2024 Computational Thinking Summer Institute
Survey Findings

This document presents the findings from analyzing data collected using a pre/post survey of teachers in a summer institute on coding and computational thinking. Rich et al. (2020) developed the Teacher Beliefs about Coding and Computational Thinking (TBaCCT) survey to explore teacher knowledge about and self-efficacy for teaching coding in elementary grade levels. We administered the TBaCCT twice, at the start and the completion of the one-week summer institute. The surveys required that teachers enter their first and last name, which then allowed for linking the pre- and post-survey data by respondent for analysis.

The TBaCCT consisted of four subscales: Coding (7 items), Teaching (11 items), Value (10 items), and Computational Thinking (4 items). Example items included: Coding, "I can read a formula, (e.g., algorithm, equation, input/output process) and explain what it can do"; Teaching, "I can find uses of computer programming that are relevant for students"; Values, "Computing is an important 21st century literacy"; Computational Thinking, "I can identify where and how to use variables in the solution of a problem." The survey had six response options ranging from Strongly Disagree (1) to Strongly Agree (6). All items were positively worded, with high scores indicating high agreement.

CT Attitudes, Dispositions, and Self-Efficacy

Among the 27 teachers enrolled in the summer institute, a total of 24 completed both the pre- and post-surveys, indicating a loss of three to attrition. Table 1 shows basic descriptive statistics for the pre- and post-survey responses for the 24 teachers at the domain level, Coding, Teaching, Values, and Computational Thinking. Between the pre- to post-survey data, the results indicate the mean scores increased, and the standard deviations decreased suggesting that teachers' belief in and self-efficacy for CT understanding and classroom implementation increased during the duration of the summer institute.

Table 1. Survey Means and Standard Deviations Pre- and Post-Institute

		Mean		Standard Deviation	
Domain (subscale)	N	Pre-Institute	Post-Institute	Pre-Institute	Post-Institute
Coding (e.g., I can read a formula (e.g., algorithm, equation, input/output process) and explain what it should do.)	192	3.30	5.25	1.37	0.70
Teaching (e.g., I can find uses for computer programming that are relevant for students.)	264	3.66	5.56	1.45	0.56
Values (e.g., Computing is an important 21st-century literacy.)	240	5.19	5.81	0.97	0.48
Computational Thinking (e.g., I can identify where and how to use variables in the solution of a problem.)	96	4.51	5.26	1.12	0.73

N values represent 24 participants times the number of items per domain as follows:
Coding Domain (8) = items C01 – C08; Teaching Domain (11) = items T01 – T11.
Values Domain (10) = items V01 – V10; Computational Thinking Domain (4) = CT01 – CT04.

Table 2 shows the results from paired pre-/post survey t-test analysis. The results show that the changes in all four subscales for pre- to post-survey were statistically significant. Cohen's D statistics were also calculated. The commonly used interpretation defines Cohen's D calculations as effect sizes at select benchmarks of 0.2 or less (small), 0.5 (medium), 0.8 (large), and 1.3 or greater (very large) (Sullivan & Feinn, 2012, Table 1). Based on these effect size benchmarks statistics all domains were significant in increasing teachers' belief in and self-efficacy for CT understanding and classroom implementation with the greatest effective size coming from the domains of Coding (1.79) and Teaching (1.73).

Table 2. Paired t-test Results by Domain

						Cohen's D	
Domain	N	Mean Diff	Std Err	t-test	Pr>|t|	Calc.	Effect Size
Coding	192	1.95	0.10	20.33	<.0001	1.79	Very Large
Teaching	264	1.91	0.09	22.17	<.0001	1.73	Very Large
Values	240	0.63	0.06	10.97	<.0001	0.81	Large
Computational Thinking	96	0.75	0.12	6.38	<.0001	0.79	Large

N values represent 24 participants times the number of items per domain as follows:
Coding Domain (8) = items C01 – C08; Teaching Domain (11) = items T01 – T11.
Values Domain (10) = items V01 – V10; Computational Thinking Domain (4) = CT01 – CT04.

Per Domain Item Results – Summary

The remaining portion of this report provides an item-by-item analysis per domain. Table 3 summarizes the Cohen's D effect size found in Tables 4b, 5b, 6b, and 7b. Based on the effect size benchmarks statistics, most of the items were significant in increasing teachers' belief in and self-efficacy for CT understanding and classroom implementation with the greatest effective size coming from items in Coding and Teaching domains.

