Supplemental Materials

DISCOVERY PARTNERS INSTITUTE

IWERC

Illinois Workforce and Education Research Collaborative

PART OF THE UNIVERSITY OF ILLINOIS SYSTEM

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

Last updated December 2025

Table of Contents

Notes for Part 1 – What is the landscape of CS coursework?

What proportion of students take multiple CS courses?

This analysis excluded those who repeated a course due to a failing grade or withdrawing from the course. The analysis only included students who enrolled in two different courses during the data timeframe.

Notes for Part 2 – What are the characteristics of the CS student body?

While the report focuses on several student demographic groups, not all are provided in the main text. Below are figures and tables for all student demographic groups for each section of the main report. Some data is purposefully not shared to maintain student anonymity; ISBE disclosure-proofing rules were followed.

Who enrolls in CS coursework?

Figure 1. Representation of each gender category in CS high school enrollment and total high school enrollment for Illinois (left) and Illinois without CPS (right) between SY 2018-2022.

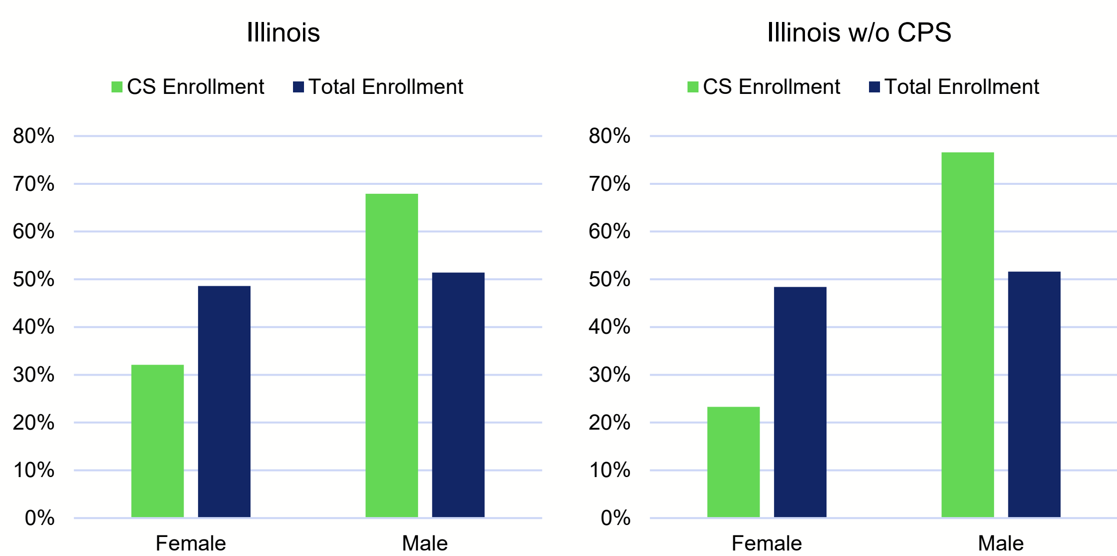


Figure 2. Representation of each racial category in CS high school enrollment and total high school enrollment for Illinois (left) and Illinois without CPS (right) between SY 2018-2022.

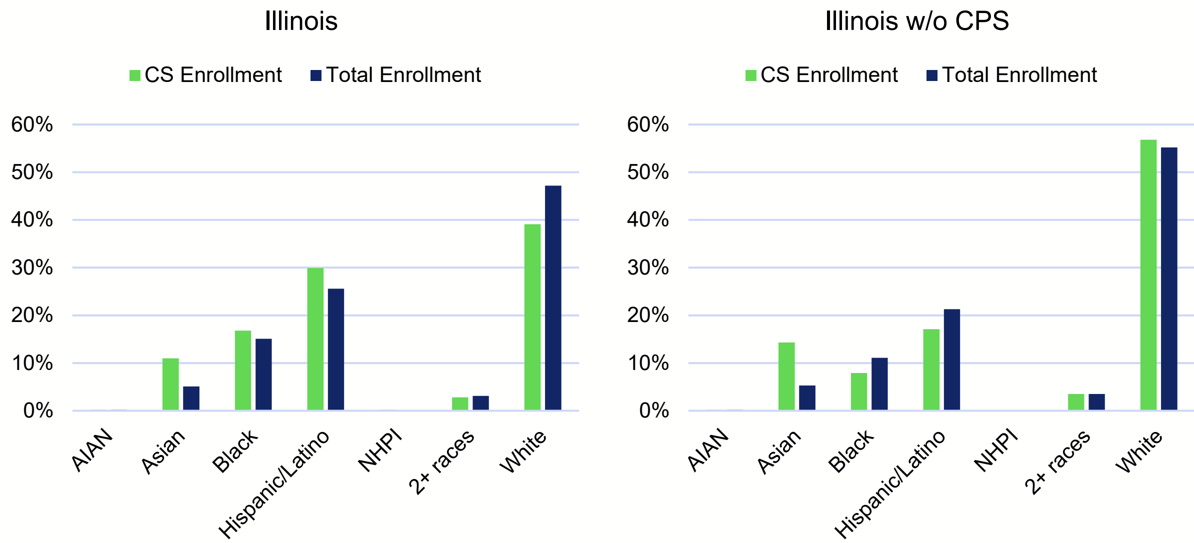
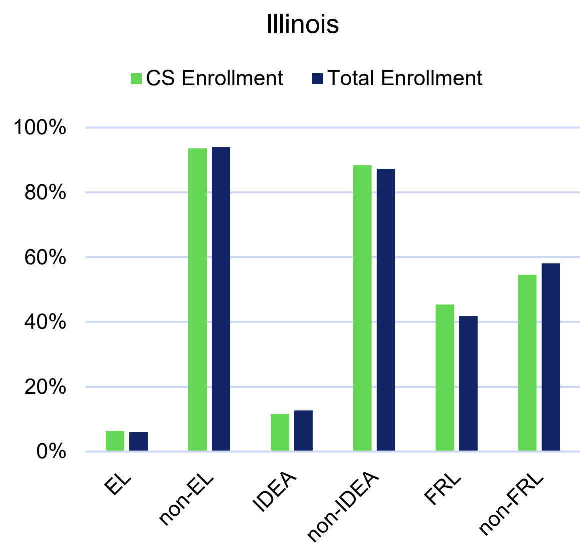
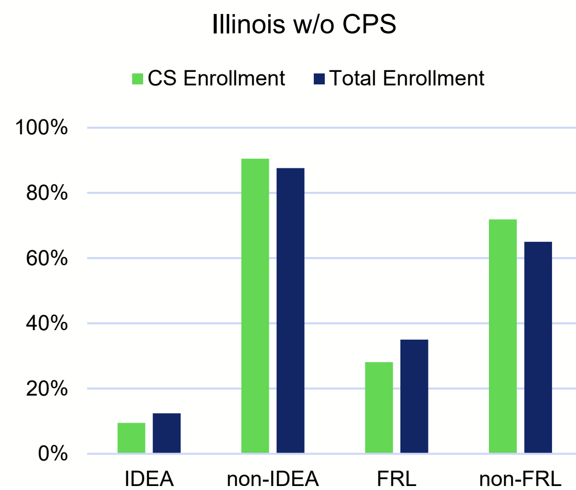


Table 1. Representation of intersectional student demographic groups in CS high school enrollment for Illinois and Illinois without CPS.

	Illinois	**Illinois w/o CPS**
Female AIAN	< 5%	< 5%
Male AIAN	< 5%	< 5%
Female Asian	< 5%	< 5%
Male Asian	7.5%	10.1%
Female Black	7.2%	< 5%
Male Black	9.7%	5.7%
Female Hispanic/Latino	10.9%	< 5%
Male Hispanic/Latino	19.0%	13.6%
Female NHPI	< 5%	< 5%
Male NHPI	< 5%	< 5%
Female 2+ races	< 5%	< 5%
Male 2+ races	< 5%	< 5%
Female White	9.6%	12.5%
Male White	29.5%	44.3%

Figure 3. Representation of English learners (EL), students with disabilities (IDEA), low-income students (FRL) categories in CS high school enrollment and total high school enrollment for Illinois (left) and Illinois without CPS (right) between SY 2018-2022.





Equation 1. Percent relative change equation used to calculate the change in enrollment for all student groups between SY 2018-2022.

$$Percent\ relative\ change = \frac{\%\ in\ enrollment_{SY22} - \%\ in\ enrollment_{SY18}}{\%\ in\ enrollment_{SY18}} \times 100$$

Table 2. Percent relative change of representation in enrollment of various student groups in CS high school enrollment and total high school enrollment between SY 2018-2022 for Illinois and Illinois without CPS.

	CS Enrollment		Total Enrollment	
	Illinois	**Illinois w/o CPS**	**Illinois**	**Illinois w/o CPS**
Female	12.2%	7.6%	0.1%*	0.1%*
Male	-5.3%	-2.6%	-0.1%*	-0.1%*
AIAN	-1.7%	9.6%	-4.6%	-0.9%
Asian	14.6%	24.7%	6.6%	7.3%
Black	1.4%	-1.4%	-2.6%	0.2%
Hispanic/Latino	5.4%	5.0%	11.2%	14.8%
NHPI	21.8%	-31.7%	3.1%	-10.0%
2+ races	9.2%	9.6%	15.5%	15.6%
White	-8.5%	-7.2%	-6.3%	-6.7%
EL	53.2%	77.1%	57.6%	65.1%
Non-EL	-2.9%	-1.9%	-3.0%	-2.7%
IDEA	-2.8%	-8.0%	9.9%	9.7%
Non-IDEA	0.4%	0.9%	-1.4%	-1.4%
FRL	3.7%	-6.5%	-4.4%	-2.2%
Non-FRL	-2.8%	2.8%	3.5%	1.3%

* Calculations for female representation in total high school enrollment were from data including all grade levels, rather than just 9th-12th grade, due to only high school data not being available. Calculations for female representation in CS high school enrollment were from data that only included 9th-12th grade.

To compare to findings from Part 1[1], Figure 4 includes the representation of each student demographic group that enrolls in CS coursework out of all students in that demographic group in high school.

Figure 4. Percentage of CS enrollment within a gender (left) and racial (right) demographic group for Illinois (purple) and Illinois without CPS (teal) between SY 2018-2022 compared to the state averages, respectively.

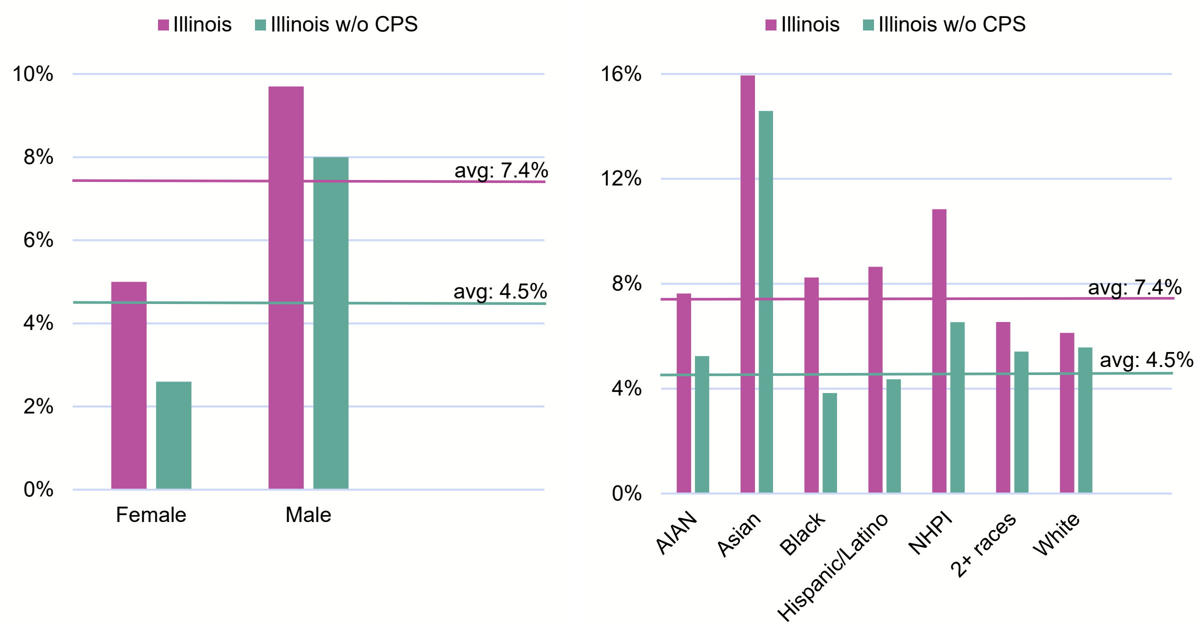
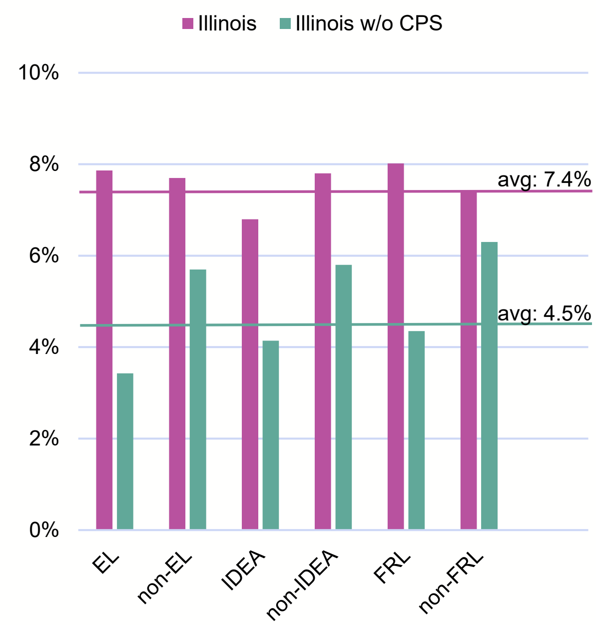


Figure 5. Percentage of CS enrollment within a demographic group for Illinois (purple) and Illinois without CPS (teal) between SY 2018-2022 compared to the state averages, respectively.



What are the characteristics of CS students by course level?

In our dataset, AP CS courses could be counted as general, enriched, or honors as reported by school districts. However, we removed AP CS A and AP CS Principles from these counts within general, enriched, or honors and analyzed them independently in their own category (AP).

Table 3. Percentage of each student demographic group within course level (remedial, general, enriched, honors, and advanced placement) between SY 2018-2022 for Illinois and Illinois without CPS.

	Remedial		General		Enriched		Honors		AP	
	Illinois	Illinois w/o CPS	Illinois	Illinois w/o CPS	Illinois	Illinois w/o CPS	Illinois	Illinois w/o CPS	Illinois	Illinois w/o CPS
Female	27.6%	11.7%	32.0%	16.2%	29.3%	16.6%	42.4%	18.5%	30.1%	18.3%
Male	72.4%	88.3%	68.0%	83.8%	70.7%	83.4%	57.6%	81.5%	69.8%	81.7%
AIAN	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%
Asian	< 5.0%	6.7%	5.5%	13.8%	5.0%	8.5%	9.9%	30.6%	25.6%	33.5%
Black	23.7%	18.3%	19.6%	6.0%	18.5%	10.0%	21.3%	< 5.0%	7.7%	< 5.0%
Hispanic/Latino	10.3%	5.0%	32.5%	16.6%	25.7%	16.5%	37.1%	13.1%	21.1%	11.3%
NHPI	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%
2+ races	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%
White	59.4%	68.3%	39.6%	59.9%	47.1%	60.0%	28.1%	48.7%	41.7%	48.2%
EL	< 5.0%	< 5.0%	8.9%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%	< 5.0%
IDEA	90.7%	91.7%	15.8%	9.5%	9.0%	7.9%	7.3%	< 5.0%	< 5.0%	< 5.0%
Non-FRL	45.1%	55.0%	48.1%	72.4%	54.1%	68.7%	50.6%	84.8%	72.4%	85.4%
FRL	54.9%	45.0%	51.9%	27.6%	45.9%	31.3%	49.4%	15.2%	27.6%	14.6%

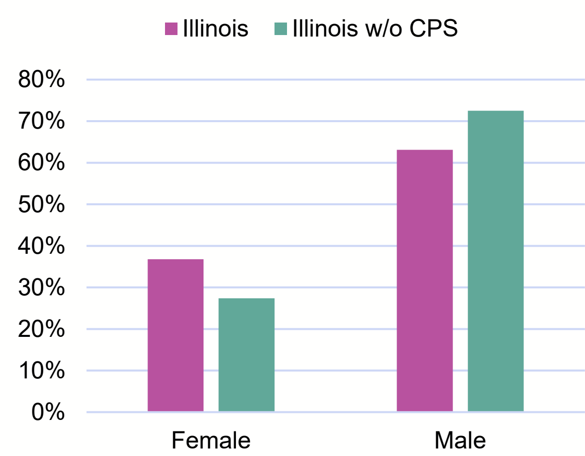
What are the characteristics of CS students in CTE or DC coursework?

Table 4. Percentage of each student demographic group within CTE or dual credit coursework between SY 2018-2022 for Illinois and Illinois without CPS.

	CTE		DC	
	Illinois	**Illinois w/o CPS**	**Illinois**	**Illinois w/o CPS**
Female	23.8%	22.8%	22.7%	22.1%
Male	76.1%	77.1%	77.3%	77.9%
AIAN	< 5.0%	< 5.0%	< 5.0%	< 5.0%
Asian	9.7%	10.0%	< 5.0%	5.1%
Black	10.0%	7.8%	7.8%	6.5%
Hispanic/Latino	22.4%	18.8%	23.6%	23.0%
NHPI	< 5.0%	< 5.0%	< 5.0%	< 5.0%
2+ races	< 5.0%	< 5.0%	< 5.0%	< 5.0%
White	54.4%	59.7%	60.3%	62.0%
EL	< 5.0%	< 5.0%	< 5.0%	< 5.0%
IDEA	10.6%	10.2%	10.0%	10.1%
Non-IDEA	89.4%	89.8%	90.0%	89.9%
FRL	35.6%	31.1%	35.8%	34.5%
Non-FRL	64.4%	68.9%	64.2%	65.5%

What are the characteristics of CS students who take only one CS course?

Figure 6. Percentage of students who take only one CS course for Illinois (purple) and Illinois without CPS (teal) for gender (left) and racial identity (left) between SY 2018-2022.



