Engelman, S., McKlin, T., Ericson, B., & Guzdial, M. (2012). Georgia Computes! Roll-Up Analysis: Student Summer Camps 2012.

GA COMPUTES!
ROLL-UP ANALYSIS: STUDENT SUMMER CAMPS
2012

Executive Summary. Approximately 1,005 K-12 students participated in computing summer camps associated with Georgia Computes! between May and August 2012. The 5-day summer computing camps consisted of camps held at Georgia Tech and the following Seeded Summer Camp locations:

- Boys & Girls Club of Atlanta
- Columbus State University
- Georgia Gwinnett College
- Georgia Tech, Savannah
- Mercer University
- Spelman College
- Brookwood High School
- Lanier High School
- North Gwinnett High School
- Tri-Cities High School
- Southwest Atlanta Christian Academy

Georgia Computes! provided training and funding, where appropriate, to the above mentioned institutions to host their own summer camps for K-12 students.
At each camp, surveys were administered on day one (pre) and day five (post) to assess changes in attitudes toward computing. It is hypothesized that participating in summer computing camps increases the following psychosocial constructs:

1. Computing Confidence- “I can get good grades in computing.”
2. Computing Enjoyment- “Computers are fun.”
3. Computing Importance & Perceived Usefulness of Computing – “I will use computing in many ways throughout my life.”
4. Motivation to Succeed in Computing- “When a computing problem arises that I can’t immediately solve, I stick with it until I have the solution.”
5. Computing Identity and Belongingness- “I feel like I “belong” in computer science.”
6. Gender Equity- “Girls can do just as well as boys in computing.”
7. Intention to Persist- “I can see myself working in a computing field.”
8. Creativity- “I am able to be expressive and creative while doing computing.”

Additionally, content knowledge assessment items were administered at pre and post to students who participated in camps related to Scratch, Alice, or App Inventor. See Appendices A, B and C for more information pertaining to the content knowledge assessments items across these three areas.

Major Findings

Attitudinal Items

- Overall
  - Across all students, the computing summer camps statistically significantly increase attitudes from pre to post on 7 of the 8 measured psychosocial constructs. According to the effect sizes (Cohen's *d*), the computing camps had a "medium" impact in enhancing students' attitudes[1]. The largest impacts were found in the areas of intent to persist, confidence, and belongingness in computing. **That is, the computing camps were particularly effective at increasing students' intent to pursue additional computing, self-efficacy in doing computing, and sense of belonging in computing.**
- Gender
  - Both male and female students reported statistically significant increases on most constructs (7 out of 8 and 5 out of 8, respectively). Among females, the largest increases were found in the areas of persistence, creativity, and belongingness in computing. Male students' attitudes increased most on confidence, belongingness in computing, and beliefs in gender equity.
  - **Comparing males and females' effect sizes (Cohen's *d*), it is evident that the workshop had a larger effect on the latter group than the former.**
  - Likewise, female students show significantly more growth from pre to post than male students in their motivation to succeed, intent to persist and creativity in computing.
- Race/Ethnicity
  - Students in the racial majority (White,Asian) reported significant increases on 7 of the 8 constructs, and students in the racial minority (multiracial, Hispanic, Native American, Black) reported significant increases in 6 out of 8 areas.
  - When comparing construct rating growth across ethnicities, **minority students reported significantly more growth in their intent to persist in computing than majority students**.
- Grade
  - Elementary school students and middle school students reported significant increases on most constructs (6 out of 8 and 5 out of 8, respectively). Five of these increases were in the same areas for both grade levels: confidence, belongingness, gender equity, intent to persist, and creativity. High school students reported a significant increase in only 1 of the 8 constructs measured: enjoyment of computing.
  - This may suggest that the **computing camps have a greater effect on elementary and middle school students than high school students.**

Content Knowledge Assessment Items

- Overall
  - **Across all students, statistically significant improvements in content knowledge were found for Scratch, Alice, and App Inventor**. Significant increases in scores were evident across genders, ethnic groups, and grade levels.
  - Albeit approaching significance at $p<.10$, f**emale students show more growth in their knowledge of Scratch and Alice** concepts than male students.
  - **Minority students** (multiracial, Hispanic, Native American, Black) **show statistically significantly more growth** from pre to post **in their knowledge of Scratch** than majority students (White, Asian).

Discussion & Recommendations

- Despite statistically significant gains in attitudes, the results suggest that additional improvement may be needed in improving students' motivations to succeed in computing. For example, majority students and male students are slightly more likely to say that computing is boring following the camps. Likewise, the reported ratings at the end of the camps (post scores) across most psychosocial construct still fall below the target range of 4.00 or better on a 5-point likert scale where 1 signifies strongly disagree and 5 signifies strongly agree. For a program to operate at its optimal capacity, we would expect post scores to be at or above 4.00.

[1] See Appendix D for more information regarding effect sizes.

Recommendations & Suggestions, continued

- Although statistically significant increases were found in female students' attitudes, their post scores remain lower than males' scores across all psychosocial construct, with the exception of Gender Equity. That is, despite their growth in attitudes, females continue to express lower confidence, enjoyment, belongingness, motivation, and intent to persist in computing than males.
- Likewise, despite statistically significant growth in attitudes among racial minorities, their scores at post survey are comparatively lower across all psychosocial constructs than majority students.
- Together, this seems to suggest that **the computing camps are effective at narrowing the gender and race gap in attitudes towards computing.**
    - However, additional **effort may be needed in specifically addressing the issue that females and minorities hold less positive attitudes about computing and less frequently aspire to a career in computing than their male and majority counterparts.**
- Future computing camps may **consider integrating social-psychological interventions** that have been empirically demonstrated to improve students' attitudes towards computer science and enhance female and minority students' sense of belonging in an area where they do not see many representations of themselves.
    - Recent research has found that brief class exercises and activities that are directed at students' thoughts, feelings and beliefs about school have a significant impact on students' achievement and intent to persist (Yeager & Walton, 2011)[2]. For example, researchers found that a 15-minute writing exercise in which students were asked to write a letter to a younger student endorsing the belief that intelligence is malleable (Dweck, 2006)[3] as opposed to fixed led to a statistically significant improvement in their GPA at the end of the term.
        - Likewise, researchers demonstrated how the racial achievement gap could be reduced by 52% through a 1-hour laboratory session in which students read the results of a survey demonstrating that many students feel they do not belong in college at first but that such worries dissipate with time. Researchers contend that increasing students' sense of social belonging in school or in an academic domain can increase motivation and performance, particularly for underrepresented minority students (Walton & Cohen, 2007)[4]. Similarly, researchers are finding that such interventions that mitigate stereotype threat (e.g., the experience of anxiety or concern in a situation where a person has the potential to confirm a negative stereotype about their social group) are important in bolstering academic performance among ethnic minority student and women in math and science fields. Stereotype threat has been found to lead to a vicious cycle of undermined confidence, poor performance, and loss of interest in the domain of study (Steele, Spencer, & Aronson, 2002)[5].

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[2] Yeager, D.S., & Walton, G.M. (2011). Social-psychological interventions in education; They're not magic. *Review of Educational Research, 81*, 267-301.

[3] Dweck, C.S. (2006*). Mindset*. New York, NY: Random House.

[4] Walton, G.M., & Cohen, G.L. (2007). A question of belonging: Race, social fit and achievement. *Journal of Personality and Social Psychology,* 92, 82-96.

[5] Steele, C.M., Spencer, S.J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 34, pp. 379-440). San Diego, CA: Academic Press.

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Demographic Information[6]

LOCATIONS (N)

	n
Georgia Tech-ICE	217
Boys & Girls Club	49
Brookwood High School	47
Columbus State University	200
Georgia Gwinnett College	66
Georgia Tech-Savannah	159
Lanier High School	41
Mercer University	98
North Gwinnett High School	15
Southwest Atlanta Christian Academy	15
Spelman College	40
Tri-Cities	43
Valdosta State University	15
Total	1005

GENDER (N)

	Female	Male	Total
Georgia Tech-ICE	63	139	202
Boys & Girls Club	30	14	44
Brookwood High School	6	39	45
Columbus State University	28	169	197
Georgia Gwinnett College	18	48	66
Georgia Tech-Savannah	28	121	149
Lanier High School	9	29	38
Mercer University	15	83	98
North Gwinnett High School	6	9	15
Southwest Atlanta Christian Academy	7	7	14
Spelman College	25	14	39
Tri-Cities	10	32	42
Valdosta State University	3	12	15
Total	185 (23%)	577 (72%)	762

RACE/ETHNICITY (N)

	Majority (White, Asian)	Minority (Multicultural, Hispanic, Black, Native American)	Total
Georgia Tech-ICE	107	96	203
Boys & Girls Club	1	45	46
Brookwood High School	29	17	46
Columbus State University	145	52	197
Georgia Gwinnett College	30	35	65
Georgia Tech-Savannah	120	29	149
Lanier High School	30	8	38
Mercer University	68	30	98
North Gwinnett High School	6	9	15
Southwest Atlanta Christian Academy	0	14	14
Spelman College	0	39	39
Tri-Cities	2	41	43
Valdosta State University	13	2	15
Total	551 (57%)	417 (43%)	968

[6] Numbers represent students who had matching (i.e. via student ID number) pre and post survey responses.

