Illinois without CPS. Moreover, Black/African American teachers are slightly better represented in the CS teacher workforce (7.2%) compared to their representation in the high school teacher workforce (4.7%) for Illinois. Moderate changes were observed in the representation of some racial groups over the 5-year period. However, non-White teachers still represent 8.9% and 16.4% of the CS teacher workforce for Illinois without CPS and Illinois, respectively.

[g] See the Supplemental Materials for the Series on changes over time.
[h] Indigenous teachers include American Indian and Alaska Native (AIAN) and Native Hawaiian and Pacific Islander (NHPI) teachers.

Figure 3. Average percent representation of high school CS teachers by race/ethnicity for SY 2018-2022 in Illinois (purple), Illinois without CPS (teal), and Illinois for all high school teachers (purple striped).



In addition to binary gender and race, we analyzed the CS teacher workforce by their licensure and endorsements (see Table 2). The first section of the table, License Certificate, lists the licensure certificates held by those teaching CS. The vast majority of CS teachers (over 90%) in both Illinois and Illinois without CPS hold a PEL. Career and Technical Educator Endorsement represents about 10% of CS teachers. The remaining types of licensure certificates represent a small proportion of all licenses held by CS teachers. The second section of the table, License Endorsement, lists the most held license endorsements by those teaching CS. Secondary Education is the most widely held endorsement of the CS teacher workforce, with about 65% of teachers holding it. Other popular endorsements include Social Science, Mathematics, and several business-oriented endorsements. Business, Marketing and Computer Education is the only CS endorsement in the top nine, indicating that many CS teachers hold endorsements in subject areas other than CS. Each of the other 325 endorsements not listed in the table are held by 14% or less of the CS teacher workforce. Because CS endorsements were not well represented in the most held endorsements of those who teach CS, we pulled out the 16 CS endorsements (9 currently available CS endorsements plus 7 previously offered CS endorsements) and the percentage of CS teachers who hold them—this is the third section of Table 2: License Endorsement (ISBE recommended CS endorsements only). CS endorsements are held by only a small percentage of all those who teach CS, and some endorsements are actually quite rare in the CS teacher workforce. Again, Business, Marketing and Computer Education is the most held CS endorsement of CS teachers, followed by Information Processing, Computer Science, and Technology Education. The other 12 CS endorsements are held by 4% or less of the CS teacher workforce.

Table 2. Average representation of high school CS teachers by their license certificate, license endorsement, and license endorsement for CS endorsements for SY 2018-2022 in Illinois and Illinois without CPS.

	Illinois	Illinois w/o CPS
License Certificate		
Professional Educator License (PEL)	92.8%	93.3%
Educator License with Stipulations (ELS)		
Career and Technical Educator Endorsement	12.7%	11.1%
Paraprofessional Educator Endorsement	1.8%	1.5%
Provisional Career and Technical Educator Endorsement	0.3%	0.3%
Transitional Bilingual Educator Endorsement	0.1%	0.1%
Alternative Provisional Educator Endorsement	0.1%	< 0.1%
Part-Time Provisional Career and Technical Educator Endorsement	< 0.1%	< 0.1%
License Endorsement		
Secondary Education	64.3%	66.9%
Social Science	19.0%	19.3%
Business, Marketing and Computer Education*	18.9%	21.1%
Mathematics	18.6%	17.4%
General Administrative	16.3%	16.8%
Basic Business	16.1%	17.7%
Learning Behavior Specialist I	15.5%	14.6%
Business Education	15.1%	17.0%
Business, Marketing and Management	15.0%	16.1%
License Endorsement (ISBE recommended CS endorsements only)		
Business, Marketing and Computer Education	18.9%	21.1%
Information Processing	10.4%	10.9%
Computer Science	9.1%	7.4%
Technology Education	8.2%	9.2%
Business Computer Programming/Systems	3.6%	3.6%
Computer Applications	3.3%	2.9%
Technology Specialist	2.7%	2.6%
Business, Marketing and Computer Ed – Programming	2.4%	2.6%
Industrial Technology Education	2.4%	2.4%
Industrial Technology	1.8%	2.1%
Computer Programming, Specific Applications (CIP: 11.0202)	1.7%	0.6%
Web Page, Digital/Multimedia and Information Resources Design (CIP: 11.0801)	1.4%	0.8%
Computer Systems Networking and Telecommunications (CIP: 11.0901)	1.3%	0.5%
Graphic Communications	0.9%	1.1%
Information Technology	0.6%	0.6%
Manufacturing - Computer Installation Repair	<0.1%	0.1%

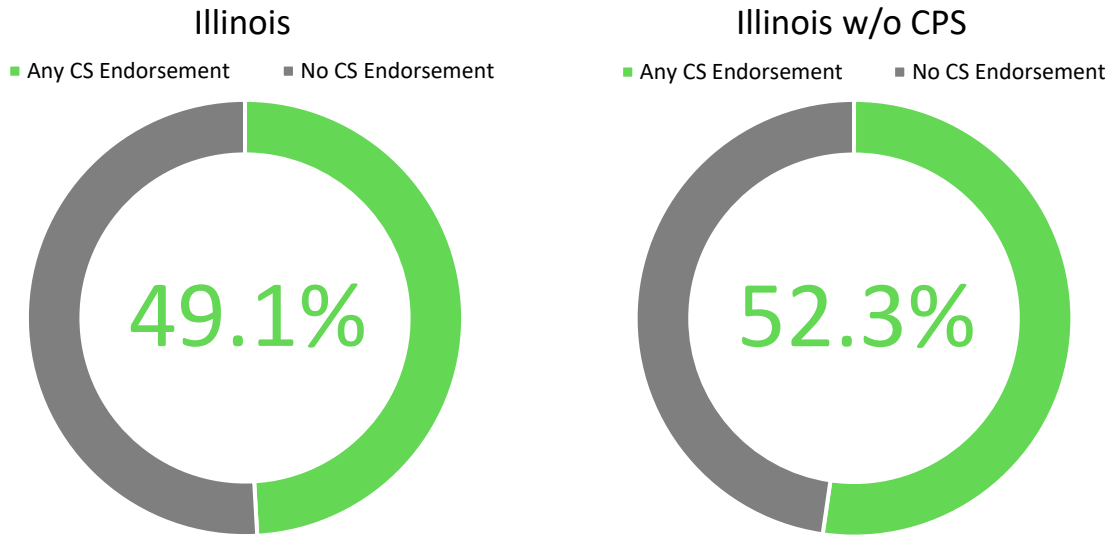
*The only CS endorsement in the most held license endorsement subjects.

Summary. The number of teachers teaching CS has increased over the last five years, especially outside of CPS. While there is gender parity in those teaching CS overall, the CS teacher workforce is overwhelmingly White. The majority of the CS teacher workforce holds PEL or CTE licenses and there is significant diversity in the endorsements held by the CS teacher workforce, including CS and non-CS endorsements.