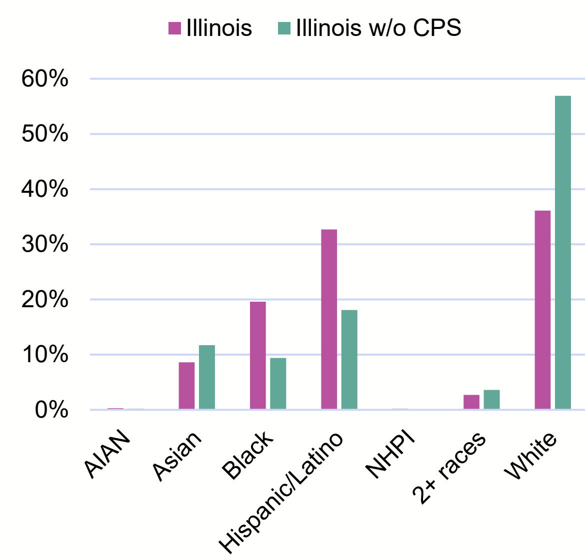


Figure 7. Percentage of students who take only one CS course for Illinois (purple) and Illinois without CPS (teal) for students with disabilities (IDEA), low-income students (FRL), and students without those designations between SY 2018-2022.

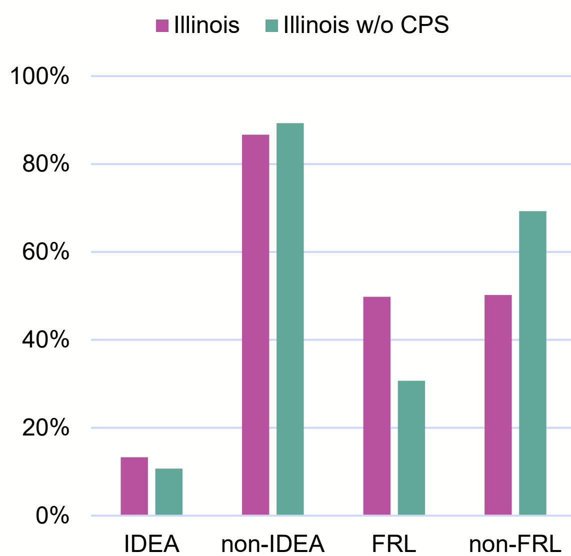
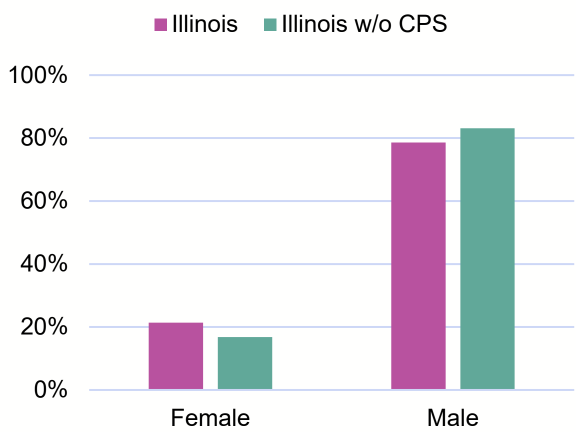


Table 5. Percent relative change of representation of various student groups who took only one CS course between SY 2018-2022 for Illinois and Illinois without CPS.

	Illinois	**Illinois w/o CPS**
Female	9.4%	4.1%
Male	-4.9%	-1.9%
AIAN	-15.4%	-9.0%
Asian	15.8%	26.4%
Black	-0.2%	0.4%
Hispanic/Latino	5.0%	8.4%
NHPI	42.0%	-41.1%
2+ races	16.3%	13.2%
White	-8.4%	-8.2%
EL	43.6%	74.5%
Non-EL	-2.9%	-2.0%
IDEA	-4.1%	-7.7%
Non-IDEA	0.6%	0.9%
FRL	4.1%	-3.6%
Non-FRL	-3.5%	1.6%

What are the characteristics of CS students who take a CS course sequence?

Figure 8. Representation of students who take two or more CS courses for Illinois (purple) and Illinois without CPS (teal) for gender (left) and racial identity (left) between SY 2018-2022.



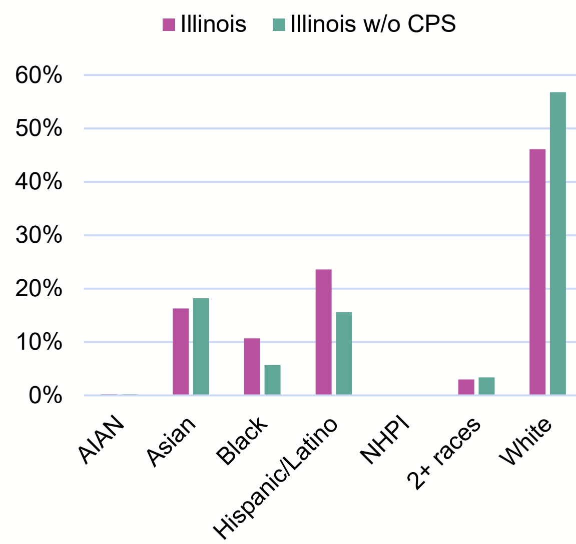


Figure 9. Representation of students who take two or more CS courses for Illinois (purple) and Illinois without CPS (teal) for students with disabilities (IDEA), low-income students (FRL), and students without those designations between SY 2018-2022.

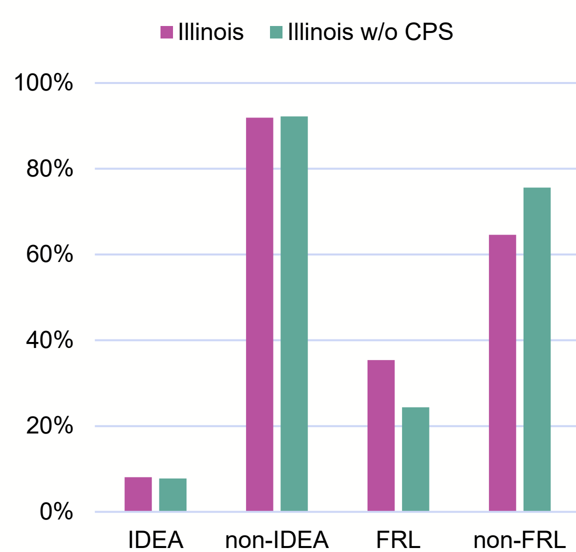


Table 6. Percent relative change of representation in enrollment of student demographic groups who took two or more CS courses between SY 2018-2022 for Illinois and Illinois without CPS.

	Illinois	Illinois w/o CPS
Female	11.4%	11.6%
Male	-2.9%	-2.4%
AIAN	56.8%	68.7%
Asian	23.6%	28.4%
Black	-3.6%	-12.2%
Hispanic/Latino	-1.3%	-4.6%
NHPI	-9.3%	-15.0%
2+ races	-5.6%	1.1%
White	-5.5%	-5.2%
EL	85.0%	85.7%
Non-EL	-2.2%	-1.6%
IDEA	-4.8%	-8.3%
Non-IDEA	0.4%	0.8%
FRL	-5.2%	-15.5%
Non-FRL	2.8%	5.8%

Table 7. Representation of each student demographic group in four 2-course sequences between SY 2018-2022 for Illinois, the total student enrollment in these sequences, and the representation of CPS students within each sequence.

	Computer Programming → AP Computer Science A	Computer Operations and Programming I → Computer Operations and Programming II	Web Page and Interactive Media Development I → Web Page and Interactive Media Development II	Computer Programming → Web Page and Interactive Media Development I
Female	30.2%	17.9%	31.3%	33.9%
Male	69.8%	82.1%	68.7%	66.1%
AIAN	< 5.0%	< 5.0%	< 5.0%	< 5.0%
Asian	26.9%	14.4%	5.6%	17.1%
Black	13.3%	8.9%	15.7%	13.5%
Hispanic/Latino	29.7%	24.1%	25.3%	39.3%
NHPI	< 5.0%	< 5.0%	< 5.0%	< 5.0%
2+ races	< 5.0%	< 5.0%	< 5.0%	< 5.0%
White	27.2%	48.7%	50.1%	27.8%
EL	< 5.0%	< 5.0%	5.8%	7.3%
IDEA	< 5.0%	9.1%	12.0%	10.3%
FRL	41.1%	32.9%	45.7%	47.8%
Non-FRL	58.9%	67.1%	54.3%	52.2%
Total enrollment	4371	3544	2362	813
% within CPS	57.4%	23.0%	28.3%	69.7%

Do CS course grades vary by CS student characteristics?

In this analysis, passing grades included A, B, C (including +/-) and failing grades included D, F, W (withdraw), WP (withdraw with credit; including +/-). Even though some districts count it as passing and students earn credit, we made the choice to include grades of D with failing grades because some argue that low of a grade suggests wide gaps in a student's content knowledge and may prove them ineligible for continuing their CS coursework. We understand this may be a limitation of the analysis, but we prioritized content knowledge over course credit. Further, we acknowledge that grades may not be the best indicator for students' knowledge; however, no standardized CS test exists that all students take. Final course grade was the one standardized measure we could use as an outcome for the vast majority of CS students.

Table 8. Percentage of each student demographic group who received a failing or passing grade in their CS course between SY 2018-2022 for Illinois and Illinois without CPS.

	Illinois		Illinois w/o CPS	
	Fail	**Pass**	**Fail**	**Pass**
Female	20.4%	79.6%	13.3%	86.7%
Male	21.4%	78.6%	16.6%	83.4%
AIAN	23.5%	76.5%	20.8%	79.2%
Asian	9.0%	91.0%	6.9%	93.1%
Black/AA	33.5%	66.5%	28.8%	71.2%
Hispanic/Latino	28.1%	71.9%	25.0%	75.0%
NHPI	15.5%	84.5%	15.3%	84.7%
Two or more races	18.6%	81.4%	17.2%	82.8%
White	14.1%	85.9%	13.4%	86.6%
EL	36.2%	63.8%	32.5%	67.5%
Non-EL	20.0%	80.0%	15.3%	84.7%
IDEA	35.1%	64.9%	28.8%	71.2%
Non-IDEA	19.2%	80.8%	14.5%	85.5%
FRL	30.2%	69.8%	26.8%	73.2%
Non-FRL	13.6%	86.4%	11.5%	88.5%
Overall	21.1%	78.9%	15.8%	84.2%

Logistic regression

In this section of the study, a multivariate logistic regression model was conducted to estimate the relationships between student characteristics and the likelihood of receiving a failing grade. The predicting variables in the model included gender, race/ethnicity, English Learner (EL) status, disability status (IDEA), and income status (FRL). We included all relevant variables in one model to help control for confounding factors. A confounder may influence both the dependent variable and an independent variable, potentially distorting the true relationship. The logistic regression coefficients derived from this model explained the change in the log odds of receiving a failing grade for the status change in the predictor variables, as shown in Table 9. To provide more intuitively interpretable results, the log odds coefficients were transformed to odds ratios (displayed in Figure 4 in the text). The odds ratios represent the factor by which the odds of receiving a failing grade are multiplied, for the change of status in the corresponding predicting variables, while all other variables remain equal.

Table 9. Logistic regression results for students' binary learning outcome between SY 2018-2022

	*b**	*SE*	*Wald* χ²	*P*	95% CI [LL, UL]
(Intercept)	-2.01	0.01	-181.56	< .001***	[-2.03, -1.99]
Female	-0.24	0.01	-20.10	< .001***	[-0.27, -0.22]
Asian	-0.55	0.03	-21.79	< .001***	[-0.60, -0.50]
Black	0.79	0.02	48.26	< .001***	[0.76, 0.82]
Hispanic/Latino	0.50	0.01	33.24	< .001***	[0.47, 0.52]
NHPI	-0.13	0.16	-0.79	.432	[-0.45, 0.18]
Two or more races	0.29	0.03	8.22	< .001***	[0.22, 0.36]
AIAN	0.41	0.10	3.97	< .001***	[0.20, 0.61]
EL	0.44	0.02	21.28	< .001***	[0.40, 0.48]
FRL	0.63	0.01	50.02	< .001***	[0.61, 0.66]
IDEA	0.53	0.02	34.14	< .001***	[0.50, 0.56]
Pseudo R^2 = 0.076					

Note: *b** = unstandardized regression weight; SE B = standard error of the coefficients; Wald χ² = Wald Chi-Square Test statistic; *p* = significance level; LL and UL indicate the lower and upper limits of a confidence interval, respectively. Pseudo R^2 reflects the model's improvement over the null model rather than the proportion of variance explained as in linear regression.

The logistic regression analysis was conducted to predict the likelihood of students failing a course based on Gender, Race, English Learner, Free or Reduced Lunch, and IDEA. The model was statistically significant, χ^2 (10, N = 218,853) = 15,226, p < .001. The likelihood ratio test comparing the null model to the model with predictors was significant, indicating that the predictors as a set reliably distinguished between students who failed and those who did not (p < .001). The model had a dispersion parameter for the binomial family taken to be 1, and the Akaike Information Criterion (AIC) was 206,345. The model explains 7.6% log-likelihood of the outcome variable compared to a null model, which may initially seem modest. However, a lower pseudo R^2 value in a model that uses only demographic variables as predictors is acceptable because it indicates that these variables, which are fixed effects in this model, do not overwhelmingly predict student outcomes. If demographic variables accounted for a much larger percentage of variance, it would suggest a deterministic view where student outcomes are predominantly fixed by their identities, which is obviously not true. Disparities in student outcomes are shaped by structural and systemic barriers.

Intersectional descriptives

Equation 2. Equation to calculate odds of receving a failing grade compared to the reference group.

$$Odds\ of\ receving\ a\ failing\ grade = \frac{Fail\ rate\ of\ student\ group}{Fail\ rate\ of\ reference\ group}$$

If odds are less than one in the equation above, we use the inverse and then provide the odds of receiving a passing grade (as opposed to a failing grade). Intersectional descriptive analyses (Tables 10 - 14 below) were not statistically tested. As we have the complete state dataset, these are the definitive data for the population at that time. Therefore, traditional significance testing for determining if the observed results reflect the state population are unnecessary.

Table 10. Percentage of each intersectional student demographic group (gender x race) who received a failing or passing grade in their CS course between SY 2018-2022 and their associated odds of receiving one of those grades compared to White male students (reference group).

	Fail	Pass	Odds of receiving a failing grade	Odds of receiving a passing grade
Female, AIAN	17.9%	82.1%	1.3x	-
Male, AIAN	26.1%	73.9%	1.8x	-
Female, Asian	7.6%	92.4%	-	1.9x
Male, Asian	8.9%	91.1%	-	1.6x
Female, Black/African American	28.9%	71.1%	2.0x	-
Male, Black/African American	35.3%	64.7%	2.5x	-
Female, Hispanic/Latino	24.2%	75.8%	1.7x	-
Male, Hispanic/Latino	29.1%	70.9%	2.0x	-
Female, NHPI	9.3%	90.7%	-	1.5x
Male, NHPI	16.2%	83.8%	1.1x	-
Female, 2+	16.6%	83.4%	1.2x	-
Male, 2+	18.9%	81.1%	1.3x	-
Female, White	12.2%	87.8%	-	1.2x
Male, White	14.3%	85.7%	1.0x	1.0x

Table 11. Percentage of each intersectional student demographic group (race x income) who received a failing or passing grade in their CS course between SY 2018-2022 and their associated odds of receiving one of those grades compared to White non-FRL students (reference group).

	Fail	Pass	Odds of receiving a failing grade	Odds of receiving a passing grade
AIAN, FRL	27.2%	72.8%	2.5x	-
AIAN, non-FRL	18.5%	81.5%	1.7x	-
Asian, FRL	14.5%	85.5%	1.3x	-
Asian, non-FRL	6.5%	93.5%	-	1.7x
Black/African American, FRL	35.6%	64.4%	3.2x	-
Black/African American, non-FRL	24.4%	75.6%	2.2x	-
Hispanic/Latino, FRL	29.6%	70.4%	2.7x	-
Hispanic/Latino, non-FRL	22.0%	78.0%	2.0x	-
NHPI, FRL	19.2%	80.8%	1.8x	-
NHPI, non-FRL	10.3%	89.7%	-	1.1x
2+, FRL	31.6%	68.4%	2.9x	-
2+, non-FRL	12.6%	87.4%	1.2x	-
White, FRL	24.3%	75.7%	2.2x	-
White, non-FRL	11.0%	89.0%	1.0x	1.0x

Table 12. Percentage of each intersectional student demographic group (race x EL status) who received a failing or passing grade in their CS course between SY 2018-2022 and their associated odds of receiving one of those grades compared to White non-EL students (reference group).

	Fail	Pass	Odds of receiving a failing grade	Odds of receiving a passing grade
AIAN, EL	14.6%	85.4%	1.1x	-
AIAN, non-EL	24.1%	75.9%	1.8x	-
Asian, EL	24.8%	75.2%	1.8x	-
Asian, non-EL	7.2%	92.8%	-	1.9x
Black/African American, EL	31.1%	68.9%	2.3x	-
Black/African American, non-EL	32.6%	67.4%	2.4x	-
Hispanic/Latino, EL	38.7%	61.3%	2.8x	-
Hispanic/Latino, non-EL	25.2%	74.8%	1.9x	-
NHPI, EL	25.8%	74.2%	1.9x	-
NHPI, non-EL	12.5%	87.5%	-	1.1x
2+, EL	21.5%	78.5%	1.6x	-
2+, non-EL	18.2%	81.8%	1.3x	-
White, EL	27.1%	72.9%	2.0x	-
White, non-EL	13.6%	86.4%	1.0x	1.0x

Table 13. Percentage of each intersectional student demographic group (race x IDEA status) who received a failing or passing grade in their CS course between SY 2018-2022 and their associated odds of receiving one of those grades compared to White non-IDEA students (reference group).

	Fail	Pass	Odds of receiving a failing grade	Odds of receiving a passing grade
AIAN, IDEA	42.6%	57.4%	3.4x	-
AIAN, non-IDEA	21.2%	78.8%	1.7x	-
Asian, IDEA	21.8%	78.2%	1.7x	-
Asian, non-IDEA	8.1%	91.9%	-	1.5x
Black/African American, IDEA	42.0%	58.0%	3.4x	-
Black/African American, non-IDEA	30.6%	69.4%	2.4x	-
Hispanic/Latino, IDEA	38.0%	62.0%	3.0x	-
Hispanic/Latino, non-IDEA	25.6%	74.4%	2.0x	-
NHPI, IDEA	19.2%	80.8%	1.5x	-
NHPI, non-IDEA	13.3%	86.7%	1.1x	-
2+, IDEA	35.7%	64.3%	2.9x	-
2+, non-IDEA	16.5%	83.5%	1.3x	-
White, IDEA	26.1%	73.9%	2.1x	-
White, non-IDEA	12.5%	87.5%	1.0x	1.0x

Table 14. Percentage of each intersectional student demographic group (gender x race x income) who received a failing or passing grade in their CS course between SY 2018-2022 and their associated odds of receiving one of those grades compared to White male non-FRL students (reference group).