I. Student Attitudes: Construct Analysis

A. Overall

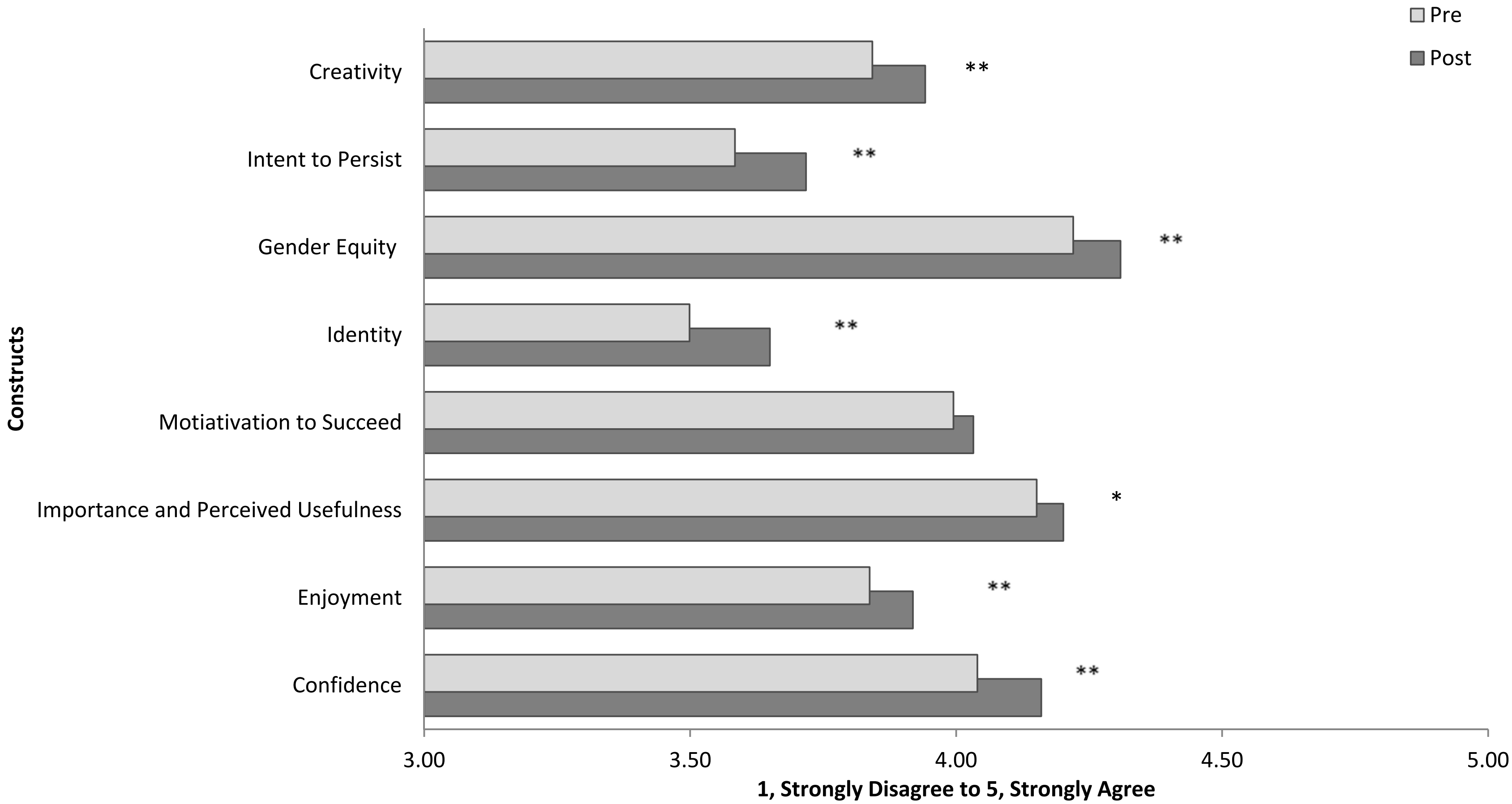
Table 1. Student Attitudes- Construct Analysis, Overall

Student Attitudes- Construct Analysis, Overall						
		n	Mean[1]	Std. Deviation	t-test	Effect Size
Computing Confidence	Pre	797	4.04	.74	.000**	0.34
	Post	797	4.16	.75		
Computer Enjoyment	Pre	800	3.84	.64	.001**	0.24
	Post	800	3.92	.71		
Computer Importance and Perceived Usefulness of Computing	Pre	809	4.15	.73	.047*	0.14
	Post	809	4.20	.79		
Motivation to Succeed in Computing	Pre	801	4.00	.72	.139	0.10
	Post	801	4.03	.73		
Computing Identity & Belongingness	Pre	794	3.50	1.05	.000**	0.32
	Post	794	3.65	1.08		
Gender Equity	Pre	811	4.22	.87	.001**	0.24
	Post	811	4.31	.86		
Intent to persist	Pre	813	3.58	.94	.000**	0.35
	Post	813	3.72	.95		
Creativity	Pre	812	3.84	.74	.000**	0.31
	Post	812	3.94	.77		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+. Scale=1, *strongly disagree* to 5, *strongly agree*.

Across all students, statistically significant increases from pre to post were found in 7 out of 8 psychosocial constructs. That is, students are significantly more likely to express confidence and enjoyment in computing, perceive computing as being important and useful, feel a sense of belonging in computing, assert egalitarian gender attitudes, express more creativity, and report intending to persist in computing after participating in the summer computing camps. The largest gains, per effect size, were found in confidence, belongingness, creativity, and intent to persist.

Figure 1. Constructs, Pre/Post- Overall



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

B. By Gender

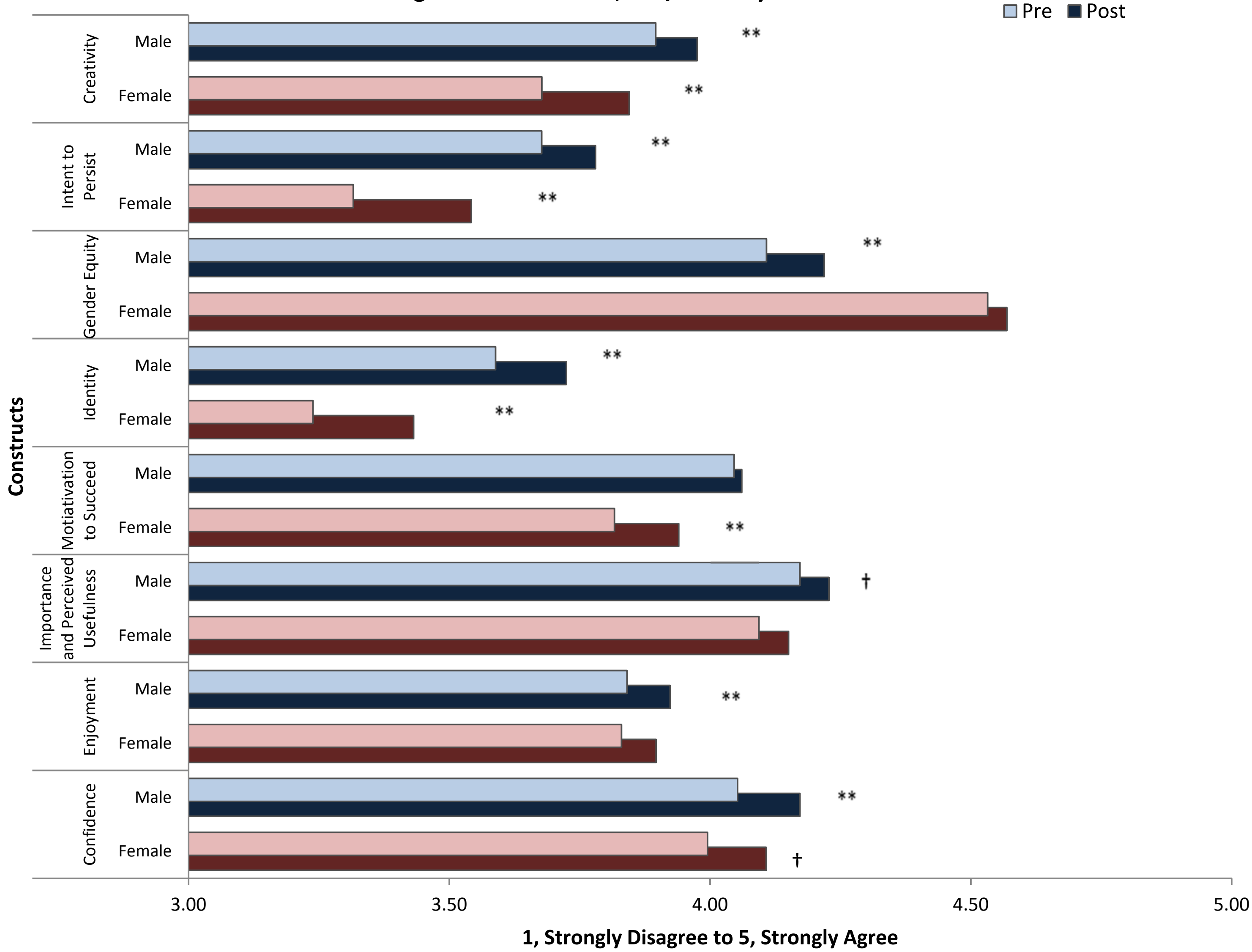
Table 2. Student Attitudes- Construct Analysis, By Gender