Are CS teachers appropriately assigned to courses according to their endorsement?

What the data tells us. On average, about half of all teachers who taught at least one CS course between SY 2018-2022 held at least one CS endorsement (see Figure 4). Illinois without CPS has a slightly higher percentage of teachers with a CS endorsement compared to when CPS is included in the analysis.[i] Between SY 2018 and SY 2022, the percentage of CS teachers with at least one CS endorsement declined for both Illinois (-10.5%) and Illinois without CPS (-6.9%)[j], indicating that despite an increase in the number of teachers overall (as noted above), many teachers entering the CS teacher workforce do not have a CS endorsement. This number does not include teachers who may be actively working towards their CS endorsement and are assigned to teach CS with some content knowledge.

Figure 4. Average percent of high school CS teachers who hold at least one CS endorsement between SY 2018-2022 in Illinois (left) and Illinois without CPS (right).



Of those that hold at least one CS endorsement, 13.4% (Illinois) and 11.9% (Illinois without CPS) hold two or more CS endorsements. So, while there is some overlap in endorsement content area tests and courses, not many CS teachers hold multiple CS endorsements.

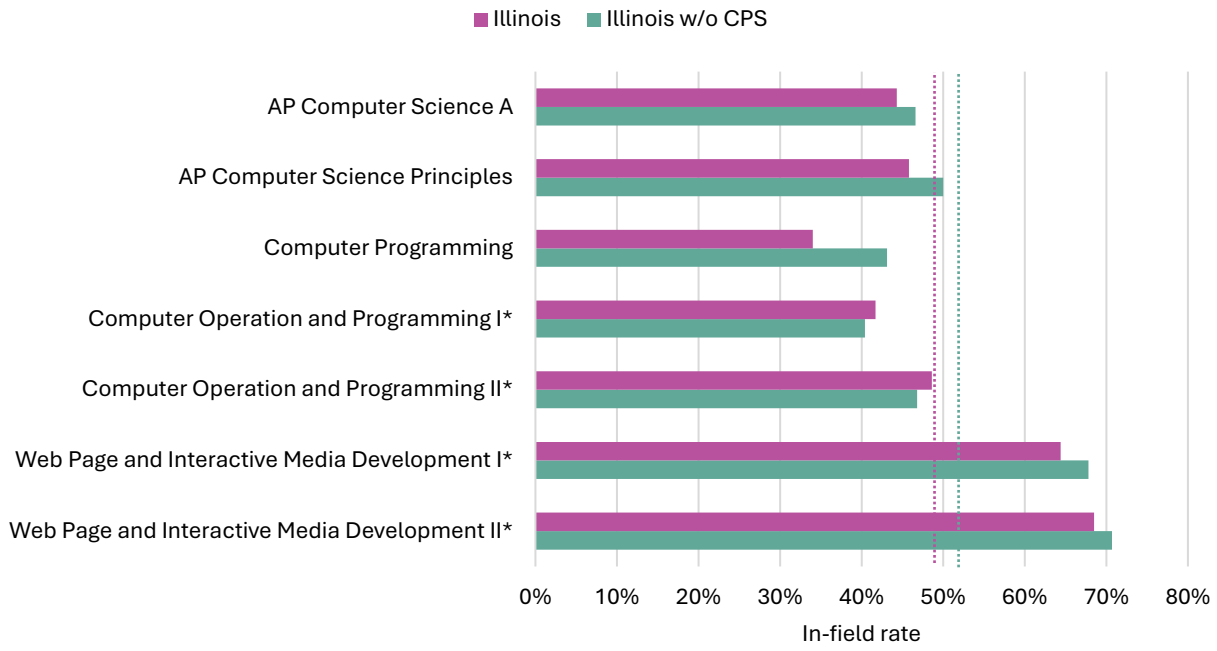
As noted earlier, in this report endorsements are considered in-field if they are aligned with the appropriate course they are meant to cover as outlined in ISBE's *Computer Science Courses and Assignability Recommendations* document. For example, a CS teacher would be considered in-field for the most enrolled CS course in Illinois, Computer Programming, if they were to hold any of the following endorsements: Business, Marketing & Computer Education, Business, Marketing & Computer Programming, Computer Science, and Computer Applications.[11] If a teacher did not hold at least one of those endorsements, that

[i] See the Supplemental Materials for this analysis broken down by binary gender and racial groups.
[j] See Supplemental Materials for associated graph.

teacher is considered out-of-field and not appropriately endorsed or recommended to teach the course. As such, analyzing CS teachers and their endorsements in the context of the course(s) they teach is essential.

Figure 5 shows the seven CS courses in the state with the highest enrollment (as shown in Part 1 of this Series) and the percentage of teachers who hold the recommended in-field CS endorsement to teach the respective courses. The percentage of CS teachers that hold the recommended endorsement for the CS course they teach varies with each course. Of the highest-enrollment courses, Web Page and Interactive Media Development I and II had the highest percentage of teachers who hold the proper endorsement, ranging between 64.4% and 70.7% of those teachers. Computer Programming had the lowest in-field rate with only 34.0% of Illinois teachers and 43.1% of teachers in Illinois without CPS holding the recommended endorsements.[k]

Figure 5. Average percent of high school CS teachers who hold an in-field CS endorsement for the respective CS course, and state average across all CS courses (dotted lines) between SY 2018-2022 in Illinois (purple) and Illinois without CPS (teal).



*Asterisks indicate CTE CS courses.

[k] This report follows *ISBE's Computer Science Courses and Assignability Recommendations* document to determine in-field teachers and subsequent calculations of in-field rates. This calculation may be different from how ISBE calculates in-field rates more broadly.

To understand how appropriately assigned in-field CS teachers have changed over time, we analyzed the data in two different ways. First, we calculated the change in representation of in-field CS endorsed teachers in each of the seven courses between SY 2018-2022 (see Table 3). For each of the courses, the *representation* of appropriately assigned in-field CS endorsed teachers has declined over the 5-year period, with some courses seeing steeper declines than others. However, this trend does not account for changes in the CS teacher workforce by course assignment.

Table 3. Percent relative change in representation of in-field CS endorsed high school CS teachers for their respective course between SY 2018-2022 in Illinois and Illinois without CPS.