	Fail	Pass	Odds of receiving a failing grade	Odds of receiving a passing grade
Female, White, non-FRL	9.0%	91.0%	-	1.3x
Male, White, non-FRL	11.6%	88.4%	1.0x	1.0x
Female, White, FRL	22.1%	77.9%	1.9x	-
Male, White, FRL	25.1%	74.9%	2.2x	-
Female, Black, FRL	31.5%	68.5%	2.7x	-
Female, Black, non-FRL	20.7%	79.3%	1.8x	-
Male, Black, FRL	38.8%	61.2%	3.4x	-
Male, Black, non-FRL	26.7%	73.3%	2.3x	-
Female, Hispanic/Latino, non-FRL	19.6%	80.4%	1.7x	-
Male, Hispanic/Latino, non-FRL	23.1%	76.9%	2.0x	-
Female, Hispanic/Latino, FRL	25.7%	74.3%	2.2x	-
Male, Hispanic/Latino, FRL	32.1%	67.9%	2.8x	-

Notes for Part 3 – What are the characteristics of the CS teacher workforce?

Post-secondary Institutions offering CS-related Endorsements

Table 15. Information on Illinois institutions that offer a CS endorsement program.

Institution	Program	Credit hours needed	Number of courses	Time to endorsement	Modality	Tuition (in-state for AY24-25)	Program-specific financial aid	Website	Notes
DePaul University	Computer Science Endorsement	36	9	1-2 years	Choice of online or in-person	$723 per credit hour = $26,028	--	Program website	
Eastern Illinois University	Computer Science Minor for Teacher Licensure	22	8	4 semesters	In-person	$344.25 per credit hour = $7,573.50	--	Program website	
Illinois State University	Computer Science	18	ISU does not have a set course map for their CS endorsements. Rather, they offer a crosswalk between their course catalog and ISBE's required courses for each endorsement. Because of this, number of courses to endorsement, time to endorsement, and modality of courses is subject to student choice and course availability.			$422.57 per credit hour = $7,606.26	--	Teacher Education Subsequent Endorsement Guide	
	Business, Marketing and Computer Education	18					--		
	Business, Marketing and Computer Programming	18					--		
	Technology Education	18					--		
Northeastern Illinois University	Computer Science Endorsement	18	6	6 semesters	Almost all online (1 course hybrid and requires in-person 4 weeks)	$1,050 per 3 credit hour course = $6,300	CPS offers 80% tuition assistance	Program website	Teachers have a special rate for tuition to lower cost.
Northern Illinois University	M.S.Ed. in Instructional Technology with a 5-12 Computer Science endorsement	33	11 (and 3 credit hours of field experience)	5 terms	Fully online	$534.75 per hour = $16,577.25	--	Program website	New application portal coming soon to their website.
University of Illinois Springfield	Computer Science Endorsement	18	5	5 semesters or less depending on previous coursework	Online	$365.75 per hour = $6,583.50	State Farm provides funding for 6-12th grade teachers in McLean County	Program website	
University of Illinois Urbana-Champaign	Teaching Endorsement in Computer Science	20	6 required 1 optional	5 semesters	Fully online	$520 per credit hour = $10,400 - $12,480	--	Program website	

*Note: Information in this table was sourced from endorsement program websites and each institution was given the opportunity to add, correct, or comment on the information for accuracy.

Who teaches CS courses in Illinois?

Table 16. Percent relative change of binary gender and racial/ethnic representation of CS high school teachers and all high school teachers between SY 2018-2022 for Illinois and Illinois without CPS.

	Illinois	Illinois w/o CPS	Illinois (all HS teachers)
Female	-1.2%	1.6%	0.6%
Male	1.2%	-1.6%	-0.7%
AIAN	31.5%	-13.0%	25.4%
Asian	25.6%	36.7%	16.6%
Black or African American	-11.0%	13.9%	19.4%
Hispanic or Latino	26.0%	74.0%	45.7%
NHPI	0%	0%	-0.8%
2+ races	-5.1%	-2.2%	10.8%
Unknown	-50.4%	-56.5%	-55.2%
White	1.2%	0.4%	-2.0%

Table 17. Average representation of high school CS teachers by gender and race/ethnicity for SY 2018-2022 in Illinois and Illinois without CPS.

	Illinois	Illinois w/o CPS
AIAN Female	0.0%	0.0%
AIAN Male	0.1%	0.1%
Asian Female	0.6%	0.3%
Asian Male	1.4%	0.9%
Black or African American Female	4.3%	1.8%
Black or African American Male	2.9%	1.3%
Hispanic or Latino Female	1.7%	0.6%
Hispanic or Latino Male	2.3%	0.7%
NHPI Female	0.0%	0.0%
NHPI Male	0.0%	0.1%
Two or More Races Female	0.4%	0.2%
Two or More Races Male	0.4%	0.4%
Unknown Female	1.3%	1.4%
Unknown Male	1.1%	1.0%
White Female	41.4%	45.5%
White Male	42.2%	45.5%

Table 18. Percent relative change of binary gender and racial/ethnic representation of CS high school teachers and all high school teachers between SY 2018-2022 for Illinois and Illinois without CPS.

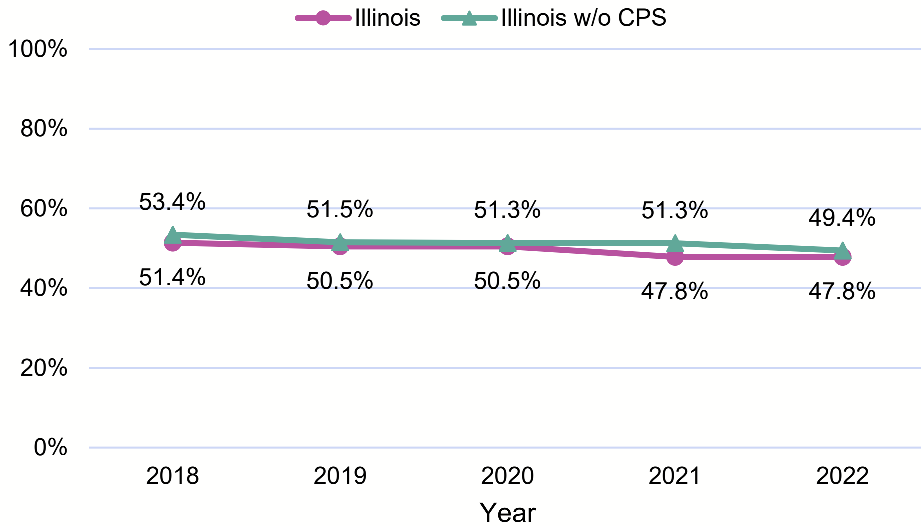
	Illinois	Illinois w/o CPS
AIAN Female	0.0%	0.0%
AIAN Male	-12.4%	-13.0%
Asian Female	100.3%	102.9%
Asian Male	2.9%	18.6%
Black or African American Female	-4.4%	47.9%
Black or African American Male	-20.3%	-17.0%
Hispanic or Latino Female	18.9%	131.9%
Hispanic or Latino Male	31.5%	35.3%
NHPI Female	0.0%	0.0%
NHPI Male	0.0%	0.0%
Two or More Races Female	-37.4%	-13.0%
Two or More Races Male	40.2%	4.4%
Unknown Female	-44.8%	-47.8%
Unknown Male	-56.2%	-66.0%
White Female	-0.8%	0.4%
White Male	3.2%	0.3%

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

Table 19. Average representation of high school CS teachers holding a CS endorsement within a binary gender and racial/ethnic category for SY 2018-2022 in Illinois and Illinois without CPS.

	Illinois	Illinois w/o CPS
Female	43.2%	45.5%
Male	54.8%	59.0%
AIAN	75.0%	100%
Asian	54.5%	80.6%
Black/African American	49.7%	72.7%
Hispanic/Latino	39.1%	55.6%
NHPI	--	--
2+ races	48.4%	61.5%
Unknown	37.7%	45.3%
White	49.6%	53.9%
All CS teachers	49.1%	52.3%

Figure 10. Percentage of high school CS teachers who held at least one CS endorsement between SY 2018-2022 for Illinois (purple) and Illinois without CPS (teal).



Does the CS teacher workforce match the CS student body?

The chances of a student matching their teachers' demographics are calculated as a conditional probability problem using data on the distribution of teachers' and students' gender and racial identities.

Equation 3. Example of equation to calculate chances of a student having the same demographics as their teacher.

$$P\ (Female\ teacher \mid Female\ student) = \frac{P\ (Female\ teacher\ and\ Female\ student)}{P\ (Female\ student)}$$

Where,

$$P\ (Female\ student) = \frac{Number\ of\ female\ students}{Total\ number\ of\ students}$$

$$P\ (Female\ teacher\ and\ Female\ student) = \frac{Number\ of\ female\ students\ with\ female\ teachers}{Total\ number\ of\ students}$$

Table 20. Chances of students having a CS teacher who has the same gender or racial identity as them for female, Black/African American, and Hispanic/Latino students between SY 2018-2022 for Illinois and Illinois without CPS.

	Illinois	**Illinois w/o CPS**
Female	45.1%	45.3%
Black/African American	35.1%	9.9%
Hispanic/Latino	17.6%	6.7%

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

Table 21. Average representation of high school CS teachers' race/ethnicity by CS course level for SY 2018-2022 in Illinois.

	Remedial	General	Enriched	Honors	AP
AIAN	0.0%	0.2%	0.0%	0.0%	0.0%
Asian	0.4%	1.4%	1.3%	3.8%	6.6%
Black/AA	3.7%	7.7%	7.1%	9.1%	5.6%
Hispanic/Latino	2.3%	3.7%	3.7%	6.7%	4.1%
NHPI	0.0%	0.0%	0.0%	0.0%	0.3%
2+ Races	1.1%	0.6%	1.1%	0.6%	0.9%
Unknown	2.0%	2.5%	1.1%	2.2%	1.0%
White	90.4%	83.8%	85.6%	77.6%	81.5%

Table 22. Average representation of high school CS teachers' race/ethnicity by CS course level for SY 2018-2022 in Illinois without CPS.

	Remedial	General	Enriched	Honors	AP
AIAN	0.0%	0.2%	0.0%	0.0%	0.0%
Asian	0.3%	1.1%	0.6%	1.0%	4.5%
Black/AA	2.4%	3.5%	2.5%	1.7%	2.9%
Hispanic/Latino	1.0%	1.3%	1.3%	0.9%	1.8%
NHPI	0.0%	0.1%	0.0%	0.0%	0.3%
2+ Races	0.8%	0.5%	1.2%	0.0%	0.4%
Unknown	1.7%	2.7%	0.8%	2.0%	1.2%
White	93.8%	90.8%	93.6%	94.4%	88.8%

Table 23. Average representation of high school CS teachers' licensure by CS course level for SY 2018-2022 in Illinois.

	Remedial	General	Enriched	Honors	AP
Professional Educator License	98.5%	91.9%	91.7%	93.0%	97.5%
Career and Technical Educator Endorsement	2.2%	13.6%	15.0%	19.7%	5.6%
Paraprofessional Educator Endorsement	3.5%	2.0%	2.0%	1.0%	0.4%
Provisional Career and Technical Educator Endorsement	--	0.3%	0.8%	0.4%	--
Transitional Bilingual Educator Endorsement	--	0.1%	0.8%	1.6%	0.3%
Alternative Provisional Educator Endorsement	2.2%	0.1%	--	--	--
Part-Time Provisional Career and Technical Educator Endorsement	--	0.1%	--	--	--

Table 24. Average representation of high school CS teachers' licensure by CS course level for SY 2018-2022 in Illinois without CPS.

	Remedial	General	Enriched	Honors	AP
Professional Educator License	98.3%	92.3%	93.5%	96.4%	98.8%
Career and Technical Educator Endorsement	2.5%	12.7%	12.2%	10.0%	4.2%
Paraprofessional Educator Endorsement	3.3%	1.6%	2.9%	1.9%	0.6%
Provisional Career and Technical Educator Endorsement	--	0.3%	1.0%	--	--
Transitional Bilingual Educator Endorsement	--	0.1%	1.0%	1.3%	--
Alternative Provisional Educator Endorsement	2.5%	--	--	--	--
Part-Time Provisional Career and Technical Educator Endorsement	--	0.1%	--	--	--

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

Table 25. Average representation of high school CS teachers' race/ethnicity by CTE and non-CTE for SY 2018-2022 in Illinois.

	Illinois		Illinois w/o CPS	
	CTE	Non-CTE	CTE	Non-CTE
AIAN	0.2%	0.1%	0.3%	0.1%
Asian	1.1%	1.8%	1.1%	1.0%
Black/AA	5.3%	8.2%	2.4%	3.3%
Hispanic/Latino	1.2%	4.7%	0.7%	1.4%
NHPI	0.0%	0.0%	0.0%	0.0%
2+ Races	1.5%	0.5%	1.3%	0.3%
Unknown	1.0%	2.7%	1.1%	2.8%
White	89.7%	81.9%	93.2%	91.1%

Table 26. Average representation of high school CS teachers' licensure by CTE and non-CTE for SY 2018-2022 in Illinois.

	Illinois		Illinois w/o CPS	
	CTE	Non-CTE	CTE	Non-CTE
Professional Educator License	90.5%	92.6%	92.0%	94.6%
Career and Technical Educator Endorsement	18.9%	12.4%	15.2%	11.0%
Paraprofessional Educator Endorsement	0.8%	2.0%	0.9%	1.7%
Provisional Career and Technical Educator Endorsement	0.5%	0.2%	0.6%	0.2%
Transitional Bilingual Educator Endorsement	0.3%	0.1%	0.3%	0.1%
Alternative Provisional Educator Endorsement	--	0.1%	--	0.2%
Part-Time Provisional Career and Technical Educator Endorsement	--	0.1%	--	0.1%

What is the average CS workload for teachers?

Table 27. Average representation of CS endorsed high school teachers by the number of CS courses taught in a given year and across 5 years between SY 2018-2022 in Illinois and Illinois without CPS.

	In a given year		Across 5 years	
	Illinois	Illinois w/o CPS	Illinois	Illinois w/o CPS
1 course	40.8%	44.0%	26.9%	29.8%
2 courses	61.1%	62.4%	46.1%	48.0%
3 courses	69.1%	70.7%	64.1%	65.1%
4 or more courses	41.3%	49.2%	59.8%	65.5%

Notes for Part 4 – What factors predict CS student outcomes?

What factors predict the likelihood of students receiving a passing grade in their CS course?

The outcome variable, whether a student received a passing grade the likelihood , is binary at the student level. Similar to Part 2 of this series, passing grades included A, B, C (including +/-) and failing grades included D, F, W (withdraw), WP (withdraw with credit; including +/-). Even though some districts count it as passing and students earn credit, we made the choice to include grades of D with failing grades because some argue that low of a grade suggests wide gaps in a student's content knowledge and may prove them ineligible for continuing their CS coursework. We understand this may be a limitation of the analysis, but we prioritized content knowledge over course credit. Further, we acknowledge that grades may not be the best indicator for students' knowledge; however, no standardized CS test exists that all students take. Final course grade was the one standardized measure we could use as an outcome for the vast majority of CS students.

We examined this research question using three cross-classified multilevel models (e.g., students are clustered within teachers and courses, and courses are offered across multiple districts). First, we estimated the probability that an enrolled student received a passing grade statewide in a given year across all CS courses, conditional on student, teacher, and course characteristics, for each school year from SY 2018 through SY 2022. Second, we focused on the seven most-enrolled courses identified in Part 1 of this Series and estimated how the probability of passing differed across these courses in SY 2022 without accounting for district-level differences. Lastly, we fitted the model for the same seven courses while accounting for district-level variation to examine whether these differences persisted once district context was taken into consideration.

Considering our data are cross-classified and hierarchically structured, we did not use linear probability models, or ordinary least squares (OLS) regression. Standard single-level models assume independence of observations, meaning that each data point contributes unique information uncorrelated with others.[2] However, in our dataset, students are simultaneously nested within multiple contexts, for example, they may be linked to both a specific teacher and a particular course. This creates dependencies among observations: students sharing the same teacher, course, or district tend to be more similar to each other than to students outside those clusters. As a result, standard single-level models would underestimate standard errors and inflate Type I error rates in this context, leading to biased standard errors and less reliable estimates.[3,4]

We also did not rely on bivariate correlations because both the outcome and most predictors are binary (e.g., pass/fail, enrolled/not enrolled, teacher credential yes/no). In such cases, phi or tetrachoric correlations can be computed. However, both are with limitations: they describe only pairwise association without controlling for other covariates or accounting for the hierarchical structure of the data. Moreover, correlations between binary variables are constrained by the marginal distributions, meaning the values are heavily influenced by how common or rare each condition occurs.[5] For instance, if one category overwhelmingly dominates (e.g., most students receive passing grades), the observed correlation may be masked, even when a true relationship exists. This makes bivariate correlations difficult to interpret and potentially misleading. In contrast, the multilevel logistic models estimate conditional associations between binary variables while accounting for shared variance at different levels. In doing so, the multilevel model (MLM) provides a more accurate and interpretable representation of the relationships among variables than simple pairwise correlations could offer.

We recognize that fixed-effects models can also address clustered data by controlling for unobserved characteristics within each level. However, the multilevel models offer better flexibility by accounting for higher-level factors (e.g., course- or district-level characteristics) variation and estimating how higher-level factors relate to students' CS outcomes. In contrast, a fixed-effects model removes all between-group variance, phasing out higher-level effects and precluding those predictors.[4,6] To address this, we use the random effects that capture differences in outcomes across groups while allowing for the inclusion of higher-level covariates. Furthermore, given the cross-classified structure of our data, where students, teachers, and courses can intersect rather than follow a strict hierarchy, a standard fixed-effects approach would be inappropriate, as it can only control for clustering within a single grouping factor.[7]

Step 1: Year-specific, statewide cross-classified overall model

For each year we fit a logistic mixed model with crossed random intercepts for course type and teacher, plus a random intercept for student to accounting for within-student variance:

Let $Pass_{itcs}$ be a binary outcome indicating whether student s in course c with teacher t (observation i) received a passing grade. We specify the model as:

$$logit\{Pr(Pass_{itcs} = 1)\} = \beta_0 + \boldsymbol{x}_{itcs}^{\top}\boldsymbol{\beta} + u_c + v_t + w_s,$$
$$u_c \sim \mathcal{N}(0, \sigma_{course}^2), v_t \sim \mathcal{N}(0, \sigma_{teacher}^2), w_s \sim \mathcal{N}(0, \sigma_{student}^2)$$

Where

$\boldsymbol{x}_{itcs}^{\top}$ is the vector of fixed effects including student-, teacher-, and course-level covariates, endorsement-by-course cross-level interactions, and student-teacher demographic matching terms.