Student Attitudes- Construct Analysis, By Gender										
	Female (n=203)					Male (n=596)				
		Mean[1]	Std. Deviation	t-test	Effect Size		Mean[1]	Std. Deviation	t-test	Effect Size
Computing Confidence	Pre	4.00	.71	.053†	.28	Pre	4.05	.74	.000**	.35
	Post	4.11	.77			Post	4.17	.73		
Computer Enjoyment	Pre	3.83	.62	.189	.19	Pre	3.84	.64	.002**	.25
	Post	3.90	.73			Post	3.92	.70		
Computer Importance and Perceived Usefulness of Computing	Pre	4.09	.76	.280	.15	Pre	4.17	.71	.054†	.16
	Post	4.15	.81			Post	4.23	.77		
Motivation to Succeed in Computing	Pre	3.82	.77	.020*	.33	Pre	4.05	.69	.622	.04
	Post	3.94	.75			Post	4.06	.73		
Computing Identity & Belongingness	Pre	3.24	1.07	.006**	.40	Pre	3.59	1.02	.001**	.29
	Post	3.43	1.09			Post	3.72	1.05		
Gender Equity	Pre	4.53	.69	.390	.12	Pre	4.11	.90	.001**	.29
	Post	4.57	.71			Post	4.22	.88		
Intent to persist	Pre	3.32	.91	.000**	.56	Pre	3.68	.92	.001**	.28
	Post	3.54	.94			Post	3.78	.94		
Creativity	Pre	3.68	.78	.000**	.55	Pre	3.90	.71	.003**	.24
	Post	3.84	.76			Post	3.98	.76		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+. Scale=1, *strongly disagree* to 5, *strongly agree*.

The data in Table 2 suggest that female students reported a significant or nearly significant increase from pre to post on 5 of 8 constructs: intent to persist in computing, creativity, belongingness in the computing world, motivation to succeed in computing, and confidence in computing. Large effect sizes from pre to post were found in female students' intent to persist, computing creativity, and sense of identity and belongingness. Male students reported significant or almost significant increases in 7 of the 8 areas measured: computing confidence, belongingness in computing, gender equity, intent to persist, enjoyment of computing, creativity, and perceived usefulness of computing. The largest gains, per effect size, for male students were made in the areas of confidence, computing identity and belongingness, and gender equity. Comparing males and females, it is evident that the workshop had a larger effect on the latter group than the former.

Figure 2. Constructs, Pre/Post- By Gender



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

Growth Analysis

Table 3. Student Attitudes- Growth Analysis, By Gender

Growth Analysis by Gender			
	Gender	**Mean Growth from Pre to Post**	**Significant difference in Growth between genders (*t-test*)**
Computing Confidence	Female	+.11	.905
	Male	+.12	
Computer Enjoyment	Female	+.07	.768
	Male	+.08	
Computer Importance and Perceived Usefulness of Computing	Female	+.06	.990
	Male	+.06	
Motivation to Succeed in Computing	Female	+.12	.066† Female students report significantly more growth from pre to post in their motivation to succeed than male students.
	Male	+.01	
Computing Identity & Belongingness	Female	+.19	.468
	Male	+.14	
Gender Equity	Female	+.04	.217
	Male	+.11	
Intent to persist	Female	+.23	.048* Female students show significantly more growth from pre to post in their intent to persist in computing than male students.
	Male	+.10	
Creativity	Female	+.17	.094† Female students report significantly more growth from pre to post in their creative expressiveness than male students.
	Male	+.08	

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10. Scale=1, *strongly disagree* to 5, *strongly agree*.

C. By Race/Ethnicity

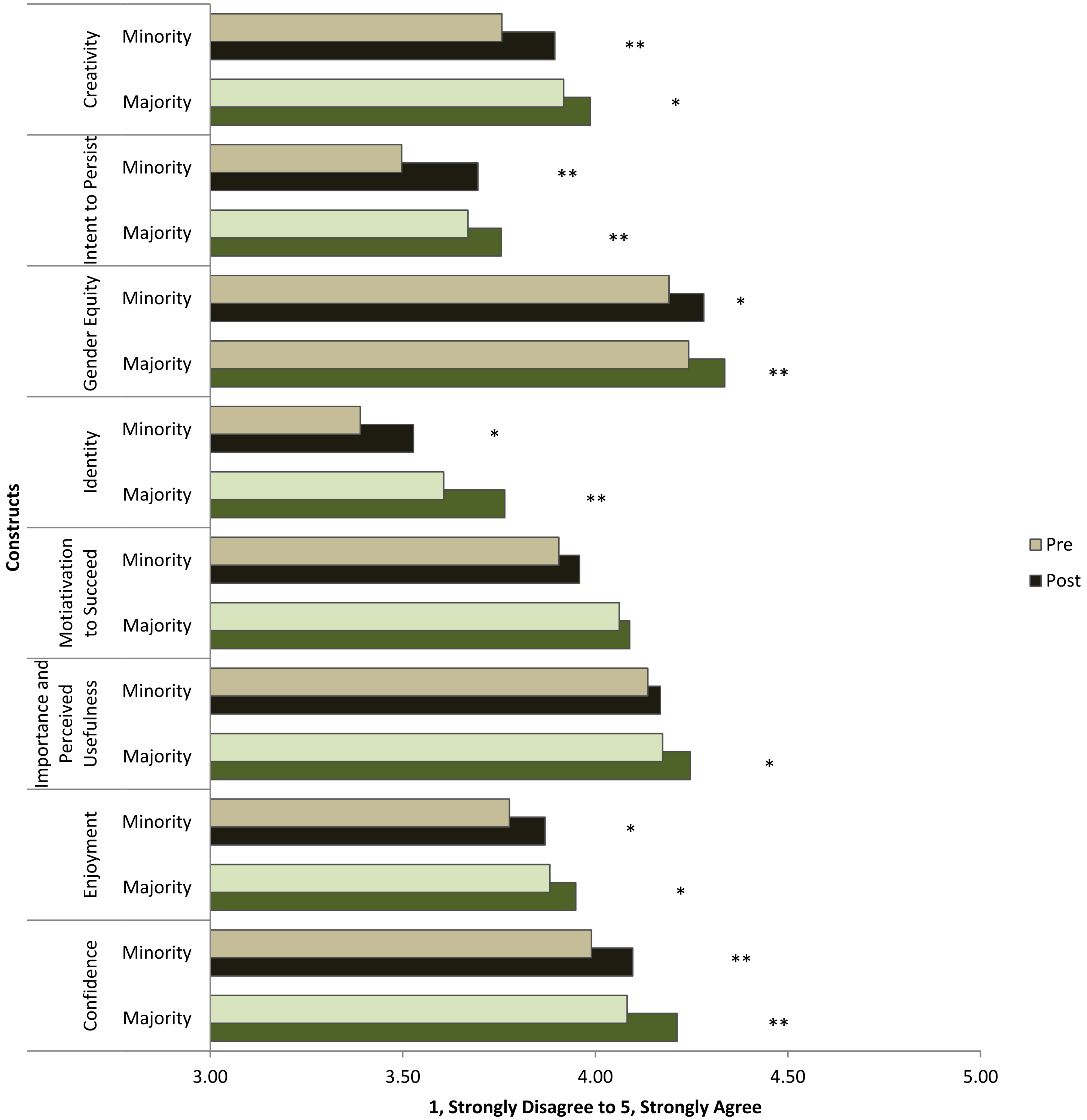
Table 4. Student Attitudes- Construct Analysis, By Race/Ethnicity