Table 3. Cohen's D Effect Size Item Distribution per Domain - Summary

		Cohen's D Effect Size			
Domain	Items	Small	Medium	Large	Very Large
Coding	8	0	0	1	7
Teaching	11	0	0	2	9
Values	10	0	2	7	1
Computational Thinking	4	0	2	2	0

Table 4a. Survey Means and Standard Deviations Pre- and Post-Institute by Coding Domain Item

		Mean		Standard Deviation	
Item	N	Pre-Institute	Post-Institute	Pre-Institute	Post-Institute
C01: I can describe fundamental computing concepts (e.g., loops, variables, algorithms, conditional logic, etc.).	24	2.96	5.46	1.23	0.66
C02: I can correct mistakes in the coding of a computer program on my own.	24	2.63	5.13	1.31	0.68
C03: I can suggest different solutions in order to solve coding problems.	24	3.58	5.29	1.44	0.69
C04: I can look at a computer program and explain the purpose of each command.	24	3.00	5.13	1.22	0.74
C05: I am good at finding patterns in data.	24	4.29	5.21	1.12	0.59
C06: I can apply Boolean logic (e.g., IF, AND, NOT, OR) to solve problems with multiple conditions.	24	3.13	5.13	1.51	0.85
C07: I can read a formula (e.g., algorithm, equation, input/output process) and explain what it should do.	24	3.79	5.46	1.32	0.51
C08: I can plan out the logic for a computer program even if I do not know the specific programming language.	24	3.00	5.21	1.14	0.83

Table 4b. Paired t-test Results by Coding Domain Item

						Cohen's D	
Item	N	Mean Diff	Std Err	t Value	Pr>|t|	Calc.	Effect Size
C01: I can describe fundamental computing concepts (e.g., loops, variables, algorithms, conditional logic, etc.).							
	24	2.50	0.24	10.38	<.0001	2.53	Very Large
C02: I can correct mistakes in the coding of a computer program on my own.							
	24	2.50	0.24	10.38	<.0001	2.40	Very Large
C03: I can suggest different solutions in order to solve coding problems.							
	24	1.71	0.29	5.99	<.0001	1.51	Very Large
C04: I can look at a computer program and explain the purpose of each command.							
	24	2.13	0.25	8.48	<.0001	2.11	Very Large
C05: I am good at finding patterns in data.							
	24	0.92	0.22	4.24	<.001	1.03	Large
C06: I can apply Boolean logic (e.g., IF, AND, NOT, OR) to solve problems with multiple conditions.							
	24	2.00	0.30	6.65	<.0001	1.63	Very Large
C07: I can read a formula (e.g., algorithm, equation, input/output process) and explain what it should do.							
	24	1.67	0.25	6.78	<.0001	1.67	Very Large
C08: I can plan out the logic for a computer program even if I do not know the specific programming language.							
	24	2.21	0.27	8.21	<.0001	2.22	Very Large

Table 5a. Survey Means and Standard Deviations Pre- and Post-Institute by Teaching Domain Item

		Mean		Standard Deviation	
Item	N	Pre-Institute	Post-Institute	Pre-Institute	Post-Institute
T01: I can explain basic computing concepts to children (e.g., algorithms, loops, conditionals, functions, variables, debugging, pattern-finding).	24	2.92	5.58	1.25	0.50
T02: I can help students debug their computer programs.	24	3.00	5.29	1.38	0.69
T03: I can find uses for computer programming that are relevant for students.	24	4.33	5.71	1.49	0.46
T04: I can integrate computer programming into my current curriculum.	24	4.38	5.75	1.38	0.44
T05: I know where to find the resources to help students learn to code.	24	3.63	5.75	1.44	0.44
T06: I believe that I have the requisite computer programming skills to integrate computing content into my class lessons.	24	3.63	5.54	1.35	0.51
T07: I can recognize and appreciate computing concepts in all subject areas.	24	4.46	5.71	1.47	0.46
T08: I can create computing activities at the appropriate level for my students.	24	3.33	5.58	1.27	0.58
T09: I can explain computing concepts well enough to be effective in teaching computing.	24	3.13	5.33	1.30	0.64
T10: I can explain how computing concepts are connected to daily life.	24	4.08	5.54	1.28	0.59
T11: I can develop and plan effective computing lessons.	24	3.33	5.38	1.37	0.58

Table 5b. Paired t-test Results by Teaching Domain Item

						Cohen's D	
Item	N	Mean	Std Err	t Value	Pr>|t|	Calc.	Effect Size
T01: I can explain basic computing concepts to children (e.g., algorithms, loops, conditionals, functions, variables, debugging, pattern-finding).	24	2.67	0.27	9.99	<.0001	2.79	Very Large
T02: I can help students debug their computer programs.	24	2.29	0.27	8.63	<.0001	2.10	Very Large
T03: I can find uses for computer programming that are relevant for students.	24	1.38	0.31	4.41	<.001	1.25	Large
T04: I can integrate computer programming into my current curriculum.	24	1.38	0.27	5.01	<.0001	1.34	Very Large
T05: I know where to find the resources to help students learn to code.	24	2.13	0.29	7.31	<.0001	1.99	Very Large
T06: I believe that I have the requisite computer programming skills to integrate computing content into my class lessons.	24	1.92	0.26	7.32	<.0001	1.87	Very Large
T07: I can recognize and appreciate computing concepts in all subject areas.	24	1.25	0.32	3.91	<.001	1.15	Large
T08: I can create computing activities at the appropriate level for my students.	24	2.25	0.25	9.00	<.0001	2.28	Very Large
T09: I can explain computing concepts well enough to be effective in teaching computing.	24	2.21	0.27	8.21	<.0001	2.15	Very Large
T10: I can explain how computing concepts are connected to daily life.	24	1.46	0.23	6.26	<.0001	1.46	Very Large
T11: I can develop and plan effective computing lessons.	24	2.04	0.27	7.50	<.0001	1.95	Very Large