$u_c \sim \mathcal{N}(0, \sigma_{course}^2)$ is a random intercept for course level.

$v_t \sim \mathcal{N}(0, \sigma_{teacher}^2)$ is a random intercept for teacher level.

$w_s \sim \mathcal{N}(0, \sigma_{student}^2)$ is a random intercept for student level.

Student-level covariates $X^{(s)}$:gender (binary), race/ethnicity indicators (American Indian or Alaska Native, Asian, Black/African American, Hispanic/Latino, Native Hawaiian/Pacific Islander, Two or More Races, White as the reference), free/reduced-price lunch (FRL) eligibility, year in school, special education status under IDEA, and English learner (EL) status.

Teacher-level covariates $X^{(t)}$:teacher gender, teacher race/ethnicity indicators (as defined above), and licensure/credential variables including CTE license, professional educator license (PEL), and computer science endorsement.

Course-level covariates $X^{(c)}$:course level indicators including AP, Enriched, Honors, Remedial offerings and General as reference. To allow the effect of endorsement to vary across course types, we specified interaction terms between CS endorsement and the AP, Enriched, and Honors indicators.

Demographic matching terms: female student x female teacher, Black student x Black teacher, and Hispanic/Latino student x Hispanic/Latino teacher. These terms test whether shared demographic characteristics between students and teachers are associated with increased likelihood of receiving a passing grade.

This model provides year-specific, statewide estimates while accounting for unobserved heterogeneity at the course and teacher levels. It produces variance component estimates for both course and teacher random effects, and fixed-effect associations for student, teacher, and course covariates, including endorsement-by-course interactions. These estimates are obtained prior to limiting the analysis to just one course at a time, thereby reflecting overall statewide relationships.

Step 2: Course models for the seven most-enrolled courses

To examine differences across courses, we fitted separate models for each of the seven highest-enrolled courses identified in Part 1 of this series. For student *i* in course *c* with teacher *t* and student *i*dentifier s, the model is specified as:

$$logit\{Pr(Pass_{its} = 1)\} = \beta_0 + \boldsymbol{x}_{its}^{\top}\boldsymbol{\beta} + v_t + w_{s(t)},$$
$$v_t \sim \mathcal{N}\left(0, \sigma^2_{teacher}\right), w_{s(t)} \sim \mathcal{N}\left(0, \sigma^2_{student/teacher}\right)$$

Where

$v_t \sim \mathcal{N}\left(0, \sigma^2_{teacher}\right)$ is a random intercept for teacher, and $w_{s(t)} \sim \mathcal{N}\left(0, \sigma^2_{student/teacher}\right)$ is a random intercept for students nested within teachers.

The vector of fixed effects $\boldsymbol{x}_{its}^{\top}$ included student-, teacher-, and course-level covariates, endorsement-by-course-level interactions, and student–teacher demographic matching terms as defined in step 1. These course-specific models provide variance components for teachers and students within teachers, along with adjusted associations for student and teacher characteristics, while restricting estimation to a single course context.

Because each specification conditioned on a single course ID, the course-level random intercept was no longer included. Instead, the mixed-effects structure included a teacher-level random intercept and a student-within-teacher term, thereby accounting for both teacher-level variation and clustering effects that students taught by the same teacher. The fixed-effect structure mirrored the statewide specification, with adjustments for within-course variability. Specifically, course level predictors for AP, Enriched, Honors, or Remedial levels were retained only when the course had sufficient variation; when these variants were absent, the corresponding predictors were excluded due to zero or near-zero variance.

Whereas the statewide model averages across a diverse mix of CS course offerings, the course-specific models eliminate this compositional averaging and yield parameters that are directly interpretable within the context of a single course. This design allows the associations of teacher endorsement, student–

teacher demographic matching, and student background factors to differ across courses, providing evidence whether effects observed at the statewide level hold consistently across settings or are course-dependent.

Step 3: District course models to account for unobserved district context.

To account for unobserved district context, we estimated reduced course-specific models that added a district random intercept and simplified the fixed-effect structure to focus on variables most likely to vary within districts, while preserving the demographic matching terms. For student *i* with teacher *t* and district *d*, the model is specified as:

$$logit\{Pr(\textit{Pass}_{itd} = 1)\} = \alpha_0 + \boldsymbol{z}_{itd}^{\top}\boldsymbol{\alpha} + v_t + q_d,$$
$$v_t \sim \mathcal{N}(0, \sigma^2_{teacher}), q_d \sim \mathcal{N}(0, \sigma^2_{student\backslash district})$$

Where *i* indexes to one student within a single focal course, *t* is the teacher, and *d* is the district (RCDT). The reduced fixed-effect vector $\mathbf{z}$ retains student gender, race/ethnicity, FRL status, year in school, IDEA status, and English learner status, along with teacher gender, teacher race/ethnicity, preparation and credentials (CTE, PEL, CS endorsement).

This specification includes random intercepts for teachers and districts, acknowledging clustering within both instructional and district contexts. Prior to fitting, chi-square tests showed that endorsement and district membership were not independent across the seven courses. Endorsed teachers were disproportionately concentrated in particular districts, as confirmed by the cross-tabulated distributions. This pattern explains why endorsement effects that appeared in the course-specific models often attenuated or became nonsignificant after adding district random effects. Without district controls, endorsement partially captured between-district differences in staffing; once district intercepts were included, those differences were absorbed at the district level, leaving endorsement with limited additional explanatory value. Variance-reduction comparisons were consistent with this interpretation, indicating that district clustering accounted for a substantial share of variability initially attributed to endorsement. Power to detect within-district endorsement effects was further limited because only a subset of districts employed both endorsed and non-endorsed teachers.

Further, we dropped the demographic matching interactions (female student with female teacher, Black student with Black teacher, Hispanic student with Hispanic teacher) because several districts employ only a small number of CS teachers and have sparse counts of matched pairs; under these conditions, the teacher and district random intercepts induce strong shrinkage, making the BLUPs close to 0 and leaving the matching coefficients weakly identified with large standard errors and frequent convergence issues.

Course-level indicators and endorsement-by-course-level interactions were excluded in this step due to cell size constraints. When the data are partitioned simultaneously by district, teacher endorsement, and specific course levels (e.g., AP, Enriched, Honors, Remedial), some cells contain very few or no observations. Sparse cells produce quasi-separation in the outcome, which leads to unstable parameter estimates and prevents the model from converging to a solution. This issue is especially pronounced in the district models, where an additional random intercept absorbs between-district variation, leaving limited residual variation within some course-by-district combinations. To ensure model convergence and stable estimation, we therefore omitted course-level predictors and their interactions with endorsement in the district-adjusted models. This simplification trades some specificity for greater statistical stability and comparability across courses.

Table 28. Estimated log-odds for passing likelihood by student, teacher, and course characteristics (SY2018–2022).

	2018			2019			2020			2021			2022		
	Log-Odds	*std. Error*	*p*	*Log-Odds*	*std. Error*	*p*	*Log-Odds*	*std. Error*	*p*	*Log-Odds*	*std. Error*	*p*	*Log-Odds*	*std. Error*	*p*
(Intercept)	2.76	0.24	**<0.001**	2.14	0.21	**<0.001**	2.70	0.22	**<0.001**	3.15	0.20	**<0.001**	2.55	0.18	**<0.001**
Student Characteristics															
Female	0.23	0.04	**<0.001**	0.25	0.04	**<0.001**	0.21	0.04	**<0.001**	0.24	0.04	**<0.001**	0.25	0.04	**<0.001**
AIAN	-0.63	0.26	**0.017**	-0.22	0.25	0.373	-0.64	0.26	**0.013**	-0.29	0.25	0.248	-0.46	0.27	0.078
Asian	0.41	0.07	**<0.001**	0.54	0.07	**<0.001**	0.30	0.07	**<0.001**	0.45	0.06	**<0.001**	0.38	0.06	**<0.001**
Black/African American	-0.68	0.06	**<0.001**	-0.72	0.06	**<0.001**	-0.66	0.06	**<0.001**	-0.57	0.06	**<0.001**	-0.79	0.05	**<0.001**
Hispanic/Latino	-0.46	0.05	**<0.001**	-0.42	0.04	**<0.001**	-0.30	0.05	**<0.001**	-0.46	0.04	**<0.001**	-0.48	0.04	**<0.001**
NHPI	0.40	0.46	0.382	-0.05	0.40	0.893	-0.37	0.35	0.285	-0.41	0.30	0.174	0.74	0.48	0.110
Two or More Races	-0.26	0.09	**0.004**	-0.18	0.09	**0.042**	-0.31	0.09	**0.001**	-0.28	0.08	**0.001**	-0.37	0.08	**<0.001**
FRL	-0.40	0.03	**<0.001**	-0.57	0.03	**<0.001**	-0.50	0.03	**<0.001**	-0.59	0.03	**<0.001**	-0.43	0.03	**<0.001**
Year in School	-0.04	0.02	**0.010**	-0.05	0.02	**0.001**	-0.08	0.02	**<0.001**	-0.25	0.01	**<0.001**	-0.02	0.01	0.153
IDEA	-0.53	0.04	**<0.001**	-0.57	0.04	**<0.001**	-0.61	0.04	**<0.001**	-0.36	0.04	**<0.001**	-0.56	0.04	**<0.001**
EL	-0.40	0.06	**<0.001**	-0.27	0.05	**<0.001**	-0.22	0.05	**<0.001**	-0.18	0.05	**0.001**	-0.30	0.05	**<0.001**
Dual Credit Enrollment	0.35	0.13	**0.006**	0.23	0.14	0.089	0.14	0.14	0.318	0.05	0.12	0.710	0.19	0.12	0.113
Teacher Characteristics															
Female	-0.07	0.08	0.332	0.03	0.07	0.677	-0.06	0.07	0.390	-0.14	0.07	**0.039**	-0.06	0.07	0.314
AIAN	-0.49	0.76	0.516	-1.49	0.74	**0.043**	-0.55	0.75	0.461	0.36	0.71	0.619	0.25	0.63	0.678
Asian	0.10	0.21	0.628	0.05	0.19	0.782	-0.25	0.18	0.164	-0.06	0.17	0.730	0.19	0.18	0.323
Black/African American	-0.63	0.15	**<0.001**	-0.51	0.14	**<0.001**	-0.51	0.13	**<0.001**	-0.56	0.13	**<0.001**	-0.42	0.13	**0.001**

Hispanic/Latino	-0.50	0.20	**0.014**	-0.66	0.17	**<0.001**	-0.33	0.16	**0.035**	-0.38	0.16	**0.021**	-0.43	0.14	**0.002**
NHPI	-	-	-	0.19	1.17	0.868	-0.12	1.18	0.919	1.54	0.97	0.114	0.67	0.84	0.429
Two or More Races	0.51	0.32	0.108	0.30	0.30	0.308	-0.22	0.30	0.454	-0.25	0.25	0.330	-0.02	0.26	0.872
CTE Licensure	-0.06	0.12	0.628	-0.00	0.12	0.986	-0.10	0.11	0.388	-0.11	0.11	0.331	0.03	0.11	0.754
PEL Licensure	-0.42	0.21	**0.044**	0.39	0.18	**0.029**	-0.00	0.17	0.993	-0.46	0.16	**0.005**	-0.33	0.16	**0.034**
CS-Endorsed	0.30	0.10	**0.002**	0.03	0.09	**0.037**	-0.06	0.09	0.542	0.07	0.09	**0.045**	0.11	0.08	**0.017**
Course Characteristics															
CTE Course	-0.06	0.15	0.694	0.15	0.13	0.251	0.32	0.19	0.092	0.11	0.12	0.350	0.12	0.07	0.083
AP Course Level	0.33	0.27	0.215	-0.15	0.23	0.514	0.11	0.32	0.736	0.28	0.20	0.151	0.42	0.12	**0.001**
Enriched Course Level	0.19	0.20	0.333	-0.06	0.18	0.734	-0.73	0.23	**0.002**	-0.32	0.22	0.134	-0.30	0.21	0.123
Honors Course Level	0.92	0.19	**<0.001**	0.44	0.14	**0.002**	0.54	0.14	**<0.001**	0.47	0.13	**<0.001**	0.52	0.13	**<0.001**
Remedial Course Level	1.57	0.53	**0.003**	1.27	0.47	**0.007**	0.80	0.56	0.153	0.37	0.52	0.478	1.10	0.52	**0.034**
Interactions[b]															
CS Endorsed Teacher × AP Course Level	-0.39	0.22	0.069	0.08	0.20	0.687	0.07	0.19	0.717	0.04	0.17	0.795	-0.16	0.16	0.279
CS Endorsed Teacher × Enriched Course Level	-0.65	0.25	0.090	0.02	0.26	0.927	0.81	0.30	0.080	0.40	0.28	0.155	0.08	0.28	0.710
CS Endorsed Teacher × Honors Course Level	-0.42	0.22	0.056	-0.03	0.18	0.850	-0.23	0.17	0.175	0.02	0.17	0.918	-0.03	0.17	0.855
CS-Endorsed Teacher × Remedial Course Level[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Female Student × Female Teacher	0.07	0.07	0.278	0.05	0.06	0.443	0.00	0.06	0.999	0.08	0.06	0.170	-0.05	0.06	0.382
Black/AA Student × Black/AA Teacher	0.27	0.12	**0.026**	0.07	0.11	0.513	0.24	0.11	**0.032**	-0.08	0.11	0.475	0.34	0.12	**0.003**
Hispanic/Latino Student × Hispanic/Latino Teacher	0.20	0.13	0.116	0.03	0.10	0.805	0.02	0.11	0.866	-0.13	0.10	0.192	0.06	0.11	0.601
Random Effects															
σ^2	3.29			3.29			3.29			3.29			3.29		

$\tau_{00\ Student}$	0.06	0.04	0.05	0.03	0.07
$\tau_{00\ Teacher}$	0.96	0.80	0.85	0.86	0.78
$\tau_{00\ Course}$	0.05	0.04	0.14	0.03	0.12
ICC	0.25	0.22	0.23	0.27	0.23
Observations	41349	44565	43013	40263	43817
Marginal R^2 / Conditional R^2	0.088 / 0.312	0.153 / 0.397	0.096 / 0.305	0.160 / 0.401	0.131 / 0.376

Note: **Bolded** indicates significance relationships ($p < .05$). [a] For ISBE-Endorsed Teacher × Remedial Course term, the VIF test suggests that there is perfect separation or complete collinearity, where one of the predictor combinations is perfectly predicting the outcome. [b] Interaction terms explained how two factors combine to influence student receiving a passing in a CS course, interaction terms do not tell us the effect of each factor separately. τ_{00} refers to the random intercept variance. Interaction terms represent how two factors work together to influence whether a student receives a passing grade, as they do not reflect the effect of either factor on its own, thus should not be interpreted alone.

What factors predict the likelihood of students enrolling in a second CS course?

We examined this research question using two complementary multilevel models. First, we estimated the probability that a student takes a second CS course statewide across their high school career, conditioning on student, teacher, and course characteristics. Second, we estimated a within-district model that district context through a student-within-district random effect. The outcome, odds of continuing to a second CS course, is binary at the student level. Unlike in the first research question, we did not specify a course model, because both models already account for students' first course-taking experiences and includes course-level predictors (such as course type, level, and rigor). These variables capture the variance attributable to course characteristics while properly adjusting for higher level factors. In this specification, both models effectively partition the variance in continuation outcomes into student-, course-, teacher- or district-level components. In other words, the multilevel model structure already treats courses as a source of random variability. Running separate models by course would instead ignore those course-level influences, leading to higher standard errors and less reliable estimates, especially for courses with lower enrollment.

Considering our data are cross-classified and hierarchically structured (e.g., students are clustered within teachers and courses, and courses are offered across multiple districts), we did not use linear probability models, or OLS regression. Standard single-level models assume independence of observations, meaning that each data point contributes unique information uncorrelated with others.[2] However, in our dataset, students are simultaneously nested within multiple contexts, for example, they may be linked to both a specific teacher and a particular course. This creates dependencies among observations: students sharing the same teacher, course, or district tend to be more similar to each other than to students outside those clusters. As a result, standard single-level models would underestimate standard errors and inflate Type I error rates in this context, leading to biased standard errors and less reliable estimates.[3,4]

We also did not rely on bivariate correlations because both the outcome and most predictors are binary (e.g., continuation yes/no, teacher credential yes/no, EL status yes/no, DC course yes/no). IIn such cases, phi or tetrachoric correlations can be computed. However, both are with limitations: they describe only pairwise association without controlling for other covariates or accounting for the hierarchical structure of the data. Moreover, correlations between binary variables are constrained by the marginal distributions, meaning the values are heavily influenced by how common or rare each condition occurs.[5] For instance, if one category overwhelmingly dominates (e.g., most students enrolled into a second CS course), the observed correlation may be masked, even when a true relationship exists. This makes bivariate correlations difficult to interpret and potentially misleading. In contrast, the multilevel logistic models estimate conditional associations between binary variables while accounting for shared variance at different levels. In doing so, the MLM provides a more accurate and interpretable representation of the relationships among variables than simple pairwise correlations could offer.

We recognize that fixed-effects models can also address clustered data by controlling for unobserved characteristics within each level. However, they also eliminate all between-group variance, omitting the estimation of higher-level contextual effects such as course or district characteristics.[6] This study examines how variation across courses, teachers, and districts relates to students' continuation in CS, such an approach would be inappropriate. The MLM, by contrast, allows us to partition variance across multiple levels, model cross-classified dependencies (students linked to multiple teachers and courses), and retain between-group variances allowing for the estimation of both individual-level effects and higher-level contextual influences on students' CS continuation.

Step 1: Overall model

To examine whether first-course characteristics is associated with statewide student continuation differences, we fitted a statewide cross-classified model that adds explicit controls for course level and uses crossed random intercepts for course, teacher, and student:

$$\text{logit}\{\Pr(C_{\text{itcs}} = 1)\} = x_{itcs}^{\top}\beta u +_c + v_t + w_s,$$
$$u_c \sim \mathcal{N}(0, \sigma_{\text{course}}^2), v_t \sim \mathcal{N}\left(0, \sigma_{\text{teacher}}^2\right), w_s \sim \mathcal{N}\left(0, \sigma_{\text{student}}^2\right)$$

$\boldsymbol{x}_{itcs}^{\top}$ is the vector of fixed effects including student-, teacher-, and course-level covariates, endorsement-by-course cross-level interactions, and student-teacher demographic matching terms; all those variables were captured at the time of student enrolled their first CS course during their high school career.