Student Attitudes- Construct Analysis, By Race/Ethnicity										
	Majority (White, Asian) (n=449)					Minority (Multicultural, Hispanic, Black, Native Am.) (n=352)				
		Mean[1]	Std. Deviation	t-test	Effect Size		Mean[1]	Std. Deviation	t-test	Effect Size
Computing Confidence	Pre	4.08	.72	.000**	.38	Pre	3.99	.74	.009**	.28
	Post	4.21	.72			Post	4.10	.76		
Computer Enjoyment	Pre	3.88	.62	.027*	.21	Pre	3.78	.65	.013*	.27
	Post	3.95	.67			Post	3.87	.75		
Computer Importance and Perceived Usefulness of Computing	Pre	4.17	.67	.022*	.22	Pre	4.14	.77	.432	.08
	Post	4.25	.72			Post	4.17	.85		
Motivation to Succeed in Computing	Pre	4.06	.65	.384	.08	Pre	3.91	.80	.206	.14
	Post	4.09	.69			Post	3.96	.78		
Computing Identity & Belongingness	Pre	3.61	1.02	.000**	.34	Pre	3.39	1.05	.010*	.28
	Post	3.76	1.00			Post	3.53	1.14		
Gender Equity	Pre	4.24	.86	.002**	.30	Pre	4.19	.88	.047*	.21
	Post	4.34	.80			Post	4.28	.91		
Intent to persist	Pre	3.67	.88	.007**	.26	Pre	3.50	.98	.000**	.46
	Post	3.76	.89			Post	3.70	1.00		
Creativity	Pre	3.92	.69	.014*	.23	Pre	3.76	.78	.000**	.39
	Post	3.99	.72			Post	3.89	.82		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+. Scale=1, *strongly disagree* to 5, *strongly agree*.

Students belonging to a racial/ethnic majority group (i.e., White and Asian students) reported a significant increase in 7 of the 8 constructs after participating in the computing camps: confidence in computing, identity and belongingness in the computing world, gender equity, intent to persist in computing, creativity, perceived usefulness of computing, and enjoyment of computing. The most notable increases were made in the areas of computing confidence and belongingness. Students belonging to a racial/ethnic minority group (i.e., multicultural, Hispanic, Black, and Native American students) reported significant increases in 6 of the 8 constructs measured: intent to persist, creativity, confidence, identity and belongingness, computing enjoyment, and gender equity. For majority students, the workshop produced the largest effect size gains in confidence, identity and belongingness, and gender equity. Among minority students, the largest effect sizes are observed in intent to persist and creativity.

Figure 3. Constructs, Pre/Post- By Race/Ethnicity



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

Growth Analysis

Table 5. Student Attitudes- Growth Analysis, By Race/Ethnicity

Growth Analysis by Race/Ethnicity			
		Mean Growth from Pre to Post	**Significant difference in Growth between Minority and Majority students (*t-test*)**
Computing Confidence	Majority	+.13	.665
	Minority	+.11	
Computer Enjoyment	Majority	+.07	.585
	Minority	+.09	
Computer Importance and Perceived Usefulness of Computing	Majority	+.07	.441
	Minority	+.03	
Motivation to Succeed in Computing	Majority	+.03	.601
	Minority	+.05	
Computing Identity & Belongingness	Majority	+.16	.774
	Minority	+.14	
Gender Equity	Majority	+.09	.943
	Minority	+.09	
Intent to persist	Majority	+.09	.042* Minority students report significantly more growth from pre to post in their intent to persist in computing than majority students.
	Minority	+.20	
Creativity	Majority	+.07	.139
	Minority	+.14	

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10. Scale=1, *strongly disagree* to 5, *strongly agree*.

D. By Grade

Table 6. Student Attitudes- Construct Analysis, By Gender

Student Attitudes- Construct Analysis, By Grade		Elementary School (n=419)				Middle School (n=300)				High School (n=80)			
		Mean[1]	Std. Dev.	t-test	Effect size	Mean[1]	Std. Dev.	t-test	Effect size	Mean[1]	Std. Dev.	t-test	Effect size
Computing Confidence	Pre	3.98	.75	.000 **	.42	4.07	.70	.010 *	.31	4.21	.73	1.000	.00
	Post	4.13	.76			4.17	.74			4.21	.70		
Computer Enjoyment	Pre	3.89	.64	.000 **	.43	3.79	.61	.968	.00	3.68	.67	.038*	.48
	Post	4.03	.69			3.80	.72			3.78	.67		
Computer Importance and Perceived Usefulness of Computing	Pre	4.08	.76	.103	.16	4.23	.67	.135	.17	4.25	.68	.937	.02
	Post	4.14	.82			4.29	.73			4.24	.83		
Motivation to Succeed in Computing	Pre	4.05	.70	.265	.11	3.91	.72	.300	.12	3.99	.77	.571	.13
	Post	4.09	.72			3.95	.74			4.03	.75		
Computing Identity & Belongingness	Pre	3.55	1.05	.074 †	.18	3.41	1.02	.000 **	.58	3.53	1.14	.219	.28
	Post	3.64	1.09			3.67	1.02			3.65	1.16		
Gender Equity	Pre	4.16	.90	.004 **	.28	4.27	.86	.074 †	.21	4.35	.74	.765	.07
	Post	4.26	.88			4.35	.83			4.37	.83		
Intent to persist	Pre	3.47	.96	.000 **	.40	3.69	.86	.002 **	.36	3.81	1.00	.495	.15
	Post	3.63	.97			3.82	.90			3.86	1.00		
Creativity	Pre	3.87	.73	.003 **	.29	3.78	.72	.000 **	.41	3.89	.83	.541	.14
	Post	3.97	.78			3.91	.74			3.93	.84		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+. Scale=1, *strongly disagree* to 5, *strongly agree*.

Elementary school students reported significant or nearly significant increases in 6 of the 8 attitudinal constructs: computing confidence, enjoyment, intent to persist, creativity, beliefs in gender equity, and belongingness in computing. The largest effect size gains for elementary students were observed in the areas of confidence, intention to persist in computing, and enjoyment of computing. Similarly, middle school students reported significant or almost significant increases from pre to post in 5 of the 8 constructs: belongingness, creativity, intent to persist, confidence, and gender equity. Medium to large effect size gains for middle school students were in the areas of identity and belongingness in computing and creativity. High school students reported a significant increase on only 1 of the 8 constructs measured: enjoyment of computing.

Growth Analysis

Table 7. Student Attitudes- Growth Analysis, By Grade

Growth Analysis by Grade				
	Mean Growth from Pre to Post			**Difference in growth among grades (*ANOVA*)**
	Elementary School (ES)	**Middle School (MS)**	**High School (HS)**	
Computing Confidence	+0.16	+0.11	0.00	0.182
Computer Enjoyment	+0.14	0.00	+0.10	.021* Elementary school students grew significantly more in computer enjoyment than middle school students.
Computer Importance and Perceived Usefulness of Computing	+0.06	+0.06	-0.01	0.74
Motivation to Succeed in Computing	+0.04	+0.04	+0.04	1.00
Computing Identity & Belongingness	+0.09	+0.26	+0.11	.056† Middle school students grew significantly more in their sense of identity and belongingness than elementary school students.
Gender Equity	+0.10	+0.08	+0.02	0.64
Intent to persist	+0.16	+0.13	+0.06	0.54
Creativity	+0.09	+0.13	+0.05	0.58

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10. Scale=1, *strongly disagree* to 5, *strongly agree*.

II. Content Knowledge Assessment (CKA)[7] Analysis

A. Overall

Scratch

Table 8. Scratch CKA- Overall Analysis

Scratch CKA - Overall						
		n	Percent Correct	Std. Deviation	t-test	Effect Size
1. Motion	Pre	309	81%	39%	.000**	0.48
	Post	309	92%	27%		
2. Loop	Pre	309	49%	50%	.000**	0.78
	Post	309	72%	45%		
3. Handling an Event	Pre	302	17%	37%	.000**	0.45
	Post	302	29%	45%		
4. Modifying a Variable	Pre	301	37%	48%	.000**	1.18
	Post	301	70%	46%		
5. Sending a message	Pre	302	27%	45%	.000**	0.82
	Post	302	49%	50%		
6. Conditional execution	Pre	294	18%	39%	.000**	0.57
	Post	294	34%	47%		
7. Loop	Pre	309	48%	50%	.000**	1.21
	Post	309	82%	38%		
8. Tracing	Pre	306	35%	48%	.000**	1.03
	Post	306	63%	48%		
9. Conditional	Pre	307	48%	50%	.000**	0.56
	Post	307	62%	49%		
10. Tracing	Pre	311	21%	41%	.000**	0.95
	Post	311	45%	50%		
Overall Average	**Pre**	**322**	**38%**	**26%**	**.000****	**1.83**
	Post	**322**	**59%**	**23%**		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+

[7] The content knowledge assessment instruments are in appendices A , B, and C.