Course	Illinois	Illinois w/o CPS
AP Computer Science A	-6%	0%
AP Computer Science Principles	-4%	-11%
Computer Programming	-28%	-30%
Computer Operation and Programming I	-20%	-21%
Computer Operation and Programming II	-21%	-21%
Web Page and Interactive Media Development I	-7%	-7%
Web Page and Interactive Media Development II	-2%	3%

As shown in Table 4, several of the highest enrollment CS courses added to their teacher workforce between SY 2018-2022, with some showing slight declines in number of teachers assigned to the course. Yet for most courses that saw gains in the number of teachers teaching (e.g., AP CS Principles, Computer Programming, Computer Operation and Programming II), the number of teachers endorsed to teach the course (number of endorsed teachers) did not match the rate of growth (number of teachers). In fact, only two of these courses, whether in Illinois or Illinois without CPS, had a percent of relative change of in-field CS endorsed teachers that outpaced the percent of relative change of incoming CS teachers. In other words, we looked at how much the number of in-field CS endorsed teachers increased or decreased over five years. In short, not enough teachers entering the CS teacher workforce have the appropriate in-field CS endorsement for the course they are assigned to teach. This results in the proportion of in-field CS endorsed teachers decreasing over time.

Table 4. Percent relative change in total number of CS teachers and in-field CS endorsed high school teachers for their respective course between SY 2018-2022 in Illinois and Illinois without CPS.

Course	Percent relative change in the number of...			
	Illinois		Illinois w/o CPS	
	CS teachers	In-field CS endorsed teachers	CS teachers	In-field CS endorsed teachers
AP Computer Science A	44%	35%	27%	28%
AP Computer Science Principles	131%	121%	142%	116%
Computer Programming	43%	2%	18%	-18%
Computer Operation and Programming I	-2%	-22%	0%	-21%
Computer Operation and Programming II	30%	3%	42%	13%
Web Page and Interactive Media Development I	-3%	-10%	3%	-5%
Web Page and Interactive Media Development II	-10%	-12%	-17%	-15%

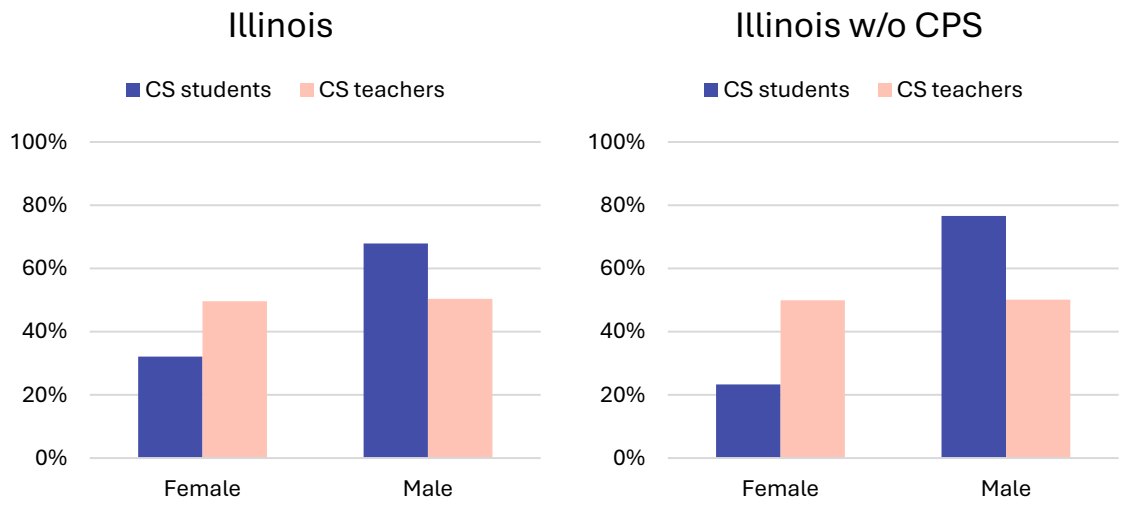
Summary. There are not enough CS-endorsed teachers to adequately cover the current CS course offerings in the state. Only half of all teachers who taught a CS course in the last five years held a CS endorsement, and analyses of appropriately assigned in-field CS teachers yielded wide variation across the highest-enrollment courses. These findings reveal a two-pronged issue. First, not enough teachers teaching CS hold any type of CS endorsement (subject endorsements are *required* by the Illinois Administrative Code[6], though which specific CS endorsement is appropriate is *recommended* by ISBE), perhaps raising questions about the preparedness and qualifications of the CS teacher workforce. Second, the assignability of appropriately endorsed teachers to CS coursework varies greatly from course to course, indicating a teacher's preparation for course content may also vary greatly from course to course. The impact of CS teacher endorsements on student outcomes will be further explored in Part 4 of this Series and assignment of in-field CS endorsed teachers by district will be further explored in Part 5 of this Series.

Does the CS teacher workforce match the CS student body?

What the data tells us. Figures 6 and 7 bring together demographic data on the CS teacher workforce (already noted above) and data from Part 2 of the Series on demographics of the CS student body. For both Illinois and Illinois without CPS, the CS teacher workforce does not match the gender representation of the CS student body (see Figure 6). As noted here and earlier, the CS teacher workforce is nearly half women whereas the CS student body reached only 32% female representation.[5] To look at it another way, in Illinois, high school girls enrolling in CS have a 45% chance that their CS teacher will be a woman.[l]

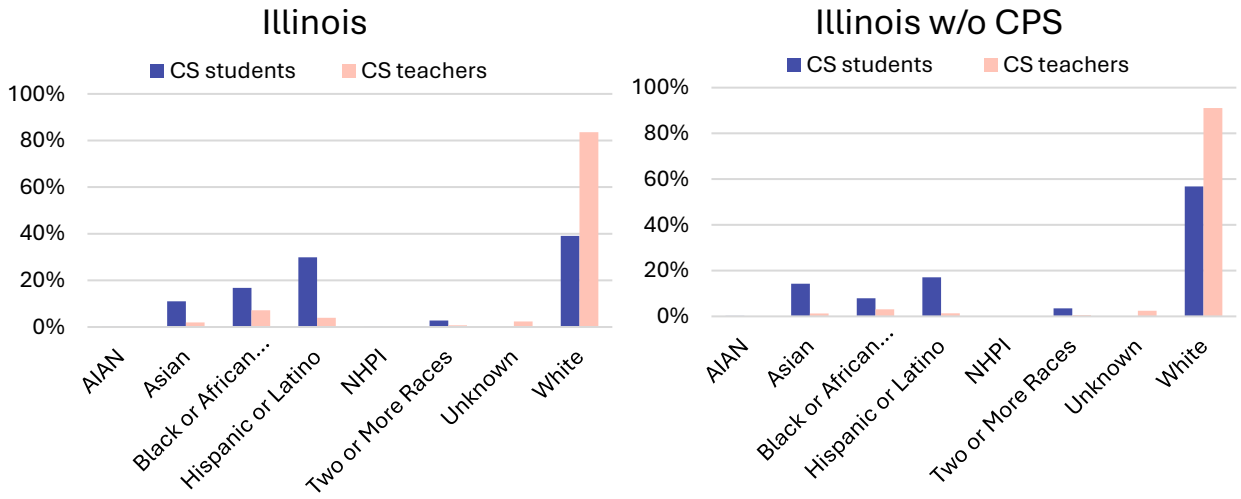
[l] Estimates of chances students will be paired with a teacher of the same race or gender are based on state-wide numbers. District-specific information will be included in Part 5 of this Series. More information on these estimates can be found in the Supplemental Materials for the Series.