$u_c \sim \mathcal{N}(0, \sigma_{course}^2)$ is a random intercept for course level.

$v_t \sim \mathcal{N}\left(0, \sigma_{teacher}^2\right)$ is a random intercept for teacher level.

$w_s \sim \mathcal{N}\left(0, \sigma_{student}^2\right)$ is a random intercept for student level.

Student covariates: gender, race/ethnicity, FRL status, year in school, IDEA status, EL status, and the year of first CS enrollment.

Teacher covariates: gender, race/ethnicity, and indicators for CTE program participation, PEL, and CS endorsement at the time of the student's first CS course.

Course covariates: course-level indicators (AP, Honors, Enriched, Remedial and General course as reference)

We also specified student–teacher demographic interaction terms (female student x female teacher, Black student x Black teacher, and Hispanic student x Hispanic teacher) to test whether demographic matching predicted continuation. However, based on variance inflation factor (VIF) diagnostics and predictive power checks, interaction terms that created quasi-separation or contributed negligible information (yielded near-zero information) were excluded from the final statewide specification. Fixed effects for student and teacher demographics were retained.

The statewide model provides a baseline view of which student, teacher, and course characteristics are associated with continuation into a second CS course. By adjusting for first-course type and including crossed random intercepts for courses, teachers, and students, the model accounts for unobserved heterogeneity at these levels while
estimating fixed effects that reflect average statewide patterns. In doing so, it clarifies how student demographics, teacher credentials, and course-level indicators relate to continuation on average across the state, before considering district-specific contexts.

Step 2: District model

We then fitted a district-adjusted model examines continuation into a second CS course while accounting for unobserved heterogeneity at the school district level. The model includes crossed random intercepts for districts and teachers, and students nested within districts. The model is specified as:

$$\text{logit}\{\Pr(C_{itcsd} = 1)\} = x_{itcsd}^{\top}\beta + u_c + v_t + w_{s(d)},$$
$$v_t \sim \mathcal{N}\left(0, \sigma^2_{\text{teacher}}\right), w_{s(d)} \sim \mathcal{N}\left(0, \sigma^2_{\text{student | district}}\right)$$

where i indexes an observation for student s with teacher t in district d. The random intercepts capture unobserved heterogeneity for teachers $v_t \sim \mathcal{N}\left(0, \sigma^2_{\text{teacher}}\right)$, districts $q_d \sim \mathcal{N}\left(0, \sigma^2_{\text{district}}\right)$, and students nested within districts $w_{s(d)} \sim \mathcal{N}\left(0, \sigma^2_{\text{student | district}}\right)$

The fixed-effect vector $x_{itcsd}^{\top}$ included the same student and teacher covariates as in Step 1, along with endorsement-by-course-level terms and student–teacher demographic matching indicators. To improve stability, course-level predictors were removed. This adjustment was justifiable because many course-by-district combinations contained relatively few students, leading to quasi-separation and unstable estimates. Modeling district heterogeneity directly through a random effect reduced these issues while still capturing contextual variation across districts.

Because the majority of students (>99%) were uniquely associated with a single district (RCDT), we specified students nested within districts as the primary structure, with courses and teachers modeled as cross-classified random effects. An alternative specification that treated students and districts as crossed factors failed to converge and yielded near-zero district-level variance. Since the nested model converged cleanly and produced substantively similar fixed-effect estimates, we retained it as the more parsimonious and stable of the data without loss of substantive interpretation.

We also removed course-level predictors and added a district random effect to improve model stability. When both course indicators and district effects are included, many course-by-district combinations contain relatively few students, leading to sparse cells. This sparsity makes the course indicators vulnerable to quasi-separation and inflates the risk of unstable or non-convergent estimates. By removing the course-level predictors and instead modeling district variation directly through a random effect, we reduce these estimation issues while still capturing contextual differences across districts.

Overall, the district model extends the statewide specification by accounting for district contextual difference, allowing us to assess whether observed associations hold once differences across districts are taken into account. By nesting students within districts and including random intercepts for teachers, the model captures unobserved heterogeneity arising from district structures such as course availability, advising practices, or graduation requirements that shape students' opportunities to continue in computer science. This complements the Step 1 statewide model: whereas Step 1 provides overall estimates of how student, teacher, and course characteristics are associated with continuation across the state, Step 2 refines those estimates by showing whether the same relationships persist when district-level variation is controlled. Together, the two models decompose continuation patterns into statewide fixed-effect associations and district-level random-effect variation, allowing us to assess whether observed relationships are consistent across the state or driven by district-specific heterogeneity.

Table 29. Decomposition of variance in taking a second course by student, teacher, and course levels across five years.

Level	Grouping Factor	Variance (τ_{00})	Std. Dev.	% of Total Variance	Interpretation
Level 3	Course	1.462	1.209	30.6%	Variation due to differences between courses themselves after accounting for fixed effects. Indicates course-level characteristics influence student continuation.
Level 2	Teacher	3.313	1.820	32.3%	Variance attributed to differences between teachers teaching different students. Suggests substantial teacher-level influence on student continuation.
Level 1	Student	0.01	0.001	0.1%	Minimal variation at the individual student level beyond what's explained by predictors, indicating negligible residual variance.
	Logistic residual (σ^2)	3.29		37.1%	The assumed fixed value accounts for unmeasured within-student variation in logistic regression models.
Total		**8.075**		**100%**	
Summary Statistics		Value			
Marginal R^2		0.229			About 22.9% of the variance in student CS course outcomes is explained by the fixed effects alone (e.g., student demographics, teacher characteristics, course type).
Conditional R^2		0.684			About 68.4% of the variance is explained by the entire model, including both fixed effects and random effects (variation across students, teachers, and courses).

Table 30. Decomposition of variance in taking a second course by student, teacher, and district levels across five years

Level	**Grouping Factor**	**Variance (τ_{00})**	**Std. Dev.**	**% of Total Variance**	**Interpretation**
Level 3	District	3.591	1.895	37.6%	Variation due to differences between district themselves after accounting for fixed effects.
Level 2	Teacher	2.613	1.616	27.4%	Variance attributed to differences between teachers teaching different students. Suggests substantial teacher-level influence on student continuation.
Level 1	Student	0.05	0.224	0.5%	Minimal variation at the individual student level beyond what's explained by predictors, indicating negligible residual variance.
	Logistic residual (σ^2)	3.29		34.5%	The assumed fixed value accounts for unmeasured within-student variation in logistic regression models.
Total		**9.544**		**100%**	
Summary Statistics		Value			
Marginal R^2		0.335			About 33.5% of the variance in student CS course outcomes is explained by the fixed effects alone (e.g., student demographics, teacher characteristics, course type).
Conditional R^2		0.768			About 76.8% of the variance is explained by the entire model, including both fixed effects and random effects (variation across students, teachers, and courses).

Table 31. Descriptive statistics for students who enrolled in a DC course statewide (SY2018–SY2022).

	Grade 9	Grade 10	Grade 11	Grade 12
2022	9.80%	11.30%	29.40%	49.60%
2021	8.70%	9.80%	29.80%	51.80%
2020	7.70%	9.60%	28.40%	54.30%
2019	7.30%	9.60%	28.50%	54.50%
2018	N/A	9.80%	31.50%	58.70%

Note: Data were reproduced from ISBE report card.

Table 32. Representation of Hispanic/Latino teachers in each level of CS courses.

	Remedial	General	Enriched	Honors	AP	CTE
Hispanic or Latino	<5%	59%	<5%	18%	15%	8%

Table 33. Estimated Odds of a student continue enrolling into a second CS course when paired with a CS-endorsed teacher and not a CS-endorsed teacher for SY 2018-2022.

	Less likely to enroll in a second CS course…	More likely to enroll in a second CS course…
Female student, CS-Endorsed teacher	1.2x	-
Female student, Not CS-Endorsed teacher	1.9x	-
Black/AA student, CS-Endorsed teacher	-	1.1x
Black/AA student, Not CS-Endorsed teacher	1.4x	-
Hispanic/Latino student, CS-Endorsed teacher	-	1.4x
Hispanic/Latino student, Not CS-Endorsed teacher	1.1x	-
EL student, CS-Endorsed teacher	-	1.1x
EL student, Not CS-Endorsed teacher	1.4x	-
IDEA student, CS-Endorsed teacher	1.3x	-
IDEA student, Not CS-Endorsed teacher	-	1.1x
FRL student, CS-Endorsed teacher	-	1.5x
FRL student, Not CS-Endorsed teacher	1.1x	-

Note: Values reflected in the table are model-predicted estimates based on the specific combinations of student and teacher characteristics noted and are generated by applying the coefficients (i.e., fixed effects) from the MLM. Only significant variables are included in this prediction. All groups are compared to the reference group: Male, White, Non-IDEA, Non-EL, Non-FRL, taught by a White, Male teacher without PEL in a General CS class.

Table 34. Estimated odds of a student continue enrolling into a second CS course by their initial CS course

	Less likely to enroll in a second CS course…	More likely to enroll in a second CS course…
Enriched Course Level		
Female student, Enriched Course Level	1.5x	-
Black/AA student, Enriched Course Level	-	1.1x
Hispanic/Latino student, Enriched Course Level	-	1.2x
EL student, Enriched Course Level	-	1.1x
IDEA student, Enriched Course Level	-	1.0x
FRL student, Enriched Course Level	-	1.2x
Honors Course Level		
Female student, Honors Course Level	-	1.1x
Black/AA student, Honors Course Level	-	1.3x
Hispanic/Latino student, Honors Course Level	-	1.6x
EL student, Honors Course Level	-	1.3x
IDEA student, Honors Course Level	-	1.4x
FRL student, Honors Course Level	-	1.7x
Remedial Course Level		
Female student, Remedial Course Level	19.6x	-
Black/AA student, Remedial Course Level	14.1x	-
Hispanic/Latino student, Remedial Course Level	11.4x	-
EL student, Remedial Course Level	14.5x	-
IDEA student, Remedial Course Level	12.9x	-
FRL student, Remedial Course Level	10.7x	-

Note: Values reflected in the table are model-predicted estimates based on the specific combinations of student and teacher characteristics noted and are generated by applying the coefficients (i.e., fixed effects) from the MLM. Only significant variables are included in this prediction. All groups are compared to the reference group: Male, White, Non-IDEA, Non-EL, Non-FRL, taught by a non-Endorsed, White, Male teacher without PEL in a General CS class.

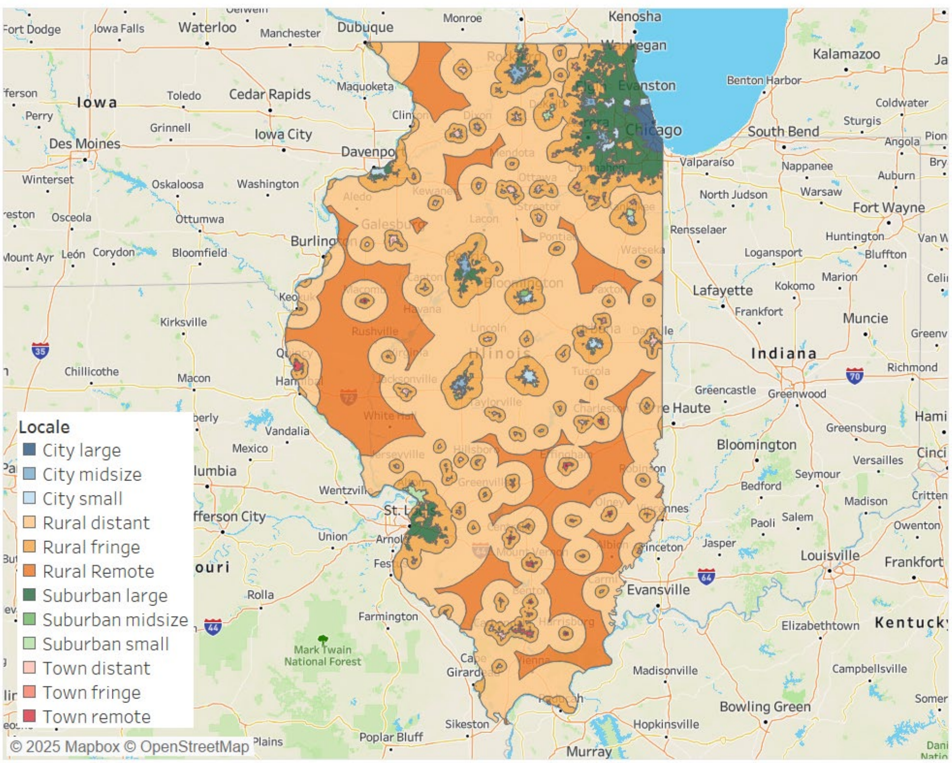
Notes for Part 5 – How do CS offerings vary by district across Illinois?

Additional data sources

Maps were created using NCES school district boundaries (shapefiles) from 2022 to match the latest year in our dataset. These boundaries represent the 2021-2022 school year and apply to the 2018-2022 period of the American Community Survey.

Source : https://nces.ed.gov/programs/edge/Geographic/DistrictBoundaries

Figure 11. Map of Illinois showing NCES locale classifications as of 2022.

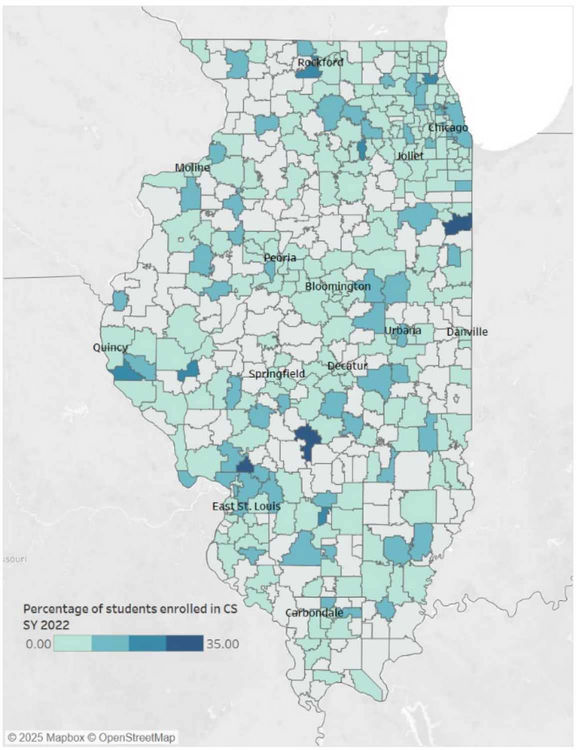


Descriptive counts tables

As noted in the main report, there are few districts in the state that enroll more than 25% of Black/African American and Hispanic/Latino students. As such, we are unable to extrapolate meaningful trends in CS programming by these district characteristics. Below we provide tables that include such characteristics for readers to get a sense of CS programming in these districts.

Tables 35 and 36 below show the counts to mirror Tables 2 and 3 in the main report, respectively.

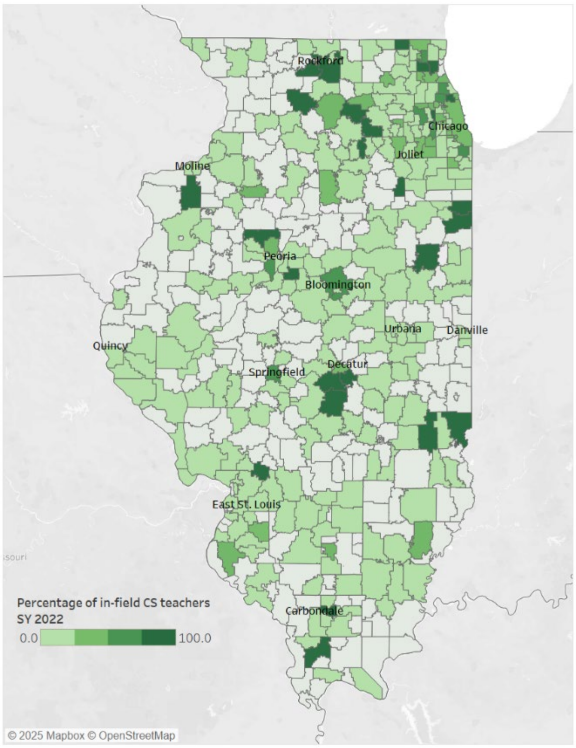
Table 35. Map showing high school districts by percentage of students enrolled in a CS course (left) and table showing number of districts in each bracket of percentage of students enrolled in a CS course by district locale, EBF tier, and percentage of low-income, Black/African American, and Hispanic/Latino students (right) during SY 2022.



	Percentage of students enrolled in a CS course				
	No CS	0-8.74%	8.75-17.4%	17.5-26.24%	26.25-35.00%
District NCES locale					
Rural	137	53	26	3	2
Town	41	65	16	1	1
Suburb	18	81	15	3	1
City	0	16	3	0	0
District EBF tier					
Tier 1	68	91	24	2	1
Tier 2	89	84	22	3	3
Tier 3	9	12	4	0	0
Tier 4	30	28	10	2	0
Percentage of district student body that is low-income					
0-25%	19	65	14	2	1
26-50%	116	95	38	3	2
51-75%	46	47	7	1	1
76-100%	15	8	1	1	0
Percentage of district student body that is Black/African American					
0-25%	189	195	55	7	4
26-50%	1	13	5	0	0
51-75%	1	4	0	0	0
76-100%	5	3	0	0	0
Percentage of district student body that is Hispanic/Latino					
0-25%	186	177	49	6	2
26-50%	9	24	9	0	2
51-75%	0	10	2	1	0
76-100%	1	4	0	0	0
All districts	196	215	60	7	4

*Note: Gray districts do not offer CS courses. The exact range for percentage of students enrolled in a CS course was [0.38%, 34.33%]. For proportion of district student body that is low-income, Black/African American, and Hispanic/Latino, exact ranges were as follows: 0-25.9%, 26.0-50.9%, 51.0-75.9%, 76.0-100%.

Table 36. Map showing high school districts by percentage of in-field CS teachers (left) and table showing number of districts in each bracket of percentage of in-field CS teachers by district locale, EBF tier, and percentage of low-income, Black/African American, and Hispanic/Latino students (right) during SY 2022.