Alice

Table 9. Alice CKA- Overall Analysis

Alice CKA - Overall						
		n	Percent Correct	Std. Deviation	t-test	Effect Size
1. Objects	Pre	77	22%	42%	.397	0.20
	Post	77	27%	45%		
2. Executing a method	Pre	77	13%	34%	.000**	1.59
	Post	77	58%	50%		
3. Changing a field	Pre	75	9%	29%	.073†	0.42
	Post	75	20%	40%		
4. Objects	Pre	76	42%	50%	.000**	1.55
	Post	76	84%	37%		
5. Creating an object	Pre	77	56%	50%	.000**	0.99
	Post	77	86%	35%		
6. Objects/Method	Pre	76	43%	50%	.000**	0.96
	Post	76	70%	46%		
7. Tracing	Pre	78	56%	50%	.000**	1.08
	Post	78	83%	38%		
8. Conditional Execution/Tracing	Pre	74	27%	45%	.000**	1.05
	Post	74	58%	50%		
9. Loop/Tracing	Pre	77	18%	39%	.015*	0.57
	Post	77	32%	47%		
10. Loop/Tracing	Pre	74	24%	43%	.010*	0.62
	Post	74	41%	49%		
11. Overall average	**Pre**	**78**	**31%**	**21%**	**.000****	**2.19**
	Post	**78**	**56%**	**18%**		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+

App Inventor

Table 10. App Inventor CKA- Overall Analysis

App Inventor CKA - Overall						
		n	Percent Correct	Std. Deviation	t-test	Effect Size
1. Control	Pre	52	33%	47%	.001**	.96
	Post	52	62%	49%		
2. Handling an event	Pre	52	6%	24%	.001**	.98
	Post	52	25%	44%		
3. Creating a list	Pre	52	58%	50%	.103	.46
	Post	52	73%	45%		
4. Modifying a Variable	Pre	51	35%	48%	.026*	.65
	Post	51	57%	50%		
5. Conditional execution	Pre	52	12%	32%	.000**	1.14
	Post	52	42%	50%		
6. Defining a procedure	Pre	53	15%	36%	.017*	.68
	Post	53	34%	48%		
7. Tracing	Pre	53	43%	50%	.000**	1.16
	Post	53	79%	41%		
8. Conditional execution/Tracing	Pre	53	13%	34%	.000**	1.100
	Post	53	40%	49%		
9. Tracing	Pre	53	8%	27%	.709	.10
	Post	53	9%	30%		
10. Tracing	Pre	51	16%	37%	.028*	.64
	Post	51	33%	48%		
11. Overall average	**Pre**	**54**	**24%**	**20%**	**.000****	**2.07**
	Post	**54**	**46%**	**20%**		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+

B. By Gender

Scratch

Table 11. Scratch CKA- By Gender

Scratch CKA – By Gender					
		Female (n=80)		Male (n=232)	
		Percent Correct	t-test	Percent Correct	t-test
1. Motion	Pre	78%	.000**	82%	.001**
	Post	95%		91%	
2. Loop	Pre	56%	.010*	45%	.000**
	Post	74%		71%	
3. Handling an Event	Pre	18%	.020*	15%	.000**
	Post	33%		28%	
4. Modifying a Variable	Pre	25%	.000**	41%	.000**
	Post	70%		70%	
5. Sending a message	Pre	23%	.000**	29%	.000**
	Post	53%		47%	
6. Conditional execution	Pre	19%	.000**	17%	.000**
	Post	40%		31%	
7. Loop	Pre	53%	.000**	46%	.000**
	Post	83%		82%	
8. Tracing	Pre	31%	.000**	37%	.000**
	Post	68%		61%	
9. Conditional	Pre	39%	.000**	51%	.020*
	Post	69%		59%	
10. Tracing	Pre	16%	.000**	22%	.000**
	Post	42%		46%	
Overall Average	**Pre**	**36%**	**.000****	**38%**	**.000****
	Post	**63%**		**59%**	

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

Alice

Table 12. Alice CKA- By Gender

Alice CKA – By Gender					
		Female (n=22)		Male (n=56)	
		Percent Correct	t-test	Percent Correct	t-test
1. Objects	Pre	19%	1.000	23%	.290
	Post	19%		30%	
2. Executing a method	Pre	14%	.000**	13%	.000**
	Post	59%		58%	
3. Changing a field	Pre	0%	.000**	13%	.780
	Post	35%		15%	
4. Objects	Pre	48%	.000**	40%	.000**
	Post	95%		80%	
5. Creating an object	Pre	64%	.096†	53%	.000**
	Post	86%		85%	
6. Objects/Method	Pre	23%	.020*	52%	.000**
	Post	59%		74%	
7. Tracing	Pre	45%	.000**	61%	.000**
	Post	86%		82%	
8. Conditional Execution/Tracing	Pre	22%	.020*	29%	.000**
	Post	67%		55%	
9. Loop/Tracing	Pre	9%	.104	22%	.070†
	Post	27%		35%	
10. Loop/Tracing	Pre	18%	.000**	27%	.290
	Post	55%		35%	
Overall average	**Pre**	**27%**	**.000****	**33%**	**.000****
	Post	**59%**		**55%**	

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

App Inventor

Table 13. App Inventor CKA- By Gender

App Inventor CKA – By Gender					
		Female (n=17)		**Male (n=37)**	
		Percent Correct	**t-test**	**Percent Correct**	**t-test**
1. Control	Pre Post	18% 53%	.009**	40% 66%	.027*
2. Handling an event	Pre Post	6% 19%	.164	6% 28%	.003**
3. Creating a list	Pre Post	56% 69%	.497	58% 75%	.136
4. Modifying a Variable	Pre Post	40% 60%	.271	33% 56%	.058†
5. Conditional execution	Pre Post	6% 41%	.029*	14% 43%	.003**
6. Defining a procedure	Pre Post	12% 29%	.269	17% 36%	.033*
7. Tracing	Pre Post	29% 76%	.016*	50% 81%	.003**
8. Conditional execution/Tracing	Pre Post	0% 41%	.004**	19% 39%	.017*
9. Tracing	Pre Post	12% 12%	1.000	6% 8%	.571
10. Tracing	Pre Post	18% 24%	.668	15% 38%	.019*
Overall average	**Pre** **Post**	**19%** **41%**	**.001****	**26%** **48%**	**.000****