Figure 6. Average representation of high school CS teachers (pink) and CS students (blue) by gender for SY 2018-2022 in Illinois (left) and Illinois without CPS (right).



As shown in Figure 7, the CS teacher workforce does not match the CS student body by racial identity either. Black/African American and Hispanic/Latino teachers represent less than 12% of the CS teacher workforce, even when CPS is included in the analysis, whereas Black/African American and Hispanic/Latino students represent 46.7% and 25.0% of the CS student body for Illinois and Illinois without CPS, respectively. Even though there is room to grow in diversifying the racial/ethnic makeup of the CS student body (see Part 2 of this Series), the CS teacher workforce requires more growth to match the increasingly racially diverse student body.

Figure 7. Average representation of high school CS teachers (pink) and CS students (blue) by race/ethnicity for SY 2018-2022 in Illinois (left) and Illinois without CPS (right).



To look at student-teacher matching another way, Black/African American CS students have a 35.1% chance of enrolling in a CS course and being paired with a Black/African American CS teacher. These odds lower to 9.9% for Black/African American students after removing CPS from the analysis. A similar trend was observed for Hispanic/Latino students, in which their odds for having a Hispanic/Latino teacher were 17.6% in Illinois and 6.7% in Illinois without CPS, indicating a higher likelihood of student-teacher matching on racial identity in CPS than across Illinois more broadly. This aligns with the increased representation of Black/African American and Hispanic/Latino students and teachers in CPS than across Illinois.

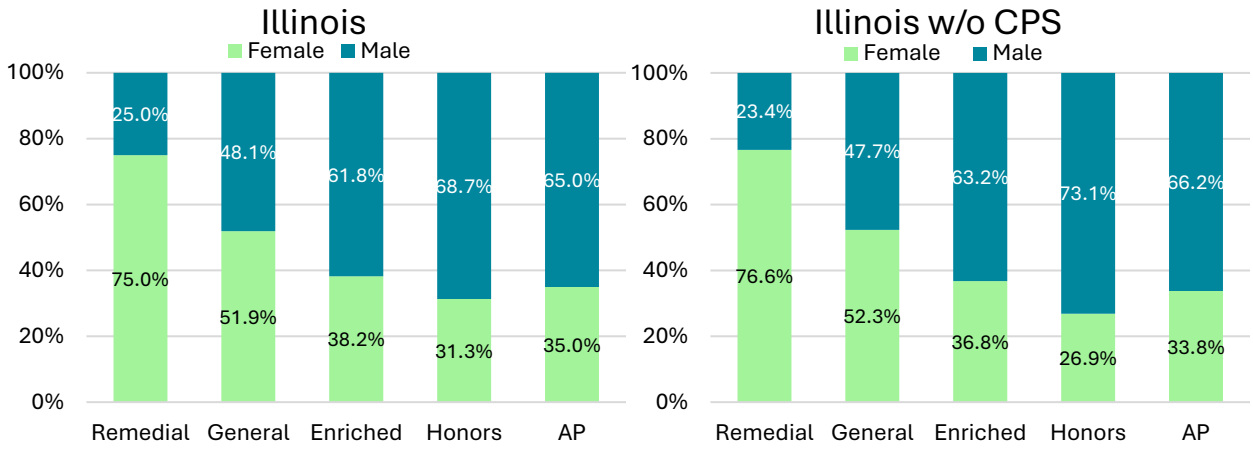
Summary. The CS teacher workforce does not match the CS student body in Illinois, but for a variety of reasons. There is better representation of women in the CS teacher workforce than there is of girls in the CS student body. Part 2 of this Series noted that female representation in the student body has increased in the past five years, so progress is being made. On the other hand, the CS student body is more racially diverse than the CS teacher workforce. Research has shown that students with teachers of the same race or ethnicity have better academic and behavioral outcomes in their courses than if they were paired with a teacher of a different race or ethnicity.[14] Moreover, seeing representation of teachers with similar identities is important to build and grow a sense of belonging and recognition in STEM and CS more specifically.[15,16] As districts throughout Illinois expand their CS offerings, consideration of the gender and racial makeup of the CS teaching staff is important.

What are the characteristics of CS teachers who teach CS courses of varying course levels?

What the data tells us. Earlier in this report, we observed gender parity across the aggregated CS teacher workforce. However, because Part 2 of this Series revealed significant differences in the representation of student groups across CS courses of varying levels[5], we repeated a similar analysis to see if the characteristics of the CS teacher workforce also differed by course level. Figure 8 shows the gender representation of the teacher workforce for CS courses of increasing rigor (as defined by ISBE[m], left to right) from remedial to Advanced Placement (AP). As shown in Figure 8, we see that the gender parity previously seen in the aggregated CS teacher workforce now disappears at most levels. Similar trends are observed for both Illinois and Illinois without CPS, where general CS coursework has gender parity in their teachers; however, representation of female teachers steadily declines as the rigor of the course increases to honors. There is a slight uptick in female representation for both Illinois and Illinois without CPS in AP, but significant disparities persist. Notably, female teachers are overrepresented in remedial CS coursework, where women represent roughly three-quarters of the CS teacher workforce.

[m] See Supplemental Materials glossary for definitions such as course level.

Figure 8. Average representation of high school CS teachers' binary gender by CS course level for SY 2018-2022 in Illinois (left) and Illinois without CPS (right).



As mentioned previously, the CS teacher workforce in Illinois is almost entirely White. Because of the overrepresentation of White CS teachers across the state, there is little difference in the racial identities of the CS teacher workforce across varying course levels. The CS teacher workforce is the most racially diverse in Illinois in honors coursework, in which representation is 3.8% Asian, 9.1% Black/African American, 6.7% Hispanic/Latino, 77.6% White, and the remaining 2.8% are two or more races or unknown. Complete tables of the breakdown of racial groups by varying course levels can be found in the Supplemental Materials.

Continuing with the demographics of the CS teacher workforce by course level, we look to their teaching licensure and endorsements. For licensure, the majority of CS teachers across course levels (over 90%) hold a PEL, with varying levels of CS teachers holding several types of ELSs. This trend holds for both Illinois and Illinois without CPS. See the Supplemental Materials for more information. Tables 4 and 5 below show the five most held teaching endorsements in descending order for those teaching CS in remedial, general, enriched, honors, and AP courses for Illinois and Illinois without CPS, respectively. The bottom row shows the average chances of a CS student enrolling in a CS course at a particular level and their teacher holding a CS endorsement.