Table 6a. Survey Means and Standard Deviations Pre- and Post-Institute by Values Domain Item

		Mean		Standard Deviation	
Item	N	Pre-Institute	Post-Institute	Pre-Institute	Post-Institute
V01: Computing should be taught in elementary school.	24	5.42	5.96	0.78	0.20
V02: Learning about computing can help elementary students become more engaged in school.	24	5.54	5.92	0.59	0.28
V03: Computing content and principles can be understood by elementary school children.	24	5.38	5.96	0.65	0.20
V04: My current teaching situation lends itself to teaching computing concepts to my students.	24	4.13	5.63	1.15	0.58
V05: Knowledge of computer programming is necessary in most careers.	24	4.38	5.42	1.41	0.83
V06: Providing more computing activities will enrich my students overall learning.	24	5.54	5.96	0.66	0.20
V07: Computing is an important 21st-century literacy.	24	5.67	5.92	0.56	0.28
V08: Computational thinking is an important part of today's science standards.	24	5.33	5.88	0.76	0.34
V09: My current students are going to need to know how to code to remain competitive for jobs by the time they are adults.	24	5.21	5.63	0.93	0.71
V10: Computing should be taught to special needs students.	24	5.29	5.88	0.69	0.34

Table 6b. Paired t-test Results by Values Item

						Cohen's D	
Item	N	Mean	Std Err	t Value	Pr>|t|	Calc.	Effect Size
V01: Computing should be taught in elementary school.							
	24	0.54	0.15	3.68	<.01	0.95	Large
V02: Learning about computing can help elementary students become more engaged in school.							
	24	0.38	0.12	3.19	<.01	0.82	Large
V03: Computing content and principles can be understood by elementary school children.							
	24	0.58	0.12	4.90	<.0001	1.21	Large
V04: My current teaching situation lends itself to teaching computing concepts to my students.							
	24	1.50	0.25	6.04	<.0001	1.65	Very Large
V05: Knowledge of computer programming is necessary in most careers.							
	24	1.04	0.27	3.82	<.001	0.90	Large
V06: Providing more computing activities will enrich my students overall learning.							
	24	0.42	0.13	3.12	<.01	0.86	Large
V07: Computing is an important 21st-century literacy.							
	24	0.25	0.11	2.30	<.05	0.56	Medium
V08: Computational thinking is an important part of today's science standards.							
	24	0.54	0.16	3.41	<.01	0.93	Large
V09: My current students are going to need to know how to code to remain competitive for jobs by the time they are adults.							
	24	0.42	0.13	3.12	<.01	0.51	Medium
V10: Computing should be taught to special needs students.							
	24	0.58	0.16	3.68	<.01	1.08	Large

Table 7a. Survey Means and Standard Deviations Pre- and Post-Institute by Computational Thinking Domain Item

		Mean		Standard Deviation	
Item	N	Pre-Institute	Post-Institute	Pre-Institute	Post-Institute
CT01: When I am presented with a problem, I can break it down into smaller steps.	24	5.17	5.63	1.05	0.49
CT02: I am able to generalize solutions that can be applied to many different problems.	24	4.50	5.29	0.88	0.69
CT03: I am good at solving puzzles.	24	4.46	5.08	1.02	0.88
CT04: I can identify where and how to use variables in the solution of a problem.	24	3.92	5.04	1.21	0.69

Table 7b. Paired t-test Results by Computational Thinking Item

						Cohen's D	
Item	N	Mean	Std Err	t Value	Pr>|t|	Calc.	Effect Size
CT01: When I am presented with a problem, I can break it down into smaller steps.							
	24	0.46	0.24	1.90	0.0694	0.56	Medium
CT02: I am able to generalize solutions that can be applied to many different problems.							
	24	0.79	0.21	3.80	<.001	1.00	Large
CT03: I am good at solving puzzles.							
	24	0.63	0.19	3.31	<.01	0.65	Medium
CT04: I can identify where and how to use variables in the solution of a problem.							
	24	1.13	0.28	3.96	<.001	1.14	Large

References:

Rich, P. J., Larsen, R. A., & Mason, S. L. (2020). Measuring teacher beliefs about coding and computational thinking. *Journal of Research on Technology in Education*, *53*(3), 296–316. https://doi.org/10.1080/15391523.2020.1771232

Sullivan, G. M., & Feinn, R. (2012). Using Effect Size-or Why the P Value Is Not Enough. *Journal of graduate medical education*, *4*(3), 279–282. https://doi.org/10.4300/JGME-D-12-00156.1