	Percentage of in-field CS teachers				
	No CS	0-25%	26-50%	51-75%	76-100%
District NCES locale					
Rural	142	67	4	1	7
Town	44	67	4	0	9
Suburb	18	65	19	8	8
City	0	12	4	1	2
District EBF tier					
Tier 1	71	94	11	1	9
Tier 2	92	82	11	5	11
Tier 3	10	11	1	1	2
Tier 4	31	24	8	3	4
Percentage of district student body that is low-income					
0-25%	20	51	16	5	9
26-50%	123	106	9	3	13
51-75%	46	46	4	2	4
76-100%	15	8	2	0	0
Percentage of district student body that is Black/African American					
0-25%	197	195	26	8	24
26-50%	1	11	4	1	2
51-75%	1	4	0	0	0
76-100%	5	1	1	1	0
Percentage of district student body that is Hispanic/Latino					
0-25%	194	179	20	7	20
26-50%	9	19	7	3	6
51-75%	0	10	3	0	0
76-100%	1	3	1	0	0
All districts	204	211	31	10	26

*Note: Gray "No CS" districts include districts that do not offer CS courses (N=196) and those that had no data for CS teachers (N=8). For proportion of district student body that is low-income, Black/African American, and Hispanic/Latino, exact ranges were as follows: 0-25.9%, 26.0-50.9%, 51.0-75.9%, 76.0-100%.

Table 37. Percentage of all districts who offer CS that offered each of the seven most enrolled CS courses during SY 2022.

Course title	Percentage of CS-offering districts offering each course
Web Page and Interactive Media Development I	54%
Computer Operations and Programming I	33%
Web Page and Interactive Media Development II	23%
AP Computer Science A	22%
AP Computer Science Principles	20%
Computer Operations and Programming II	15%
Computer Programming	14%

Development of Cases of Excellence rubric & survey

Development of the Cases of Excellence rubric started with mapping variables in our ISBE dataset with examples provided by Fletcher & Warner in their seminal CAPE framework ACM Communications piece.[8] This work was the jumping off point for IWERC's CS team as we determined which variables in our dataset aligned best with each component of the CAPE framework, which at time included using other sources of data such as the Illinois Report Card. It became clear that our quantitative data alone would not be enough to understand the underlying mechanisms that make CS education possible in these districts. As such, we began developing a second qualitative rubric that would be used to gain additional insights quantitative data alone could not provide.

An early version of the quantitative rubric was shared with our project's Advisory Board at our January 2025 meeting. Across two one-hour sessions, Advisory Board members were able to provide feedback on the draft rubric and suggest additions to the qualitative rubric that would eventually turn into the Cases of Excellence survey. After reflecting on the Advisory Board's feedback, IWERC's CS team went through additional iterations of development and review for the rubric and survey, optimizing both for fairness and robustness, but also brevity.

As noted in the report, while we believe the Cases of Excellence rubric and survey provide evidence for Illinois districts with equitable and robust CS education programming, it is limited by the absence of student voices and experiences.

Table 38 provides the cutoffs for the top quartile of Cases of Excellence rubric EBIs C1, C2, and P1. In the case of C1 (district is within the top quartile of employing a high percentage of CS-endorsed teachers), districts who met this EBI had to have 100% of their CS staff endorsed. In the case of C2 (district is within the top quartile of employing a high percentage of in-field CS teachers), rural and town districts who met this EBI had to have more than 0% of their CS teachers be considered in-field.

Table 38. Top quartile lower bound for the three EBIs that required districts to be within the top quartile of their NCES locale category.

	C1, Top quartile lower bound	C2, Top quartile lower bound	P1, Top quartile lower bound
Rural	100%	0.0%	10.53%
Town	100%	0.0%	6.85%
Suburb	100%	38.8%	8.08%
City	100%	36.7%	5.56%

The P2 and E1 EBIs are moving comparisons with respect to the individual districts for the following groups: female, Black/African American, Hispanic/Latino, and low-income students, and students with EL status.

Maps of Cases of Excellence districts

Figure 12. Maps showing the rural (upper left), town (upper right), and city (lower left) COEs with their district names labeled.

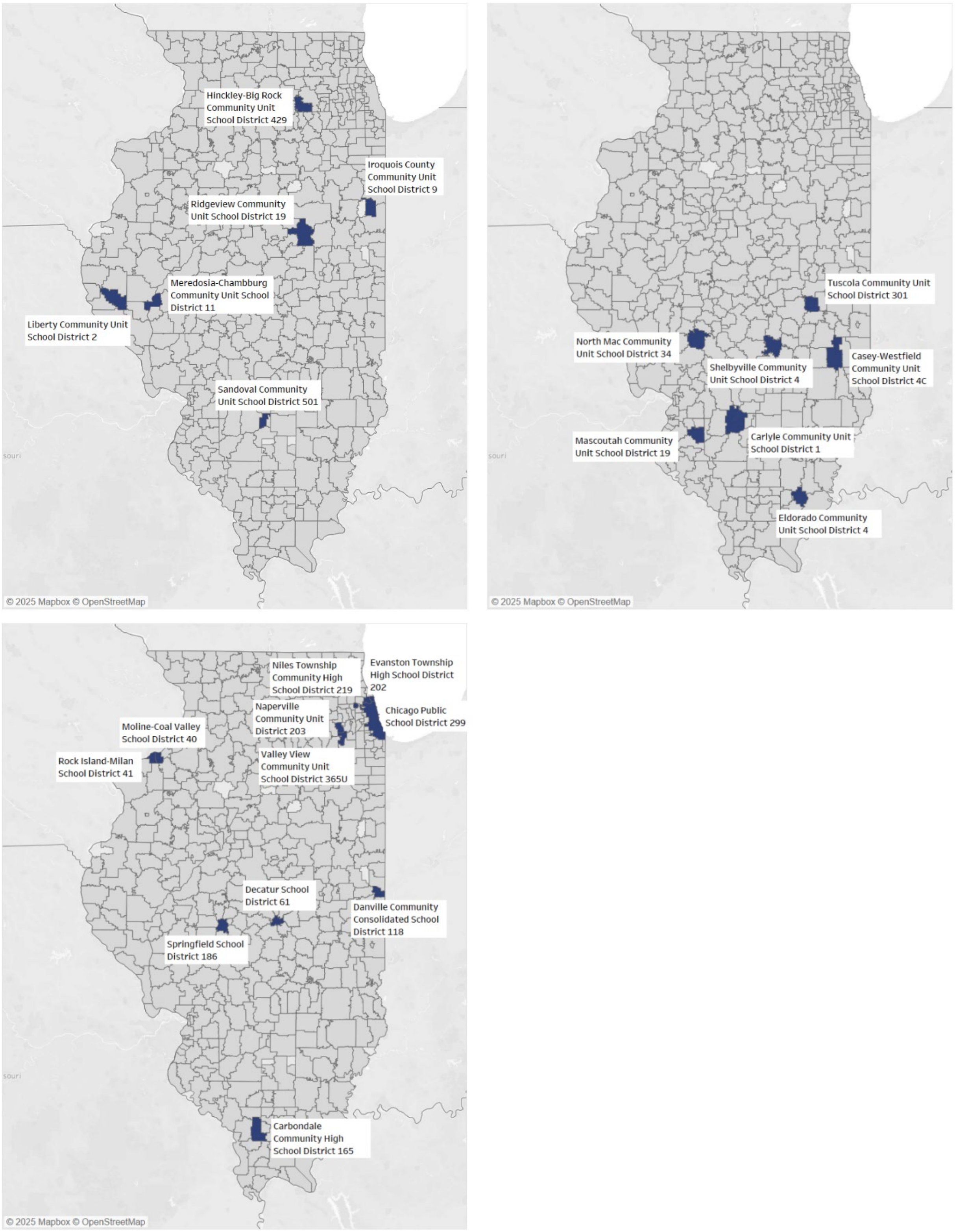
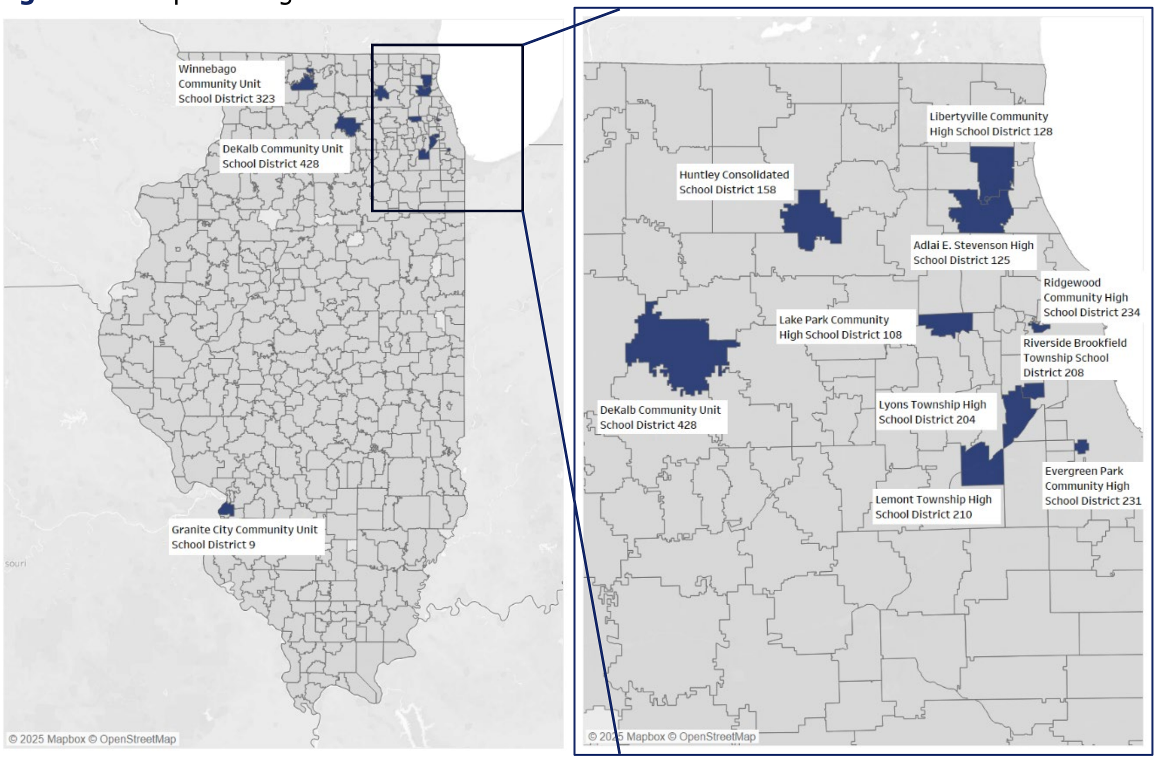


Figure 13. Map showing the suburb COEs with their district names labeled.



Cases of Excellence survey

We have selected your district as a Case of Excellence for high school computer science (CS) education in Illinois based on an analysis performed using 5 years of student-level data provided by ISBE. We would like to learn more about CS education in your district through a short survey. Responses will be used to create models of what other districts can do to build up their CS education programs. Participation is optional, but appreciated. If you are not the right person to be completing the survey, please pass it along to someone who can. The survey will only take 15-20 minutes to complete. If you are not comfortable answering a question, you can skip it. District names and your position/title may be published alongside your responses, but your name and contact information will be kept private should you choose to share it. If you have any questions, please contact Stephanie Werner (swerne3@uillinois.edu).

Respondent information

- District name (drop down list)
- Title/position (text box)
- Optional: Include contact information in case we need to follow up. This will not be shared outside our research team. (Name and email address)

Survey questions

1. What are some of your district's established mechanisms for recruiting, training, and endorsing CS teachers? Does your district have any external partnerships with other organizations (e.g., institutions of higher education, corporations, etc.) that aid in these mechanisms? How does your district fund/support this training, if at all?

2. What resources are available to CS teachers in your district? This may include PD, tech coordinators, instructional coaches for CS, and more. How does your district fund/support these resources?
3. Are there CS learning opportunities for your district's students before coming into high school? If so, please explain and share how your district funds/supports these activities.
4. Does your district offer CS and tech-related extracurricular activities (such as clubs, teams, etc.)? If so, please explain and share how your district funds/supports these activities.
5. Does your district's CS education program receive any special funding (e.g., grants, endowments, etc.) not described in the previous questions? If so, please explain.
6. How does your district inform students of CS course offerings and/or extracurriculars? When are students advised on enrolling in CS courses?
7. What are the characteristics of student participation in your district's CS extracurriculars? Does it reflect the overall population of your district?
8. Does your district have policies or strategies to ensure widespread and equitable access to CS courses and/or extracurricular activities for all students (e.g., scheduling considerations, transportation, etc.)?
9. How are district and school administrators, counselors, and parents informed about CS education and CS course offerings?
10. How does your district maintain student interest in CS education?
11. Does your district have inclusive CS classrooms for multilingual students or students with disabilities? If so, please explain.
12. Is there anything else you would like us to know about CS education in your district?

Glossary

Table 39. Glossary of terms and variables included in the Series. For dataset variables, see ISBE's Student Information System (SIS) Data Elements and Validations guide for more information.

Term	Definition
Career and Technical Education (CTE)	Courses that prepare students for the workforce by providing opportunities to gain skills and knowledge of various career paths. CTE is a course-level variable in our dataset. CTE courses are tied to state course codes. CS courses can be offered as CTE, non-CTE, or both. In cases when CS courses are offered as both, two separate state course codes are issued.
Computer literacy	"Computer literacy" is broadly defined as one's knowledge of and ability to use computers and related technologies efficiently and effectively. More specifically, computer literacy includes knowing what constitutes a computer, the uses and applications for computers, and the impact of computers on society. (Source: ISBE)
Computer science	Computer science means the study of computers and algorithms, including their principles, their hardware and software designs, their implementation, and their impact on society. "Computer science" does not include the study of everyday uses of computers and computer applications, such as keyboarding or accessing the Internet. (Source: IL legislative body, CSTA)
Course level	Course level indicates the level of rigor of a course and is a course-level variable. Values includes: **remedial** – a course that focuses primarily on skills development, is typically less rigorous than standard courses and can be used to prepare students for a general course; **general** – a course focusing on general concepts appropriate for the grade level and typically meet the state's or district's expectation of scope and difficulty; **enriched** – a course that augments its content and/or rigor of a general course, but does not carry the designation of honors; **honors** – an advanced course designed for students who have earned honors status and typically includes content not found in general courses (Source: ISBE). **Advanced Placement (AP)** courses provide students "the chance to tackle college-level work while still in high school and earn college credit and placement" (Source: College Board).
Course modality	Course setting in which the course is taught (e.g., in-person, online, etc.). Course modality (or course setting description) is a course-, school-, or district-level variable.
Dual Credit (DC)	Courses that offer students both high school and college credit. DC is a student-level variable in our dataset and is dictated at the district-level, not the state-level. Dual credit offerings differ from district to district and are not tied to a particular state course code. See a recent IWERC report on dual credit (Cashdollar, 2023) for more information. Dual credit is not the same as dual enrollment and dual enrollment is not included in this dataset.
English Learners (EL)	Students who received a score less than "proficient" on their most recent English language proficiency assessment. EL is a student-level variable in our dataset.
Free or Reduced Lunch (FRL)	Students who meet the national guidelines to receive free or reduced-price lunch services. FRL is a student-level variable in our dataset.

Individuals with Disabilities Education Act (IDEA)	Students who receive IDEA services such as an Individualized Education Program (IEP) or an Individualized Services Plan (ISP). IDEA is a student-level variable in our dataset.
In-field CS endorsement	There are several different computer science related teaching endorsements. According to ISBE, not all CS teaching endorsements are appropriate to teach all CS courses, and the alignment of CS teaching endorsements occurs at the course level. See ISBE's Computer Science Courses and Assignability Recommendations for more information.
Teaching endorsement	In addition to a teaching license, all secondary school teachers in Illinois are required to hold the appropriate subject endorsement for the courses they teach. Assignability of appropriately endorsed teachers is the responsibility of the regional office of education (ROE). See ISBE's website for more information on teaching endorsements.
Teaching license	All public school teachers in the state of Illinois are required to hold a bachelor's degree and a teaching license. In Illinois, there are two main types of teaching licensure: Professional Educator License (PEL) and Educator License with Stipulations (ELS). See ISBE's website for more information on licenses and requirements.

Courses within Dataset

Below is a table of all courses included in the dataset IWERC obtained from ISBE. In addition to the state course code, title, and description, we included columns to signify if the course is a CTE course (designated by the state), if it is considered a CS course (designated by the state), which IWERC reports that course is included in, and any additional notes regarding the course (e.g., new course codes coming in the future).

ISBE's assignability of CS and CS CTE courses can be found here. IWERC followed this guide as to what to include as CS courses. ISBE is continuing their work on assignability for independent study and workplace experiences courses that were not originally included in this list.

Because prerequisite courses are defined by districts and not the state, IWERC did not include any information on what prerequisite courses are required in the table below.

Table 40. Courses included in IWERC's dataset, their ISBE state course codes, titles, and descriptions, whether ISBE registers the course as CS or CTE, which courses are included in IWERC reports, and added notes if needed.

Course Code	Course Title	Course Description	CTE	ISBE CS Assignability	Included in IWERC Reports	Notes
10157A000	AP Computer Science A	Following the College Board's suggested curriculum designed to mirror college-level computer science courses, AP Computer Science A courses emphasize object-oriented programming methodology with a focus on problem solving and algorithm development. These courses cover such topics as object-oriented program design; program implementation; program analysis; standard data structures; standard algorithms; and the ethical and social implications of computing systems. (Available SY 2011-.)		CS	Parts 1-5	
10161A000	AP Computer Science Principles	Following the College Board's suggested curriculum designed to parallel college-level computer science principles courses, AP Computer Science Principles courses introduce students to the fundamental ideas of computer science and how to apply computational thinking across multiple disciplines. These courses teach students to apply creative designs and innovative solutions when developing computational artifacts. These courses cover such topics as creative development, data, algorithms and programming, computer systems and networks, and the impact of computing. (Available SY 2017-2023.)		CS	Parts 1-5	New code from SY 2024 - 10019A000

10160A001	Artificial Intelligence	This Artificial Intelligence course is an approved part of career and technical education program that introduce students to the concepts of Artificial Intelligence. This course will review the evolution of AI, explore future applications, and may also describes how artificial Intelligence is used in fields such as games, speech recognition, and computer vision. In this course, you will learn about different types of intelligent agents and their environments. The course Artificial Intelligence also covers the concepts of machine learning, natural language processing, expert systems, and robots. The ethics and safety issues related to artificial intelligence may also be covered in this course. The appropriate use of technology and industry-standard equipment is an integral part of this course. (Available SY 2019-.)	CTE	CS	Parts 1-5	
10103A000	Area Network Design and Protocols	Area Network Design and Protocols courses address the role of computers in a network system, the Open Systems Interconnection (OSI) model, structured wiring systems, and simple LAN (local area network) and WAN (wide area network) designs. (Available SY 2011-.)		CS	Parts 1-5	
10202A002	Beginning Digital Graphics	Beginning Digital Graphics course provides students with the opportunity to explore the capability of the computer to produce visual imagery and to apply graphic techniques to various fields, such as advertising, TV/video, and architecture. Typical course topics include modeling, simulation, animation, and image retouching. (Available SY 2012-.)				
10005A000	Business Computer Applications	In Business Computer Applications courses, students expand their knowledge of and experience in the proper and efficient use of previously written software packages, particularly those used in business. Generally, these courses explore a wide range of applications including (but not limited) 4 word processing, spreadsheet, presentation, graphics, and database programs, and they may also cover topics such as electronic mail, desktop publishing, and telecommunications. Advanced topics may include integrated software applications, including printed, electronic, and Web publications; computer maintenance activities; and Web site development. (Available SY 2011-.)				