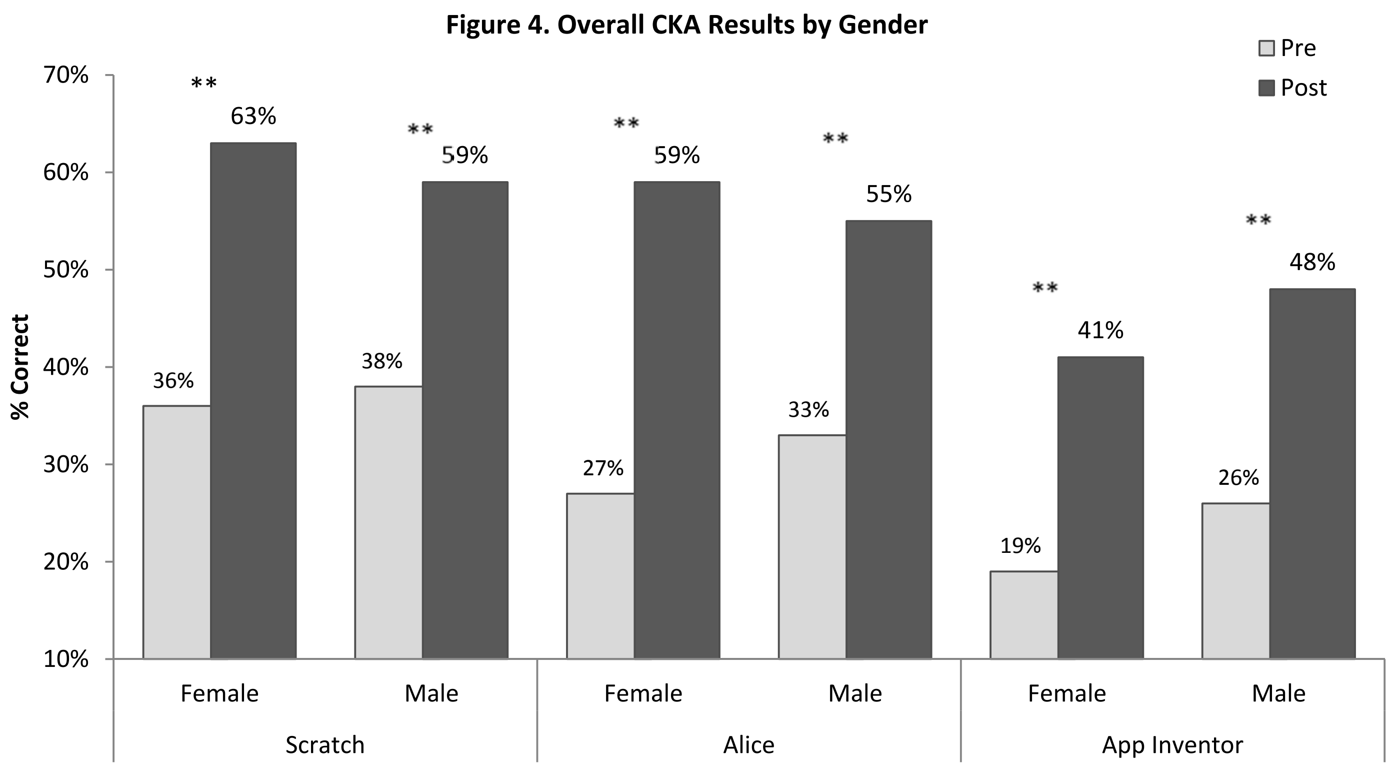
Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

Growth Analysis

Table 14. CKA- Growth Analysis, By Gender

Growth Analysis by Gender			
	Gender	**Mean Growth from Pre to Post**	**Significant difference in growth between genders**
Scratch overall average	Female	+26%	.058† Female students show significantly more growth from pre to post in their knowledge of Scratch concepts than male students.
	Male	+20%	
Alice overall average	Female	+32%	.071† Female students show significantly more growth from pre to post in their knowledge of Alice concepts than male students.
	Male	+22%	
App Inventor overall average	Female	+22%	.873
	Male	+21%	

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

C. By Race/Ethnicity

Scratch

Table 15. Scratch CKA- By Race/Ethnicity

Scratch CKA – By Race/Ethnicity					
		Majority (White, Asian) **(n= 197)**		**Minority** (Multicultural, Hispanic, Black, Native Am.) **(n=116)**	
		Percent Correct	**t-test**	**Percent Correct**	**t-test**
1. Motion	Pre	86%	.010*	75%	.004**
	Post	93%		91%	
2. Loop	Pre	57%	.000**	36%	.000**
	Post	77%		64%	
3. Handling an Event	Pre	16%	.010*	17%	.006**
	Post	26%		31%	
4. Modifying a Variable	Pre	44%	.000**	23%	.000**
	Post	73%		64%	
5. Sending a message	Pre	33%	.000**	18%	.000**
	Post	49%		48%	
6. Conditional execution	Pre	19%	.000**	17%	.023*
	Post	37%		28%	
7. Loop	Pre	52%	.000**	41%	.000**
	Post	86%		78%	
8. Tracing	Pre	44%	.000**	20%	.000**
	Post	71%		52%	
9. Conditional	Pre	57%	.011*	35%	.000**
	Post	66%		56%	
10. Tracing	Pre	25%	.000**	13%	.000**
	Post	46%		46%	
Overall Average	**Pre**	**44%**	**.000****	**29%**	**.000****
	Post	**62%**		**56%**	

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

Alice

Table 16. Alice CKA- By Race/Ethnicity

Alice CKA – By Race/Ethnicity						
		Majority (White, Asian) (n= 47)		**Minority (Multicultural, Hispanic, Black, Native Am.) (n=31)**		
		Percent Correct	**t-test**	**Percent Correct**	**t-test**	
1. Objects	Pre	21%	.200	23%	.712	
	Post	32%		20%		
2. Executing a method	Pre	17%	.000**	7%	.000**	
	Post	64%		50%		
3. Changing a field	Pre	7%	.096†	14%	.375	
	Post	17%		24%		
4. Objects	Pre	44%	.000**	39%	.000**	
	Post	84%		84%		
5. Creating an object	Pre	70%	.044*	35%	.000**	
	Post	87%		84%		
6. Objects/Method	Pre	51%	.018*	31%	.001**	
	Post	70%		69%		
7. Tracing	Pre	72%	.033*	32%	.000**	
	Post	87%		77%		
8. Conditional Execution/Tracing	Pre	36%	.002**	11%	.005**	
	Post	64%		48%		
9. Loop/Tracing	Pre	22%	.051†	13%	.161	
	Post	37%		26%		
10. Loop/Tracing	Pre	33%	.083†	10%	.056†	
	Post	47%		31%		
Overall average	**Pre**	**37%**	**.000****	**22%**	**.000****	
	Post	**59%**		**52%**		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

App Inventor

Table 17. App Inventor CKA- By Race/Ethnicity

App Inventor CKA- By Race/Ethnicity					
		Majority (White, Asian) (n= 27)		Minority (Multicultural, Hispanic, Black, Native Am.) (n=27)	
		Percent Correct	t-test	Percent Correct	t-test
1. Control	Pre Post	38% 65%	.070†	27% 58%	.003**
2. Handling an event	Pre Post	4% 31%	.006**	8% 19%	.083†
3. Creating a list	Pre Post	58% 73%	.256	58% 73%	.256
4. Modifying a Variable	Pre Post	31% 62%	.043*	40% 52%	.327
5. Conditional execution	Pre Post	4% 36%	.008**	19% 48%	.009**
6. Defining a procedure	Pre Post	12% 27%	.161	19% 41%	.056†
7. Tracing	Pre Post	44% 78%	.004**	42% 81%	.009**
8. Conditional execution/Tracing	Pre Post	19% 48%	.003**	8% 31%	.031*
9. Tracing	Pre Post	7% 11%	.574	8% 8%	1.000
10. Tracing	Pre Post	15% 38%	.056†	16% 28%	.265
Overall average	**Pre** **Post**	**23%** **47%**	**.000****	**25%** **44%**	**.000****