In Illinois (see Table 5), CS students are least likely to have a teacher with at least one CS endorsement if they are enrolled in a remedial CS course, where less than 9% of teachers have one. That said, the majority of teachers who teach remedial CS courses hold endorsements in behavior specialists, learning disabilities, and more, possibly indicating their placement is attached more to the students in the classroom than the content being taught. The percentage of teachers with at least one CS endorsement increases as the level of course rigor increases from general to honors CS coursework. CS teachers at these levels typically have their Secondary Education endorsement. Endorsements in business and mathematics are also prevalent. The Computer Science and Technology Education CS endorsements appear in the five most held for Honors

CS courses. In honors and AP, there are a significant number of CS teachers with Mathematics endorsements, possibly indicating that a significant number of math teachers were also assigned to teach CS courses. In AP, more than half of all CS teachers hold at least one CS endorsement. As we found in Part 2, female, Black/African American, Hispanic/Latino, and low-income students, as well as English learners and students with disabilities, are all underenrolled in AP coursework and some of these groups are also overenrolled in remedial CS coursework.[5] Considering these findings together, these student groups not only have inequitable access to rigorous coursework, they also have inequitable access to teachers adequately trained to provide a quality CS education.

Table 5. Average representation of high school CS teachers' endorsements by CS course level for SY 2018-2022 in Illinois.

		Remedial	General	Enriched	Honors	AP
Most held endorsements	1	Learning Behavior Specialist I (84.4%)	Secondary Education (63.7%)	Secondary Education (72.8%)	Secondary Education (68.7%)	Secondary Education (77.2%)
	2	Secondary Education (43.3%)	Business, Marketing and Computer Education* (21.6%)	General Administrative (23.4%)	Mathematics (34.6%)	Mathematics (64.4%)
	3	Learning Disabilities (21.5%)	Social Science (20.2%)	Business, Marketing and Computer Education* (22.9%)	Computer Science* (21.6%)	Computer Science* (34.2%)
	4	Social Science (21.3%)	Basic Business (19.1%)	Business Education (21.3%)	Technology Education* (20.6%)	Business, Marketing and Computer Education* (17.9%)
	5	Elementary Education (Self Contained General Education) (16.7%)	Business Education (17.9%)	Mathematics (19.2%)	General Administrative (18.6%)	General Administrative (17.7%)
At least one CS endorsement held by…		8.9%	44.3%	48.3%	59.7%	56.7%

*Asterisks note CS endorsements.

Similar trends were observed for Illinois without CPS (see Table 6). CS teachers of varying course levels were similarly endorsed with sporadic CS endorsements, as well as Mathematics, various business endorsements, and the more general Secondary Education endorsement. The main difference between the two analyses was that students across levels (with the exception of remedial CS coursework) had a higher chance (between 2-7%) of having a teacher with a CS endorsement once CPS was removed from the analysis.

Table 6. Average representation of high school CS teachers' endorsements by CS course level for SY 2018-2022 in Illinois without CPS.

		Remedial	General	Enriched	Honors	AP
Most held endorsements	1	Learning Behavior Specialist I (82.8%)	Secondary Education (74.5%)	Secondary Education (73.9%)	Secondary Education (73.1%)	Secondary Education (81.2%)
	2	Secondary Education (47.5%)	Business, Marketing and Computer Education* (25.5%)	Business, Marketing and Computer Education* (26.1%)	Mathematics (36.0%)	Mathematics (70.6%)
	3	Learning Disabilities (24.0%)	Social Science (23.9%)	Business Education (25.1%)	Technology Education* (28.6%)	Computer Science* (35.8%)
	4	Social Science (24.0%)	Basic Business (22.6%)	General Administrative (22.9%)	General Administrative (21.8%)	Business, Marketing and Computer Education* (19.9%)
	5	Elementary Education (Self Contained General Education) (16.5%)	Business Education (21.1%)	Basic Business (21.4%)	Computer Science* (18.6%)	General Administrative (18.1%)
At least one CS endorsement held by…		8.8%	46.7%	52.9%	67.9%	60.4%

*Asterisks note CS endorsements.

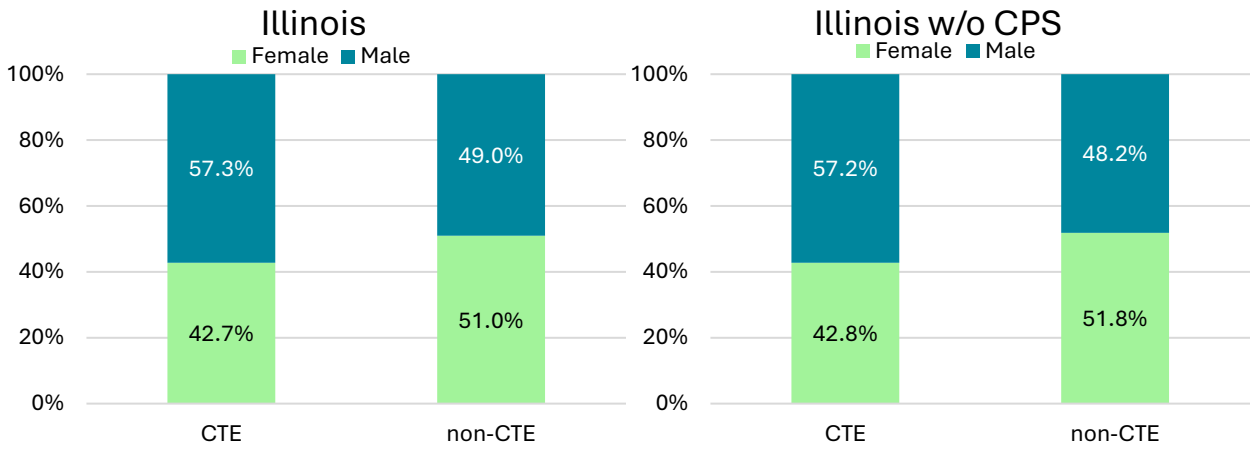
Summary. When analyzing the CS teacher workforce by course level, there was less representation of women as courses increased in rigor; however, at the same time, likelihood of teachers holding at least one CS endorsement increased with increasing rigor. Because the CS teacher workforce as a whole is not racially diverse, there was not much difference in this facet of identity across course levels. These findings suggest two things: (1) there is a need to diversify the CS teacher workforce and increase the number of female, Asian, Black/African American, Hispanic/Latino, and Indigenous teachers at *all* levels of high school CS education, not just general CS; and (2) regardless of course rigor, teachers with a CS endorsement should be appropriately assigned. Having a teacher with CS content expertise is part of a quality and equitable CS education that all students should have access to, regardless of the level of rigor of the course.[17]

What are the characteristics of CS teachers who teach CS CTE courses?

What the data tells us. Similar to the previous section, we analyzed the CS teacher workforce and their characteristics by varying courses. This section focuses on CS Career and Technical Education (CTE) courses.[n] Figure 9 shows that CS CTE courses for both Illinois and Illinois without CPS are taught by slightly more men than women compared to CS courses that are non-CTE.