10151A000	Business Programming	Business Programming courses provide students with experience in using previously written software packages. Topics may include loops, arrays, and functions as well as instruction on how to design and write programs of their own. These courses contain a business industry focus and provide an overview of the principles of object-oriented design and programming (e.g., Visual Basic [VB], C++, Java, RPL) related to the business industry. (Available SY 2011-.)		CS	Parts 1-5	
10154A000	C++ Programming	C++ Programming courses provide an opportunity for students to gain expertise in computer programs using the C++ language. As with more general computer programming courses, the emphasis is on how to write logically structured programs, include appropriate documentation, and use problem-solving techniques. More advanced topics may include multi-dimensional arrays, functions, sorting, loops, and records. (Available SY 2011-.)		CS	Parts 1-5	
10255A000	CISCO—The Panduit Network Infrastructure Essentials (PNIE)	CISCO—PNIE courses provide students with the knowledge to create innovative network infrastructure solutions. These courses offer students basic cable installer information and help them acquire the skills to build and use the physical layer of network infrastructure and develop a deeper understanding of networking devices. (Available SY 2011-.)		CS	Parts 1-5	
10003A000	Computer and Information Technology	Computer and Information Technology courses teach students to operate and use computer and information technology, emphasizing their role as tools to communicate more effectively, conduct research more efficiently, and increase productivity. Course content includes the legal and ethical issues involved with computer technology and use. (Available SY 2011-.)				

10003A001	Computer and Information Technology	Computer and Information Technology courses are an approved part of career and technical education program that teach students to operate and use computer and information technology, emphasizing their role as tools to communicate more effectively, conduct research more efficiently, and increase productivity. Course content includes the legal and ethical issues involved with computer technology and use. The appropriate use of technology and industry-standard equipment is an integral part of this course. (Available SY 2019-.)	CTE			
10004A000	Computer Applications	In Computer Applications courses, students acquire knowledge of and experience in the proper and efficient use of previously written software packages. These courses explore a wide range of applications, including (but not limited to) word-processing, spreadsheet, presentation, graphics, and database programs. Courses may also cover the use of electronic mail and online collaborative software. (Available SY 2011-.)				
10004A001	Computer Concepts and Software Applications	Computer Concepts and Software Applications is an orientation-level course designed to develop awareness and understanding of application software and equipment used by employees to perform tasks in business, marketing and management. Students will apply problem-solving skills to hands-on, real-life situations using a variety of software applications, such as word processing, spreadsheets, database management, presentation software, and desktop publishing. Students will explore topics related to computer concepts, operating systems, telecommunications and emerging technologies. The development of employability skills, as well as transition skills, will be included in the course as well as an understanding of the ethical considerations that arise in using information processing equipment and gaining access to available databases. (Available SY 2011-.)				
10205A000	Computer Gaming and Design	Computer Gaming and Design courses prepare students to design computer games by studying design, animation, artistic concepts, digital imaging, coding, scripting, multimedia production, and game play strategies. Advanced course topics include, but are not limited to, level design, environment and 3D modeling, scene and set design, motion capture, and texture mapping. (Available SY 2021-.)		CS	Parts 1-5	

10202A000	Computer Graphics	Computer Graphics courses provide students with the opportunity to explore the ways in which computers can produce visual imagery that communicates information and ideas effectively to multiple audiences using a variety of media and formats. Course topics may include principles and elements of design, image creation, image manipulation, and image types. (Available SY 2011-.)				
10010A000	Computer Literacy	Computer Literacy courses provide to students the knowledge and ability to use computers and technology efficiently. Typically, course content includes exposure to word-processing, spreadsheet, and presentation applications, but also may include the various uses of computers 221 in modern society. Specific course content aligns with state standards to promote students' technological literacy. (Available SY 2021-.)				
10047A000	Computer Literacy—Independent Study	Computer Literacy—Independent Study courses, often conducted with instructors as mentors, enable students to explore computer-related topics of interest. Independent Study courses may serve as an opportunity for students to expand their expertise in a particular specialization, to explore a topic in greater detail, or to develop more advanced skills. (Available SY 2011-.)				
10049A000	Computer Literacy—Other	Other Computer Literacy courses. (Available SY 2011-.)				New code from SY 2012-2023
10048A000	Computer Literacy—Workplace Experience	Computer Literacy—Workplace Experience courses provide work experience in fields related to computer literacy. Goals are typically set cooperatively by the student, teacher, and employer (although students are not necessarily paid). These courses may include classroom activities as well, involving further study of the field or discussion regarding experiences that students encounter in the workplace. (Available SY 2011-.)				

10252A000	Computer Maintenance	Computer Maintenance courses prepare students to apply basic electronic theory and principles in diagnosing and repairing personal computers and input/output devices. Topics may include operating, installing, maintaining, and repairing computers, network systems, digital control instruments, programmable controllers, and processors. (Available SY 2011-.)		CS	Parts 1-5	
10252A001	Computer Maintenance I	This course is designed to provide students with the skills needed to install, setup, configure, test, troubleshoot, and maintain, personal computers and peripherals. Instruction includes assembling, maintaining, and upgrading personal computers. Students learn how to install, upgrade, and troubleshoot various hardware components such as motherboards, hard drives, CD- ROMS, memory, power supplies, video cards, sound cards, and network cards. Students install and configure various desktop operating systems such as Windows, Apple, and Linux. The course includes adding and removing software programs, installing and updating system drivers, creating startup and recovery disk, and updating the BIOS and CMOS. Students learn to conduct preventive maintenance and perform system backups, data transfer, and recovery routines as well as use diagnostic utilities to troubleshoot hardware and software problems. Students also learn how to disassemble, clean, troubleshoot, and reassemble peripherals such as printers. (Available SY 2011-.)	CTE	CS	Parts 1-5	

10252A002	Computer Maintenance II	This course builds on the skills introduced in Computer Maintenance I. Students learn how to connect and install multiple computers and peripherals together to create a computer network. Students build, configure, and maintain network servers along with installing and configuring various network operating systems such as Novell, Windows, and Linux. Students learn to use troubleshooting services, system monitoring utilities, and data backup and recovery systems. Other topics include learning how to connect various network components such as servers, computers, and printers together using data cabling, hubs, and switches. Students learn to run, terminate, and troubleshoot data cabling. In addition, students learn how to install and upgrade software across the network, as well as map drives and share resources such as printers, software, and files. The course includes setting up and configuring various network services such as TCP/IP, DHCP, DNS, VPN, terminal services, e-mail, and web services. Students learn how to secure and protect network servers and data as well as setting up and configuring a firewall, intrusion detection system, and encryption software for identifying and preventing potential network attacks. (Available SY 2011-.)	CTE	CS	Parts 1-5	
02156A000	Computer Mathematics with Algebra	Intended for students who have attained the objectives of Algebra I, Computer Math—Algebra I level courses include a study of computer systems and programming, and use the computer to solve math problems. (Available SY 2011-.)		CS	Parts 1-5	Not included under Information Technology

10102A001	Computer Networking I	Computer Networking I is a skill-level course designed to provide students with the skills needed to setup, configure, test, troubleshoot, maintain, and administer a data network using various network operating systems such as Novell, Windows, and Linux. Instruction will include network planning decisions, such as choosing an appropriate network configuration, determining the performance level requirements considering the differences among operating systems, and recommending network interface cards and cabling. Students will also learn how to setup and manage file systems and resources, and network topologies, protocols, and system utilities to efficiently run software applications on a network. Students will learn to use basic operating system commands, install and configure networks, set up user accounts and rights, and establish user security and permissions. (Available SY 2011-.)	CTE	CS	Parts 1-5	
10102A002	Computer Networking II	Computer Networking II is a skill-level course for students who have completed Computer Networking I. Students will continue to learn skills to set up, configure, test, troubleshoot, maintain, and administer a data network using various network operating systems such as Novell, Windows, and Linux. Students will learn to use troubleshooting services, system monitoring utilities, and data backup and recovery systems. Instruction will include setting up and configuring various network services such as TCP/IP, DHCP, DNS, VPN, terminal services, e-mail, content filtering, and web services. Students will learn techniques to secure and protect network servers and data. Students will be introduced to some basic concepts regarding web server configuration. Students will also learn to use standard software tools to determine system vulnerabilities and correct these vulnerabilities by reconfiguring the operating system. Students will diagnose network problems using public domain network sniffers such as Ethereal. Instruction will include setting up and configuring a firewall, intrusion detection system, and encryption software for identifying and preventing potential network attacks. (Available SY 2011-.)	CTE	CS	Parts 1-5	

10301A000	Computer Forensics	Computer Forensics courses address the preservation, identification, extraction, documentation, and interpretation of computer data. Topics covered may include legal concepts, evidence handling and preservation, file system structures, chain of custody, and identification and recovery of computer data. These courses may also cover the need to perform an investigation and how to collect evidence and analyze data. (Available SY 2021-.)		CS	Parts 1-5	
10301A001	Computer Forensics	Computer Forensics courses address the preservation, identification, extraction, documentation, and interpretation of computer data. Topics covered may include legal concepts, evidence handling and preservation, file system structures, chain of custody, and identification and recovery of computer data. These courses may also cover the need to perform an investigation and how to collect evidence and analyze data. (Available SY 2021-.)	CTE	CS	Parts 1-5	

10152A001	Computer Operations and Programming I	Computer Operations and Programming I is the first of two skill-level courses designed to develop computer programming and program design skills through the use of various programming languages such as Visual Basic, C#, Java, and other object-oriented languages. Students will be exposed to the fundamentals of system analysis and design (e.g. flowcharting, diagramming, system design and planning), and the systems development life cycle. Instruction will include basic programming tools that are common to many programming languages. These may include items such as input/output statements, constants, assignment statements, string and numeric variable types, conditional processing, and branching and looping control structures. Students will learn programming techniques such as counting, averaging, rounding, and generation of random numbers to develop a good programming technique. Students will apply what they learn to create programs and applications that solve real world business related problems. Students will create programs to store, locate and retrieve data. (Available SY 2011-.)	CTE	CS	Parts 1-5	
10152A002	Computer Operations and Programming II	Computer Operations and Programming II is a skill-level course for students who have completed Computer Operations and Programming I. Students will use procedural and object-oriented programming languages such as Visual Basic, C# and Java. Students will learn programming concepts such as inheritance and polymorphism, advanced data handling (pointers, arrays, strings, and files), and common algorithms (recursion, searching and sorting). Students will be able to write, compile, run, test, debug and modify programs and applications that solve real world problems. Problem examples may include tracking inventory, scheduling rooms and facilities, accessing information and performing calculations. (Available SY 2011-.)	CTE	CS	Parts 1-5	

10152A000	Computer Programming	Computer Programming courses provide students with the knowledge and skills necessary to construct computer programs in one or more languages. Computer coding and program structure are often introduced with the BASIC language, but other computer languages, such as Visual Basic (VB), Java, Pascal, C++, and C#, may be used instead. Students learn to structure, create, document, and debug computer programs. Advanced courses may include instruction in object-oriented programming to help students develop applications for Windows, database, multimedia, games, mobile and/or Web environments. An emphasis is placed on design, style, clarity, and efficiency. In these courses, students apply the skills they learn to relevant authentic applications. (Available SY 2011-.)		CS	Parts 1-5	
10197A000	Computer Programming—Independent Study	Computer Programming courses provide students with the knowledge and skills necessary to construct computer programs in one or more languages. Computer coding and program structure are often introduced with the BASIC language, but other computer languages, such as Visual Basic (VB), Java, Pascal, C++, and C#, may be used instead. Students learn to structure, create, document, and debug computer programs. Advanced courses may include instruction in object-oriented programming to help students develop applications for Windows, database, multimedia, games, mobile and/or Web environments. An emphasis is placed on design, style, clarity, and efficiency. In these courses, students apply the skills they learn to relevant authentic applications. (Available SY 2011-.)				
10205A001	Computer Gaming and Design	Computer Gaming and Design courses prepare students to design computer games by studying design, animation, artistic concepts, digital imaging, coding, scripting, multimedia production, and game play strategies. Advanced course topics include, but are not limited to, level design, environment and 3D modeling, scene and set design, motion capture, and texture mapping. (Available SY 2021-.)	CTE	CS		
10199A000	Computer Programming—Other	Other Computer Programming courses. (Available SY 2011-.)		CS	Parts 1-5	

10156A000	Computer Programming—Other Language	Computer Programming—Other Language courses provide students with the opportunity to gain expertise in computer programs using languages other than those specified (such as Pascal, FORTRAN, Python, or emerging languages). As with other computer programming courses, the emphasis is on how to structure and document computer programs, using problem-solving techniques. As students advance, they learn how to best utilize the features and strengths of the language being used. (Available SY 2011-.)		CS	Parts 1-5	
10198A000	Computer Programming—Workplace Experience	Computer Programming—Workplace Experience courses provide students with work experience in fields related to computer programming. Goals are typically set cooperatively by the student, teacher, and employer (although students are not necessarily paid). These courses may include classroom activities as well, involving further study of the field or discussion regarding experiences that students encounter in the workplace. (Available SY 2011-.)				
10011A000	Computer Science Principles	Computer Science Principles courses are an approved part of career and technical education program that provide students the opportunity use programming, computational thinking, and data analytics to create digital artifacts and documents representing design and analysis in areas including the Internet, algorithms, and the impact that these have on science, business, and society. Computer Science Principles courses teach students to use computational tools and techniques including abstraction, modeling, and simulation to collaborate in solving problems that connect computation to their lives. Upon successful completion of this course, students will have acquired entry-level skills for employment and/or be prepared for postsecondary education (Available SY 2021-.)		CS	Parts 1-5	
10251A000	Computer Technology	Computer Technology courses introduce students to the features, functions, and design of computer hardware and provide instruction in the maintenance and repair of computer components and peripheral devices. (Available SY 2011-.)		CS	Parts 1-5	

10002A000	Computing Systems	Computing Systems courses offer a broad exploration of the use of computers in a variety of fields. These courses have a considerable range of content, but typically include the introduction of robotics and control systems, computer-assisted design, computer-aided manufacturing systems, and other computer technologies as they relate to industry applications. (Available SY 2011-.)		CS	Parts 1-5	
10020A000	Cybersecurity	Cybersecurity courses introduce students to the concepts of cybersecurity. These courses provide students with the knowledge and skills to assess cyber risks to computers, networks, and software programs. Students will learn how to create solutions to mitigate cybersecurity risks. These courses may also cover the legal environment and ethical computing behavior related to cybersecurity. (Available SY 2021-.)		CS	Parts 1-5	
10054A000	Data Systems/Processing	Data Systems/Processing courses introduce students to the uses and operation of computer hardware and software and to the programming languages used in business applications. Students typically use BASIC, COBOL, and/or RPL languages as they write flowcharts or computer programs and may also learn data-processing skills. (Available SY 2011-.)		CS	Parts 1-5	
10202A001	Digital Graphics	Digital Graphics course provides students with the opportunity to use the computer to produce visual imagery and to apply graphic techniques to various fields, such as advertising, TV/video, and architecture. Course topics include modeling, simulation, animation, and image retouching. (Available SY 2011-.)				

10008A001	Digital Literacy	This foundation-level course prepares students to use technology in a proficient and responsible manner in school, in the workforce, and in everyday life. The course contains skills for working in an Internet or networked environment and the knowledge of what it means to be a good digital citizen and the ability to use technology responsibly. Topics include the benefits and risks of sharing information online, and the possible consequences of inappropriate sharing (oversharing). Students explore the legal and ethical dimensions of respecting creative work. Technology use is a vital employability skill for entry-level and upper-level management positions. Students may be provided with the opportunity to seek industry-recognized digital literacy certifications. (Available SY 2017-.)				
21002A000	Engineering Applications	Engineering Applications courses provide students with an overview of the practical uses of a variety of engineering applications. Topics covered usually include hydraulics, pneumatics, computer interfacing, robotics, computer-aided design, computer numerical control, and electronics. (Available SY 2011-.)				Not included under Information Technology
21006A000	Engineering Design	Engineering Design courses offer students experience in solving problems by applying a design development process. Often using solid modeling computer design software, students develop, analyze, and test product solutions models as well as communicate the features of those models. (Available SY 2011-.)				Not included under Information Technology
10109A000	Essentials of Network Operating Systems	Essentials of Network Operating Systems courses provide students with an overview of multiuser, multi-tasking network operating systems. In these courses, students study the characteristics of operating systems, such as Linux, and various Windows network operating systems and explore a range of topics including installation procedures, security issues, back-up procedures, and remote access. Advanced topics may include network administration, including account management, training, evaluating new technology, developing system policies, troubleshooting, e-mail and business communications and Web site management. (Available SY 2011-.)				

10012A000	Exploring Computer Science	Exploring Computer Science courses present students with the conceptual underpinnings of computer science through an exploration of human computer interaction, web design, computer programming, data modeling, and robotics. While these courses include programming, the focus is on the computational practices associated with doing computer science, rather than just a narrow focus on coding, syntax, or tools. Exploring Computer Science courses teach students the computational practices of algorithm design, problem solving, and programming within a context that is relevant to their lives. (Available SY 2021-.)		CS	Parts 1-5	
10007A000	IB Information Technology in a Global Society	IB Digital Society courses prepare students to take the International Baccalaureate Digital Society exams and examine the interaction among information, technology, and society. Course content is designed to help students develop a systematic, problem solving approach to processing and analyzing information using a range of information tools. In these courses, students also discuss and evaluate how modern information technology affects individuals, relationships among people, and institutions and societies. This course is also called IB Information Technology in a Global Society. (Available SY 2011-.)		CS	Parts 1-5	CS IB Course
10051A000	Information Management	Information Management courses provide students with the knowledge and skills to develop and implement a plan for an information system that meets the needs of business. Students develop an understanding of information system theory, skills in administering and managing information systems, and the ability to analyze and design information systems. (Available SY 2011-.)				