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

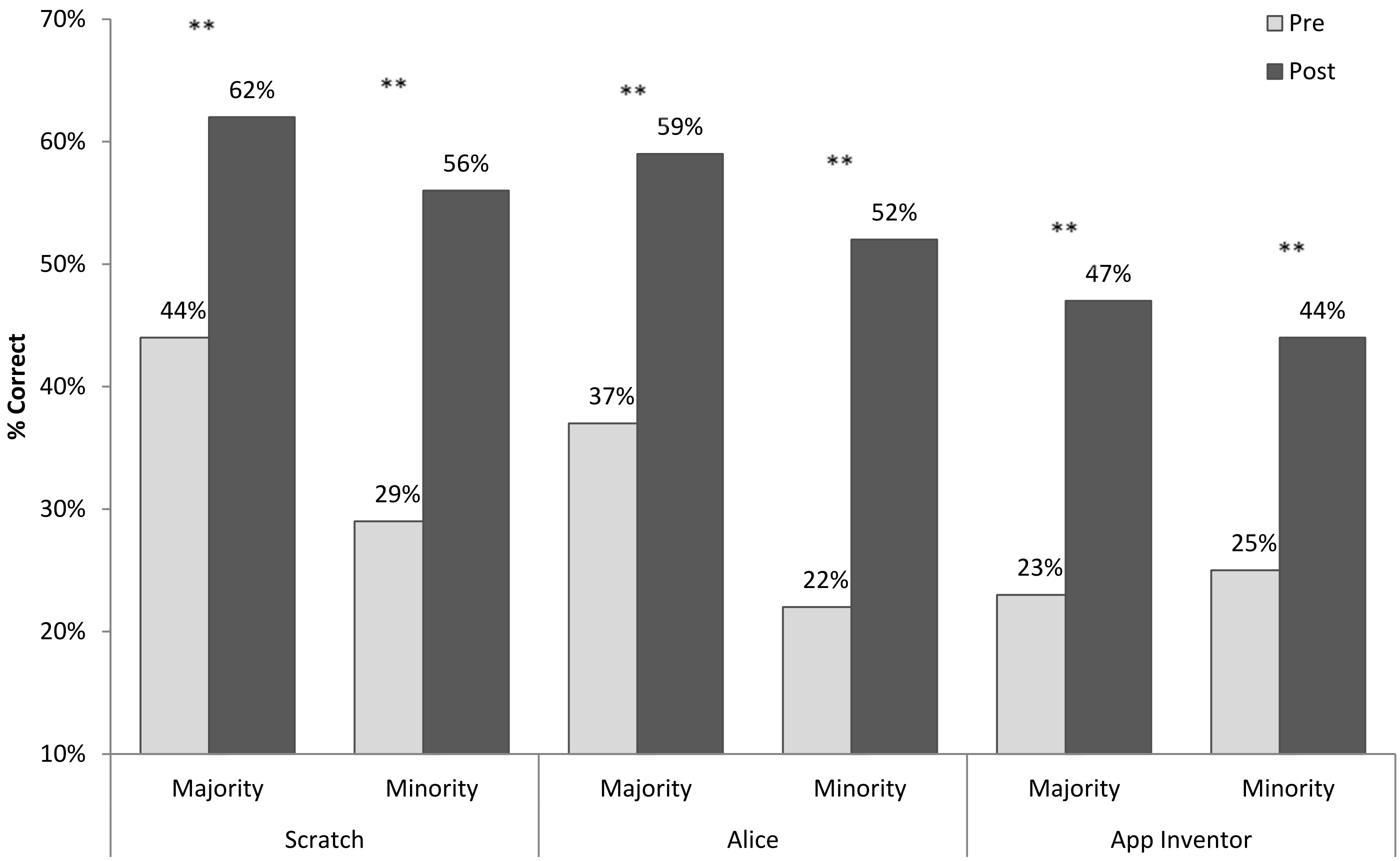
Growth Analysis

Table 18. CKA- Growth Analysis, By Race/Ethnicity

Growth Analysis by Race/Ethnicity			
		Mean Growth from Pre to Post	**Significant difference in Growth between majority and minority students**
Scratch overall average	Majority	+18%	.002** Minority students show significantly more growth from pre to post in their knowledge of Scratch concepts than majority students.
	Minority	+27%	
Alice overall average	Majority	+22%	.158
	Minority	+29%	
App Inventor overall average	Majority	+25%	.334
	Minority	+19%	

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10

Figure 5. Overall CKA Results by Race/Ethnicity



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

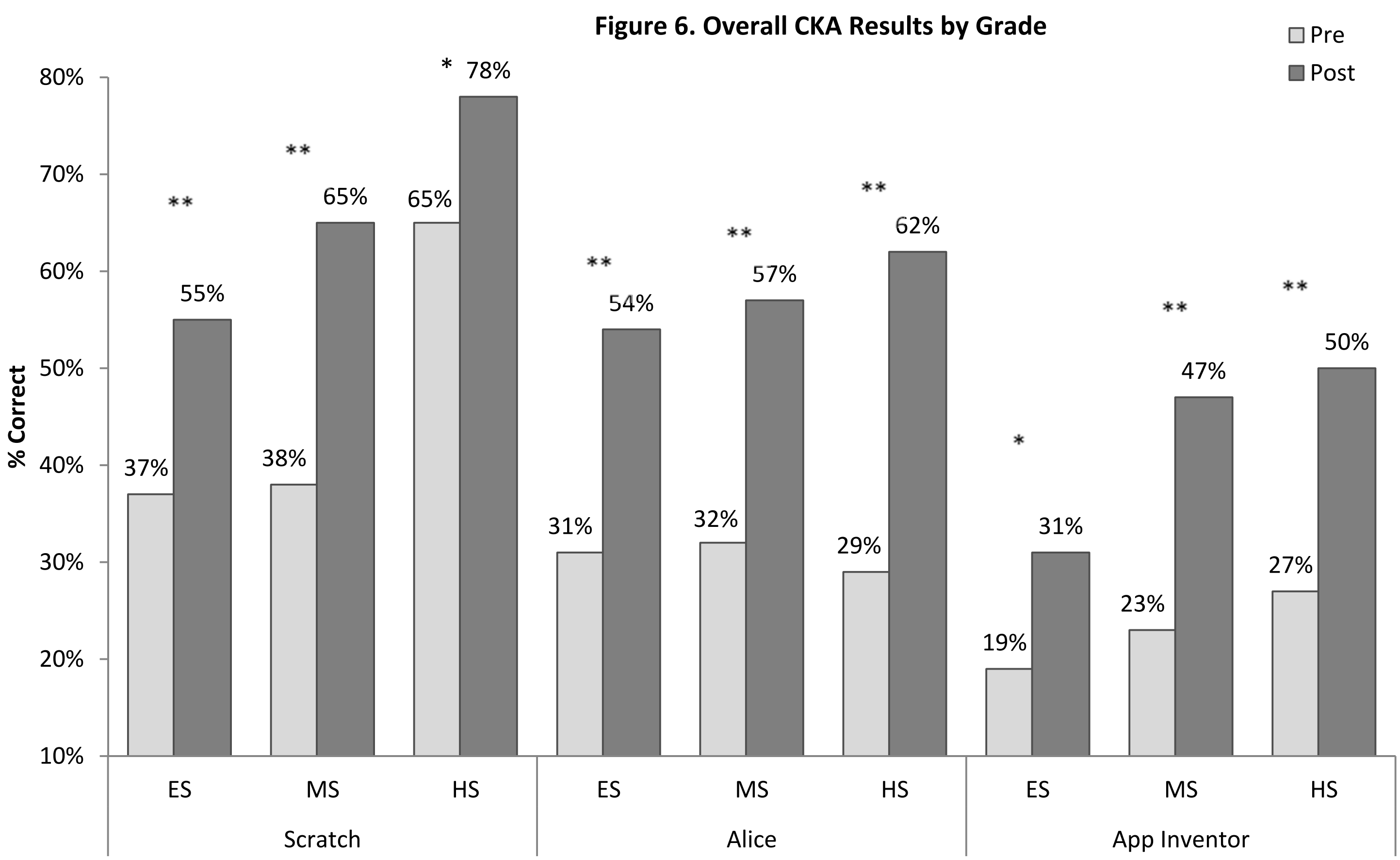
D. By Grade

Overall: Scratch, Alice, & App Inventor

Table 19. CKA- Overall, By Grade

Overall CKA Analysis- By Grade														
		Elementary School				Middle School				High School				
		n	% Correct	Std. Deviation	t-test	n	% Correct	Std. Deviation	t-test	n	% Correct	Std. Deviation	test
Scratch-Overall	Pre	198	37%	25%	.000**	102	38%	26%	.000**	14	65%	28%	.023*
	Post	198	56%	23%		102	65%	22%		14	78%	18%	
Alice-Overall	Pre	38	31%	21%	.000**	31	32%	21%	.000**	9	29%	20%	.004**
	Post	38	54%	18%		31	57%	18%		9	62%	19%	
App Inventor-Overall	Pre	7	19%	14%	.015*	29	23%	18%	.000**	18	27%	24%	.000**
	Post	7	31%	11%		29	47%	19%		18	50%	23%	

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.



Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10; Scale was truncated to enhance visual clarity.

Growth Analysis

Table 20. CKA- Growth Analysis, By Grade

Growth Analysis by Grade				
	Mean Growth from Pre to Post			**Significant difference in growth between grade**
	Elementary School (ES)	**Middle School (MS)**	**High School (HS)**	
Scratch overall average	+19%	+27%	+13%	.007** Middle school students show significantly more growth from pre to post in their knowledge of Scratch concepts than elementary school students.
Alice overall average	+23%	+25%	+34%	0.44
App Inventor overall average	+12%	+24%	+22%	0.45

Note. Growth= Pre minus Post; *p<.05; **p<.01; approaching significance at † p<.10