[n] In previous reports, we analyzed participation in dual credit (DC) CS courses similarly to CS CTE courses. DC is not analyzed in this report, as it is a student-level variable and not a class-wide variable.

Figure 9. Average representation of high school CS teachers' binary gender by CS CTE or non-CTE for SY 2018-2022 in Illinois (left) and Illinois without CPS (right).



Analysis of racial representation for CS CTE courses yielded similar results from previous sections—CS CTE teachers are mostly White. CS CTE courses have slightly higher representation of White teachers (89.7% in Illinois and 93.2% in Illinois without CPS) compared to non-CTE CS courses (81.9% and 91.1%, respectively).

In terms of teaching licenses, the vast majority of CS CTE and CS non-CTE teachers in Illinois and Illinois without CPS hold a PEL. Slightly higher proportions of CS CTE teachers hold an ELS with a CTE endorsement than those who teach non-CTE courses, but only marginally. See the Supplemental Materials for more information.

The breakdown of teaching endorsements by those who taught CS CTE courses (or non-CTE courses) is shown in Table 7. Of note, CS CTE teachers in either the Illinois or Illinois without CPS analysis are much more likely to have a business-type endorsement than others (excluding the more general Secondary Education endorsement that is still the most held). Illinois CS CTE students are much more likely to have a teacher with at least one CS endorsement than those in non-CTE courses. This trend holds for Illinois without CPS as well.

Table 7. Average representation of high school CS teachers' endorsements by CS CTE and CS non-CTE courses for SY 2018-2022 in Illinois and Illinois without CPS.

		Illinois		Illinois w/o CPS	
		CTE	**Non-CTE**	**CTE**	**Non-CTE**
Most held endorsements	1	Secondary Education (62.9%)	Secondary Education (58.6%)	Secondary Education (63.2%)	Secondary Education (61.9%)
	2	Business, Marketing and Computer Education* (27.9%)	Social Science (17.9%)	Business, Marketing and Computer Education* (29.4%)	Social Science (18.4%)
	3	Basic Business (23.2%)	Learning Behavior Specialist I (17.0%)	Basic Business (24.2%)	Business, Marketing and Computer Education* (18.3%)
	4	Business Education (21.1%)	Business, Marketing and Computer Education* (16.1%)	Business Education (22.2%)	Learning Behavior Specialist I (16.3%)
	5	Business, Marketing and Management (21.0%)	Mathematics (14.8%)	Business, Marketing and Management (20.7%)	Basic Business (15.9%)
At least one CS endorsement held by…		71.0%	50.4%	71.2%	51.9%

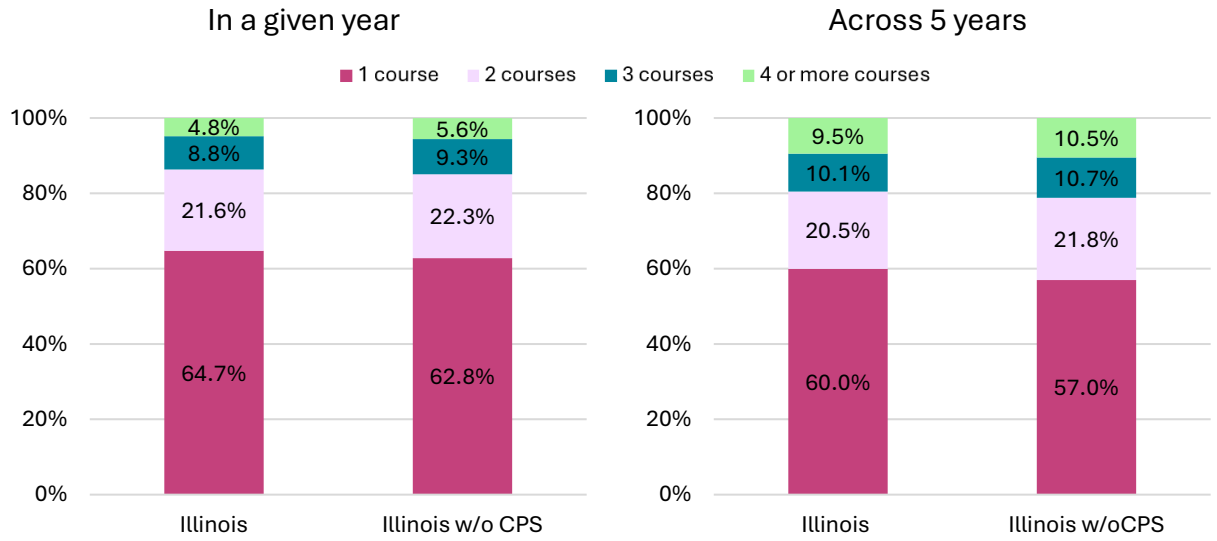
*Asterisks note CS endorsements.

Summary. Similar calls for increasing the gender and racial diversity of the teaching staff in other areas of CS education hold true for CS CTE courses. CS CTE teachers on average are more likely to hold a CS endorsement than those teaching non-CTE courses in CS, indicating slightly better assignment of adequately prepared teachers in these settings.

What is the average CS workload for teachers?

What the data tells us. Another important aspect to consider when assessing the capacity for CS education within the teacher workforce is the workload. Figure 10 shows the number of unique courses taught by CS teachers within a given year and across the five years of our dataset. On average, more than 60% of all CS teachers taught only one unique CS course in a given year. Another 20% of all CS teachers taught two CS courses in a given year, and the proportion of teachers who taught more than two CS courses declines with increasing number of courses. Between SY 2018-2022, the percentage of teachers who taught two courses increased by 21.8%, outpacing the growth in those that teach only one CS course in a given year. Relative to the graph on the left that showed unique course load in a given year, the graph on the right shows the number of unique courses taught across the five years. The majority of CS teachers taught only one unique CS course and another 20% taught two unique CS courses. That said, this graph shows a higher proportion of CS teachers who taught three, four, or more unique CS courses within those five years than compared to unique courses taught in a given year. The majority of CS teachers in the state teach only one unique CS course in a given year and across five years, indicating little course diversity for many CS teachers.

Figure 10. Average percent of high school CS teachers by the number of unique CS courses they taught in a given year (left) and across five years (right) between SY 2018-2022 in Illinois and Illinois without CPS.