10005A001	Information Processing I	Information Processing I is a skill-level course that includes the concepts and terminology related to the people, equipment, and procedures of information processing as well as skill development in the use of information processing equipment. Students will operate computer equipment to prepare memos, letters, reports, and forms. Students will create rough drafts, correct copy, process incoming and outgoing telephone calls and mail, and transmit and receive messages electronically. Students will create, input, and update databases and spreadsheets. Students will create data directories; copy, rename, move, and delete files, and perform backup procedures. In addition, students will prepare files to merge, as well as create mailing labels and envelopes from merge files. Students will learn to locate and retrieve information from hard copy and electronic sources, and prepare masters for a presentations using presentation software. Students will apply proper grammar, punctuation, spelling and proofreading practices. Accuracy will be emphasized. Workplace skills as well as communication skills (thinking, listening, composing Information Technology revising, editing, and speaking) will be taught and integrated throughout this course. (Available SY 2011-.)	CTE			

10005A002	Information Processing II	Information Processing II is a skill-level course for students who have completed Information Processing I. Students will create and update documents using word processing and desktop publishing programs and put together slideshows, speaker notes and handouts using presentation software. Students will revise data in a stored database and use queries to create customized reports. Students will edit and utilize calculation functions in spreadsheets, integrate graphics, spreadsheets, tables, text and data into documents and reports, and create graphs and charts from spreadsheets. Students will learn to conduct research on the internet and/or intranet, prepare and answer routine correspondence, organize and maintain a filing system, maintain an appointment calendar, make travel arrangements, prepare itineraries and expense reports, and prepare and process timesheets. In addition, students will maintain inventory, order equipment and supplies, and perform routine equipment maintenance. Students will apply proper grammar, punctuation, spelling and proofreading practices to documents and reports. Accuracy will be emphasized. Workplace skills as well as communication skills will be taught and integrated throughout this course. A simulated information processing center or workbased learning experience may be used to provide students with the experience of working in the environment of an information processing center. (Available SY 2011-.)	CTE			
10253A000	Information Support and Services	Information Support and Services courses prepare students to assist users of personal computers by diagnosing their problems in using application software packages and maintaining security requirements. (Available SY 2011-.)		CS	Parts 1-5	
10297A000	Information Support and Services—Independent Study	Information Support and Services—Independent Study courses, often conducted with instructors as mentors, enable students to explore topics related to computer information support and services. Independent Study courses may serve as an opportunity for students to expand their expertise in a particular specialization, to explore a topic in greater detail, or to develop more advanced skills. (Available SY 2011-.)				
10299A000	Information Support and Services—Other	Other Information Support and Services courses. (Available SY 2011-.)		CS	Parts 1-5	

10298A000	Information Support and Services—Workplace Experience	Information Support and Services—Workplace Experience courses provide students with work experience in fields related to information support and/or service. Goals are typically set cooperatively by the student, teacher, and employer (although students are not necessarily paid). These courses may include classroom activities as well, involving further study of the field or discussion regarding experiences that students encounter in the workplace. (Available SY 2011-.)				
10995A000	Information Technology—Aide	Formerly Computer and Information Sciences—Aide, Information Technology—Aide courses offer students the opportunity to assist instructors in preparing, organizing, or delivering course curricula. Students may provide tutorial or instructional assistance to other students. (Available SY 2011-.)				
10997A000	Information Technology—Independent Study	Formerly Computer and Information Sciences—Independent Study, Information Technology Independent Study courses, often conducted with instructors as mentors, enable students to explore computer-related topics of interest. Independent Study courses may serve as an opportunity for students to expand their expertise in a particular specialization, to explore a topic in greater detail, or to develop more advanced skills. (Available SY 2011-.)				
10999A000	Information Technology—Other	Other Information Technology courses. (Available SY 2011-.)		CS	Parts 1-5	
10998A000	Information Technology—Workplace Experience	Formerly Computer and Information Sciences —Workplace Experience, Information Technology—Workplace Experience courses provide students with work experience in fields related to computer and/or information sciences. Goals are typically set cooperatively by the student, teacher, and employer (although students are not necessarily paid). These courses may include classroom activities as well, involving further study of the field or discussion regarding experiences that students encounter in the workplace. (Available SY 2011-.)				

10203A000	Interactive Media	Interactive Media courses provide students with the knowledge and skills to create, design, and produce interactive digital media products and services. The courses may emphasize the development of digitally generated and/or computer-enhanced media. Course topics may include 3D animation, graphic media, web development, and virtual reality. Upon completion of these courses, students may be prepared for industry certification. (Available SY 2011-.)				
10012A001	Introduction to Computer Science	Introduction to Computer Science courses are an approved part of career and technical education program that present students with the conceptual underpinnings of computer science through an exploration of human computer interaction, web design, computer programming, data modeling, and robotics. While these courses include programming, the focus is on the computational practices associated with doing computer science, rather than just a narrow focus on coding, syntax, or tools. Introduction to Computer Science courses teach students the computational practices of algorithm design, problem solving, and programming within a context that is relevant to their lives. The appropriate use of technology and industry-standard equipment is an integral part of this course. (Available SY 2021-.)	CTE	CS	Parts 1-5	
10001A000	Introduction to Computer Technology	Formerly known as Introduction to Computers, Introduction to Computer Technology courses introduce students to computers, including peripheral and mobile devices; the functions and uses of computer technology; the language used in the industry; possible applications of various computer-based technologies; and occupations related to computer technology hardware and software industries. These courses typically explore legal and ethical issues associated with computer technology use, as well as how changes influence modern society. Students may also be required to perform some computer technology operations. (Available SY 2011-.)		CS	Parts 1-5	
21006A001	Introduction to Engineering Design	Engineering Design courses offer students experience in solving problems by applying a design development process. Often using solid modeling computer design software, students develop, analyze, and test product solutions models as well as communicate the features of those models. (Available SY 2011-.)				

10254A000	IT Essentials: PC Hardware and Software	IT Essentials: PC Hardware and Software courses provide students with in-depth exposure to computer hardware and operating systems. Course topics include the functionality of hardware and software components as well as suggested best practices in maintenance and safety issues. Students learn to assemble and configure a computer, install operating systems and software, and troubleshoot hardware and software problems. In addition, these courses introduce students to networking and often prepare them for industry certification. (Available SY 2011-.)		CS	Parts 1-5	
10155A000	Java Programming	Java Programming courses provide students with the opportunity to gain expertise in computer programs using the Java language. As with more general computer programming courses, the emphasis is on how to structure and document computer programs, using problem-solving techniques. Topics covered in the course include syntax, I/O classes, string manipulation, and recursion. (Available SY 2011-.)		CS	Parts 1-5	
12005A000	Keyboarding	Keyboarding courses provide students with an introduction to the keyboard (letters, numbers, and symbols), basic machine operation, and proper keystroke technique. As students progress, they improve their speed and accuracy and produce increasingly complex documents. Such courses help students develop keyboard proficiency, document production skills, and problem-solving skills. (Available SY 2011-.)				
10247A000	Media Technology—Independent Study	Media Technology—Independent Study courses, often conducted with instructors as mentors, enable students to explore topics related to media technology. Independent Study courses may serve as an opportunity for students to expand their expertise in a particular specialization, to explore a topic in greater detail, or to develop more advanced skills. (Available SY 2011-.)				
10249A000	Media Technology—Other	Other Media Technology courses. (Available SY 2011-.)				

10110A000	Microsoft Certified Professional (MCP)	Microsoft Certified Professional courses provide students with the knowledge and skills necessary to be employed as a network administrator in the latest Windows server-networking environment. Topics include installing, configuring, and trouble-shooting the Windows server. These courses prepare students to set up network connections; manage security issues and shares; and develop policies. Students are typically encouraged to take the MCP exam. (Available SY 2011-.)		CS	Parts 1-5	
10206A000	Mobile Applications	Mobile Applications courses provide students with opportunities to create applications for mobile devices using a variety of commercial and open source software. These courses typically address the installation and modification of these applications, as well as customer service skills to handle user issues. (Available SY 2021-.)		CS	Parts 1-5	
10108A000	Network Security	Network Security courses provide students with an understanding of network security principles and implementation. Course topics usually include authentication, the types of attacks and malicious code that may be used against computer networks, the threats and countermeasures for e-mail, Web applications, remote access, and file and print services. These courses may also cover a variety of security topologies as well as technologies and concepts used for providing secure communication channels, secure internetworking devices, intrusion detection systems, and firewalls. (Available SY 2011-.)		CS	Parts 1-5	
10101A000	Network Technology	Network Technology courses address the technology involved in the transmission of data between and among computers through data lines, telephone lines, or other transmission media, such as hard wiring, wireless, cable networks, and so on. These courses may emphasize the capabilities of networks, network technology itself, or both. Students typically learn about network capabilities and network technology, including the software, hardware, and peripherals involved in setting up and maintaining a computer network. (Available SY 2011-.)		CS	Parts 1-5	

10102A000	Networking Systems	Networking Systems courses are designed to provide students with the opportunity to understand and work with hubs, switches, and routers. Students develop an understanding of LAN (local area network), WAN (wide area network), wireless connectivity, and Internet-based communications (including cloud-based computing), with a strong emphasis on network function, design, and installation practices. Students acquire skills in the design, installation, maintenance, and management of network systems that may help them obtain network certification. (Available SY 2011-.)		CS	Parts 1-5	
10149A000	Networking Systems—Other	Other Networking Systems courses. (Available SY 2011-.)		CS	Parts 1-5	
10147A000	Networking Systems—Independent Study	Networking Systems—Independent Study courses, often conducted with instructors as mentors, enable students to explore topics related to networking systems. Independent Study courses may serve as an opportunity for students to expand their expertise in a particular specialization, to explore a topic in greater detail, or to develop more advanced skills. (Available SY 2011-.)				
10105A000	NetWare Routing	NetWare Routing courses introduce students to such topics as Virtual LANs (VLAN) and switched internetworking, comparing traditional shared local area network (LAN) configurations with switched LAN configurations, and they also discuss the benefits of using a switched VLAN architecture. These courses also may cover routing protocols like RIP, IGRP, Novell IPX, and Access Control Lists (ACLs). (Available SY 2011-.)		CS	Parts 1-5	
10008A000	Particular Topics in Computer Literacy	These courses examine particular topics related to general computer literacy other than those already described elsewhere in this classification system, such as privacy issues or instruction in using a particular software application. (Available SY 2011-.)				
10160A000	Particular Topics in Computer Programming	These courses examine particular topics in computer programming other than those already described elsewhere in this classification system. (Available SY 2011-.)		CS	Parts 1-5	

10256A000	Particular Topics in Information Support and Services	These courses examine particular topics in computer support, maintenance, and repair other than those already described elsewhere in this classification system. (Available SY 2011-.)		CS	Parts 1-5	
10204A000	Particular Topics in Media Technology	These courses examine particular topics in internet design and applications other than those already described elsewhere in this classification system. (Available SY 2011-.)				
10111A000	Particular Topics in Networking Systems	These courses examine particular topics in networking systems other than those already described elsewhere in this classification system. (Available SY 2011-.)				
10013A000	PLTW Computer Science Essentials	Following Project Lead the Way's suggested curriculum, PLTW Computer Science Essentials (formerly known as PLTW Introduction to Computer Science) courses introduce students to computational thinking concepts, fundamentals, and tools. Students will increase their understanding of programming languages through the use of visual and text-based programming. Projects will include the creation of apps and websites to address real-life topics and problems. (Available SY 2021-.)				
10016A000	PLTW Cybersecurity	Following Project Lead the Way's suggested curriculum, PLTW Cybersecurity courses introduce students to the tools and concepts of cybersecurity. In these courses, students are encouraged to understand vulnerabilities in computational resources and to create solutions that allow people to share computing resources while retaining privacy. These courses also introduce students to issues related to ethical computing behavior. (Available SY 2021-.)				
10104A000	Router Basics	Router Basics courses teach students about router components, installation, and configuration using routers (e.g., CISCO) switches and the IOS (Internetwork Operation System). These courses also cover such topics as TCP/IP protocol, IP addressing, subnetting concepts, and network trouble-shooting. (Available SY 2011-.)		CS	Parts 1-5	

10006A000	Telecommunications	Telecommunications courses address the growth in global communications and the emerging equipment and systems needed to successfully communicate in a global environment. These courses cover such topics as data communication protocol and systems, government regulations of the communications industry, the use of cost-effective and productive tools to transmit messages and data, and live synchronistic video exchanges. Other topics may include telecommunications terminology, tools and test equipment; customer service experience; and installation, repair, and delivery of telecommunications systems. In these courses, students may learn about such communication systems as e-mail, internet, or e-commerce, local area network (LAN), wide area network (WAN), voice transmission, cell phone technology, teleconferencing, and videoconferencing. (Available SY 2020-.)		CS	Parts 1-5	
10153A000	Visual Basic (VB) Programming	Visual Basic (VB) Programming courses provide an opportunity for students to gain expertise in computer programs using the Visual Basic (VB) language. As with more general computer programming courses, the emphasis is on how to structure and document computer programs and how to use problem-solving techniques. These courses cover such topics as the use of text boxes, scroll bars, menus, buttons, and Windows applications. More advanced topics may include mathematical and business functions and graphics. (Available SY 2011-.)		CS	Parts 1-5	
10201A001	Web Page and Interactive Media Development I	Web Page and Interactive Media Development I is a skill-level course designed to prepare students to plan, design, create and maintain web pages and sites. Students will learn the fundamentals of web page design using HTML, HTML editors, and graphic editors as well as programming tools such as JavaScript. Students will work in a project-based environment to create a working website. Students will learn to create pages, add hyperlinks, make tables and frames, create forms, integrate images, and set styles. Students will use image-editing programs to manipulate scanned images, computer graphics, and original artwork. Instruction will include creating graphical headers, interactive menus and buttons, and visually appealing backgrounds. Students will use hardware and software to capture, edit, create, and compress audio and video clips. (Available SY 2011-.)	CTE	CS	Parts 1-5	

10201A002	Web Page and Interactive Media Development II	Web Page and Interactive Media Development II is a skill-level course for students who have completed Web Page and Interactive Media Development I. Instruction will include using multimedia authoring applications and programming tools such as JavaScript to create a web site that combines text, hyperlinks, images, video, and sound. Instruction will include using hardware and software to capture, edit, create, and compress audio and video clips as well as create animated text, graphics, and images. Other topics will include using tables to align images with text, creating newspaper-style columns, and inserting side menus and call-outs. Students will learn how to use templates, cascading style sheets and interactive elements to enhance web pages. Students will learn to create dynamic forms that include multiple-choice questions, comment boxes, and buttons. Students will learn how to connect to a database and retrieve and write data. Students are encouraged to develop a portfolio project that demonstrates their expertise in areas such as multimedia authoring, web development, audio and video editing, and advanced JavaScript applications to create interactive web pages. (Available SY 2011-.)	CTE	CS	Parts 1-5	
10201A000	Web Page Design	Web Page Design courses teach students how to design websites by introducing them to and refining their knowledge of site planning, page layout, graphic design, and the use of markup languages—such as Extensible Hypertext Markup, JavaScript, Dynamic HTML, Document Object Model, and Cascading Style Sheets—to develop and maintain a web page. These courses may also cover security and privacy issues, copyright infringement, trademarks, and other legal issues relating to the use of the Internet. Advanced topics may include the use of forms and scripts for database access, transfer methods, and networking fundamentals. (Available SY 2011-.)		CS	Parts 1-5	

12006A000	Word Processing	Word Processing courses introduce students to automated document production using one or more software packages. These courses may introduce keyboarding techniques or may require prior experience. A parallel focus is placed on the use of software commands and functions to create, edit, format, and manipulate documents, capitalizing on the power offered by word processing software programs. These courses may also cover file and disk management and other computer-related skills. (Available SY 2011-.)				Not included under Information Technology
10106A000	Wide Area Telecommunications and Networking	Wide Area Telecommunications and Networking courses provide students with the knowledge and skills to enable them to design Wide Area Networks (WANs) using ISDN, Frame-Relay, and PPP. These courses provide students with an understanding of internetworking and expertise in trouble-shooting and assessing the adequacy of network configurations to meet changing conditions. Topics may include also Local Area Network (LAN) segmentation. (Available SY 2011-.)		CS	Parts 1-5	

References

1. Chen, Y., & Werner, S. M. (2024). *The State of Computer Science in Illinois High Schools Series: Part 1 - What is the landscape of CS coursework?* Illinois Workforce and Education Research Collaborative (IWERC), Discovery Partners Institute, University of Illinois. https://dpi.uillinois.edu/applied-research/iwerc/current-projects/cs-ed-research/
2. Martin, P. (2021). *Linear regression: An introduction to statistical models*. SAGE Publications Ltd. https://doi.org/10.4135/9781529682731
3. Garson, G. D. (2013). Fundamentals of hierarchical linear and multilevel modeling. In *Hierarchical Linear Modeling: Guide and Applications* (pp. 3–26). SAGE Publications, Inc. https://doi.org/10.4135/9781483384450.n1
4. McNeish, D. (2023). A practical guide to selecting and blending approaches for clustered data: Clustered errors, multilevel models, and fixed-effect models. *Psychological Methods*. https://doi.org/10.1037/met0000620
5. Ulrich, R., & Wirtz, M. (2004). On the correlation of a naturally and an artificially dichotomized variable. *The British Journal of Mathematical and Statistical Psychology*, *57*(Pt 2), 235–251. https://doi.org/10.1348/0007110042307203
6. McNeish, D., & Kelley, K. (2019). Fixed effects models versus mixed effects models for clustered data: Reviewing the approaches, disentangling the differences, and making recommendations. *Psychological Methods*, *24*(1), 20–35. https://doi.org/10.1037/met0000182
7. Kim, S., Jeong, Y., & Hong, S. (2021). The impact of ignoring a crossed factor in cross-classified multilevel modeling. *Frontiers in Psychology*, *12*, 637645. https://doi.org/10.3389/fpsyg.2021.637645
8. Fletcher, C. L., & Warner, J. R. (2021). CAPE: a framework for assessing equity throughout the computer science education ecosystem. *Communications of the ACM*, *64*(2), 23–25. https://doi.org/10.1145/3442373