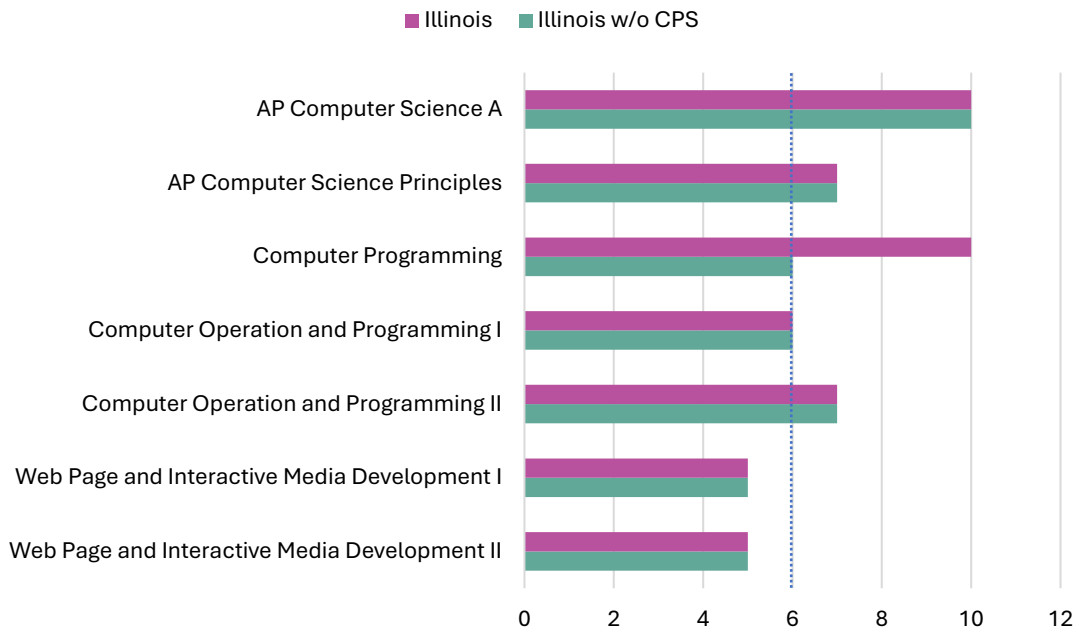


However, the story changes for those with any CS endorsement. As the number of courses increased, whether it is in a given year or across five years, teachers were more likely to have any CS endorsement with the more courses they taught. For example, in Illinois, 40.8% of all teachers who taught only 1 CS course in a given year held any CS endorsement, whereas 61.1% of all teachers who taught 2 unique CS courses in a given year held any CS endorsement. This trend was also seen in Illinois without CPS.[o] Overall, CS endorsed teachers appear to be adequately utilized, as those with a CS endorsement are teaching a diversity of CS courses both within a given year and across five years.

Further, CS teachers taught the same course an average of 6 times between SY 2018-2022 (this was the same for both Illinois and Illinois without CPS). However, this varied by course (see Figure 11 for the highest-enrollment CS courses in Illinois and the number of times teachers repeatedly taught the course). Notably, AP CS A teachers taught that course an average of ten times across the 5-year span. Illinois Computer Programming teachers taught that course an average of ten times, whereas those outside of CPS taught it an average of six times. These findings indicate that even if teachers lack diversity in their workload, they are likely repeatedly teaching the same course year after year. Repeated teaching of courses may provide teachers with content experience to improve their instruction over time.[18]

[o] See the Supplemental Materials for more information.

Figure 11. Average number of times high school CS teachers repeatedly taught a respective CS course between SY 2018-2022 in Illinois (purple) and Illinois without CPS (teal), with state average (dotted blue line).



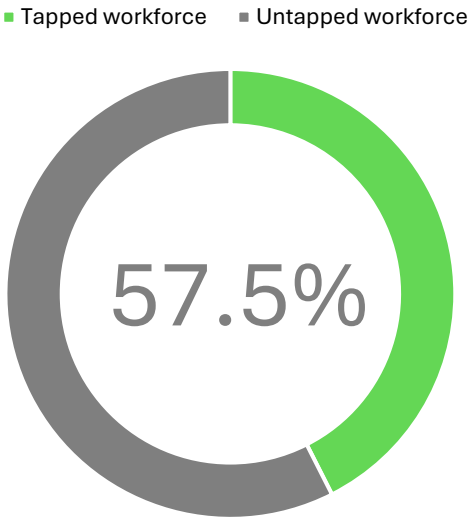
Summary. The majority of CS teachers teach only one unique CS course in a given year and across the five years available, indicating less variability in their CS workload. Moreover, CS teachers are repeatedly teaching the same courses over time, with some teaching the same course 6 or more times in a five-year period. This repetition highlights a trend of sustained focus on specific courses, which may have positive implications for both teaching effectiveness and professional development opportunities.

Spotlight: What is the state of the untapped CS teacher workforce?

What the data tells us. Because previous sections in this report indicated a gap in the number of teachers teaching a CS course and the number of those teachers being adequately endorsed to teach CS, we wanted to understand if this was due to a shortage of teachers holding CS endorsements. To do this, we obtained data on all actively employed high school educator staff in Illinois that held any of the CS endorsements between SY 2018-2022.[p] The active CS teachers with a CS endorsement in our dataset accounted for only 42.5% of all actively employed educator staff in Illinois that hold any of the CS endorsements. This means that 57.5% of all those that have a CS endorsement in the state were not actively teaching a CS course between SY 2018-2022 (see Figure 12). This equates to roughly 1,100 high school educator staff in a given

[p] Data on all actively employed educator staff in the state who held any of the CS endorsements were obtained via a FOIA request and are based off FTE data and not headcounts. Because our primary data uses headcounts whereas the supplemental FOIA data uses FTE, calculations using FTE as the denominator are conservative estimates and may be higher than stated here. Data on the number of all high school teachers in Illinois without CPS was unavailable and thus findings for Illinois are only shown. This data did not include unemployed or retired staff.

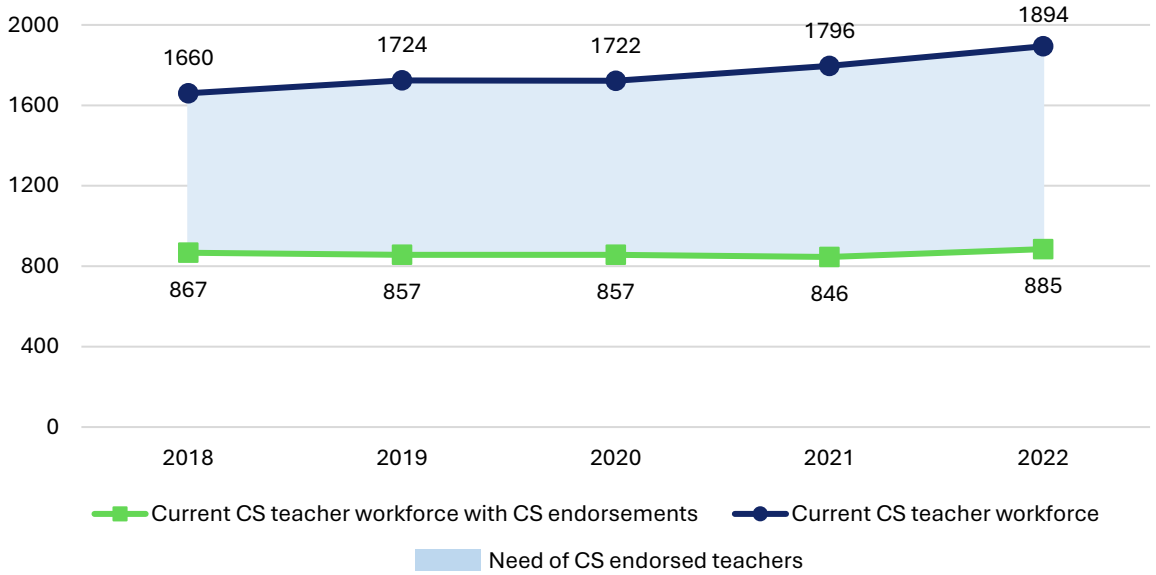
Figure 12. Average percent of high school educator staff who hold at least one CS endorsement but did not teach a CS course (untapped workforce) between SY 2018-2022 in Illinois.



year that are qualified to teach a CS course but did not. Moreover, the majority of the high school educator staff (85.8% equating to roughly 990 FTE) that hold a CS endorsement are *teachers*. The remaining 14% represent administrators (e.g., principals, deans, department chairs, superintendents), ancillary staff (e.g., paraprofessionals, curriculum specialists), and resource teachers (e.g., educators who provide instruction and support to students with disabilities).

Figure 13 shows the current CS teacher workforce as well as the number of teachers in the current workforce that hold any CS endorsement (same data shown in Figures 1 and 4 above). However, now we included the gap needed to fill with CS endorsed teachers (shown in light blue shading). In the most recent year of this data set, SY 2022, this gap stood at 1,009 teachers needing to be endorsed. As mentioned earlier in this section, on average, there are roughly 990 classroom teachers in Illinois who hold at least one of the CS endorsements required to teach CS but are not actively teaching a CS course. This indicates that there are almost enough teachers in the state to fill the gap of non-endorsed CS teachers.

Figure 13. Number of teachers in the current CS workforce (blue line), number of teachers in the current CS workforce teaching with a CS endorsement (green line), and the gap in the current teacher workforce needing CS endorsements (light blue shading) between SY 2018-2022 in Illinois.



Our current study does not have the data to explain this gap in the CS teacher workforce or why teachers with a CS endorsement were assigned to teach non-CS coursework. However, we offer several (albeit speculative) explanations: (1) This could be due to *preference*. Teachers may have a CS endorsement but no longer wish to teach CS because interests have changed; (2) This could be due to *district needs*. At the time of this dataset, only one district in the state of Illinois had CS as a graduation requirement. All other districts offered CS as an elective, so it is plausible that teachers with a CS endorsement were assigned to other subjects because that is where they were needed. Previous research has indicated that math and science courses are among the most chronically unfilled and underfilled (i.e., filled with an educator who does not have the required credentials for the position) teaching positions in the state and many CS endorsed teachers could be reassigned to such courses[19,20]; and/or (3) This could be due to a district's *lack of CS offerings*. Teachers with a CS endorsement may have moved from a district with CS offerings into districts where CS courses are not offered and as such were assigned to teach other subjects. Further research into this area is needed to fully understand this gap.

Summary. There is a large percentage of active high school educator staff with a CS endorsement not actively teaching a CS course. This population of qualified, yet untapped, CS teachers could basically meet the need in the current workforce of the number of CS teachers without the recommended CS endorsements. While we cannot fully explain the discrepancies in teaching assignments, we offer several possible reasons. In Part 5 of this Series, we will explore more of this data district by district to see how CS endorsed teachers are distributed across the state.

Can we assess equity in Illinois high school CS education using the CAPE framework?

This third report started the analysis of the **capacity** for CS education component of the CAPE framework. This report provides a description of the CS teacher workforce and highlights three important findings: (1) the number of CS teachers is increasing across the state, indicating an increased capacity for CS education; (2) the CS teacher workforce does not match the CS student body—while there is better representation of women among the CS teacher workforce than the CS student body, racial representation at the front of the classroom is nowhere near the increasing racial diversity of the students in the classroom; and (3) the state needs more CS endorsed teachers and for those teachers to be appropriately assigned to the CS course that aligns with their CS endorsement. Only about half of the current CS teacher workforce hold any CS endorsement, but there are many teachers in the state who hold a CS endorsement but are assigned elsewhere.

Figure 14. CAPE Framework assessment of Illinois high school CS education.

This report shows that while districts are assigning more and more teachers to CS coursework, there is a lack of qualified CS-endorsed teachers and, therefore, insufficient capacity for equitable CS education. Expanding CS education has become a priority for the state, with notable legislation first requiring CS course offerings (Public Act 101-0654[1]) and current pushes towards making CS a state-wide graduation requirement (HB 1891[21], introduced January 2025). That said, these expansions have little to no regard for the teacher workforce and do not address ways that districts can build up their capacity for CS education with qualified teachers. While professional development is abundantly available for CS teachers and ideas of creating micro-credentials for CS teachers have been floated to help build capacity, one could argue that, without the end goal being a CS endorsement, the students of Illinois will not have access to an equitable CS education. Teachers with the requisite pedagogical content knowledge of CS that is found in an endorsement program is a form of equity.

There are currently seven post-secondary institutions in the state that offer the coursework needed for four of the CS endorsements that can be added to a PEL. See the Supplemental Materials for a full list of institutions offering CS endorsements and related characteristics of the programs. These programs span between five and eleven courses needed to fulfill the 18-semester hour requirement as part of the CS endorsement. Some programs offer courses fully remotely, whereas others require a few in-person courses. The cost of tuition to complete the coursework ranges from $6,300 to $26,000, which could create barriers for teachers wishing to pursue an endorsement; and only two programs offer financial assistance to teachers to help reduce the cost. In addition to legislation being introduced that allows for funds to be used for CS professional development, more funding needs to be directed towards teachers attaining their endorsement in an effort to build equitable capacity for CS education.

As noted at the start of this report, the analyses discussed herein are to set a baseline for understanding the state of CS education before mandates expanding access went into effect. As recommended with our previous reports, repeated analyses of the CS teacher workforce are warranted when data for SY 2024 and later are available to truly understand how the CS teacher workforce has changed since implementation. Other future directions of this work could focus on CS teacher retention and which, if any, of the endorsements are more utilized in CS coursework than others.

Much like the other reports in this Series, while we found improvements in various aspects of CS education in the state, there is still much room for improvement to meet the needs and have the capacity for high-quality, equitable CS education.

What's coming next?

This was the third report in **The State of Computer Science in Illinois High Schools Series**. The fourth report will analyze what factors (e.g., teachers' licensure, teachers' endorsement, alignment between student and teacher identities, and indicators of students' academic levels) affect student outcomes such as final grades and enrolling in a second CS course.

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