III. Student Attitudes- Item Analysis

A. Overall

Table 21. Student Attitudes- Item Analysis, Overall

Construct	Item		n	Mean[1]	Std. Deviation	t-test	Effect Size
Confidence	1. I can get good grades in computing.	Pre	809	4.03	.85	.000**	.37
		Post	809	4.19	.83		
	2. I'm not the type to do well in computing classes. (n)	Pre	795	1.97	.98	.039*	.15
		Post	795	1.89	.99		
Enjoyment	3. Computers are fun.	Pre	797	4.58	.71	.044*	.14
		Post	797	4.52	.78		
	4. Programming is hard. (n)	Pre	798	2.88	.98	.000**	.39
		Post	798	2.69	1.06		
Importance & Usefulness	5. I will be able to get a good job if I learn how to use a computer.	Pre	794	4.17	.86	.217	.09
		Post	794	4.21	.88		
	6. I will use computing in many ways throughout my life.	Pre	787	4.16	.87	.171	.10
		Post	787	4.20	.92		
Motivation to Succeed	7. When a computing problem arises that I can't immediately solve, I stick with it until I have the solution.	Pre	802	3.59	1.02	.073†	.13
		Post	802	3.65	1.02		
	8. Computing is boring. (n)	Pre	798	1.59	.84	.413	.06
		Post	798	1.62	.86		
Identity & Belonging	9. I feel like I "belong" in computer science.	Pre	794	3.50	1.05	.000**	.32
		Post	794	3.65	1.08		
Gender Equity	10. Girls can do just as well as boys in computing.	Pre	800	4.24	1.01	.062†	.13
		Post	800	4.30	1.01		
	11. There are many females who are excellent computer scientists.	Pre	795	4.21	.90	.000**	.26
		Post	795	4.31	.89		
Intention to Persist	12. I can see myself working in a computing field.	Pre	791	3.51	1.06	.002**	.22
		Post	791	3.61	1.09		
	13. I intend to take courses related to computing in the future.	Pre	807	3.67	.99	.000**	.36
		Post	807	3.83	.98		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

Continued, Table 21. Student Attitudes- Item Analysis, Overall

Construct	Item		n	Mean[1]	Std. Deviation	t-test	Effect Size
Creativity	14. I am able to be expressive and creative while doing computing.	Pre	802	4.10	.88	.002**	.22
		Post	802	4.19	.84		
	15. I enjoy solving problems in computing.	Pre	795	3.70	1.00	.014*	.18
		Post	795	3.78	1.01		
	16. Using computing to help people is very important to me	Pre	788	3.73	.95	.000**	.29
		Post	788	3.86	.96		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

B. Gender

Table 22. Student Attitudes- Item Analysis, By Gender

Construct	Item		Female n	Female Mean[1]	Female Std. Dev.	Female t-test	Female Effect Size	Male n	Male Mean[1]	Male Std. Dev.	Male t-test	Male Effect Size
Confidence	1. I can get good grades in computing.	Pre	203	4.00	.83	.023*	.32	590	4.05	.83	.000**	.36
		Post	203	4.16	.91			590	4.20	.79		
	2. I'm not the type to do well in computing classes. (n)	Pre	199	2.03	1.01	.648	.07	580	1.95	.97	.048*	.16
		Post	199	1.99	1.03			580	1.87	.98		
Enjoyment	3. Computers are fun.	Pre	200	4.49	.76	.389	.12	581	4.61	.67	.065†	.15
		Post	200	4.44	.85			581	4.55	.73		
	4. Programming is hard. (n)	Pre	202	2.81	.94	.052†	.28	580	2.91	.99	.000*	.42
		Post	202	2.66	1.01			580	2.71	1.08		
Importance & Usefulness	5. I will be able to get a good job if I learn how to use a computer.	Pre	198	4.17	.83	.826	.03	580	4.17	.86	.074†	.15
		Post	198	4.15	.91			580	4.23	.85		
	6. I will use computing in many ways throughout my life.	Pre	196	4.07	.91	.178	.19	575	4.19	.83	.328	.08
		Post	196	4.16	.97			575	4.23	.88		
Motivation to Succeed	7. When a computing problem arises that I can't immediately solve, I stick with it until I have the solution.	Pre	200	3.40	1.03	.053†	.28	586	3.64	1.01	.222	.10
		Post	200	3.55	1.01			586	3.69	1.02		
	8. Computing is boring. (n)	Pre	198	1.77	.94	.506	.09	584	1.54	.80	.168	.11
		Post	198	1.73	.91			584	1.59	.84		
Identity & Belonging	9. I feel like I "belong" in computer science.	Pre	197	3.24	1.07	.006**	.40	581	3.59	1.02	.001**	.29
		Post	197	3.43	1.09			581	3.72	1.05		
Gender Equity	10. Girls can do just as well as boys in computing.	Pre	200	4.66	.73	1.000	.00	584	4.09	1.06	.045*	.17
		Post	200	4.66	.75			584	4.17	1.05		
	11. There are many females who are excellent computer scientists.	Pre	195	4.39	.84	.170	.20	585	4.15	.91	.000**	.29
		Post	195	4.47	.85			585	4.26	.90		
Intention to Persist	12. I can see myself working in a computing field.	Pre	196	3.23	1.02	.014*	.36	579	3.60	1.05	.032*	.18
		Post	196	3.40	1.07			579	3.69	1.07		
	13. I intend to take courses related to computing in the future.	Pre	199	3.42	.99	.000**	.57	593	3.75	.97	.001**	.28
		Post	199	3.71	.99			593	3.87	.96		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

Continued, Table 22. Student Attitudes- Item Analysis, By Gender

			Female					Male				
Construct	**Item**		**n**	**Mean[1]**	**Std. Dev.**	**t-test**	**Effect Size**	**n**	**Mean[1]**	**Std. Dev.**	**t-test**	**Effect Size**
Creativity	14. I am able to be expressive and creative while doing computing.	Pre	199	4.04	.97	.008**	.38	588	4.12	.84	.057†	.16
		Post	199	4.20	.82			588	4.19	.84		
	15. I enjoy solving problems in computing.	Pre	196	3.48	1.00	.042*	.29	583	3.77	.99	.085†	.14
		Post	196	3.62	1.02			583	3.84	.99		
	16. Using computing to help people is very important to me	Pre	193	3.53	.95	.002**	.45	581	3.79	.93	.001**	.27
		Post	193	3.73	.97			581	3.91	.94		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

C. Race/Ethnicity

Table 23. Student Attitudes- Item Analysis, By Race/Ethnicity

			Majority (White, Asian)					Minority (Multicultural, Hispanic, Black, Native Am.)				
Construct	Item		n	Mean[1]	Std. Dev.	t-test	Effect Size	n	Mean[1]	Std. Dev.	t-test	Effect Size
Confidence	1. I can get good grades in computing.	Pre	445	4.08	.78	.001**	.32	351	3.99	.88	.000**	.42
		Post	445	4.20	.76			351	4.19	.89		
	2. I'm not the type to do well in computing classes. (n)	Pre	442	1.93	.94	.005**	.27	340	2.02	1.04	.961	.01
		Post	442	1.79	.93			340	2.01	1.06		
Enjoyment	3. Computers are fun.	Pre	438	4.61	.68	.626	.05	346	4.54	.72	.012*	.27
		Post	438	4.60	.66			346	4.43	.89		
	4. Programming is hard. (n)	Pre	440	2.84	.94	.001**	.31	345	2.95	1.02	.000**	.50
		Post	440	2.70	1.03			345	2.68	1.10		
Importance & Usefulness	5. I will be able to get a good job if I learn how to use a computer.	Pre	439	4.13	.82	.005**	.27	342	4.24	.88	.416	.09
		Post	439	4.24	.79			342	4.20	.95		
	6. I will use computing in many ways throughout my life.	Pre	433	4.24	.80	.649	.04	341	4.07	.91	.109	.17
		Post	433	4.26	.85			341	4.15	.97		
Motivation to Succeed	7. When a computing problem arises that I can't immediately solve, I stick with it until I have the solution.	Pre	442	3.63	.96	.192	.12	347	3.53	1.08	.178	.15
		Post	442	3.69	.98			347	3.61	1.07		
	8. Computing is boring. (n)	Pre	443	1.51	.75	.363	.09	342	1.71	.94	.909	.01
		Post	443	1.54	.79			342	1.71	.93		
Identity & Belonging	9. I feel like I "belong" in computer science.	Pre	442	3.61	1.02	.000**	.34	339	3.39	1.05	.010*	.28
		Post	442	3.76	1.00			339	3.53	1.14		
Gender Equity	10. Girls can do just as well as boys in computing.	Pre	441	4.24	.99	.178	.13	346	4.23	1.03	.164	.15
		Post	441	4.29	.98			346	4.31	1.02		
	11. There are many females who are excellent computer scientists.	Pre	442	4.26	.88	.001**	.33	341	4.15	.91	.061†	.20
		Post	442	4.38	.81			341	4.24	.97		
Intention to Persist	12. I can see myself working in a computing field.	Pre	440	3.58	1.03	.065†	.18	339	3.44	1.08	.011*	.28
		Post	440	3.65	1.04			339	3.59	1.12		
	13. I intend to take courses related to computing in the future.	Pre	448	3.76	.90	.015*	.23	347	3.55	1.07	.000**	.50
		Post	448	3.86	.91			347	3.81	1.04		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

Continued, Table 23. Student Attitudes- Item Analysis, By Race/Ethnicity

			Majority (White, Asian)					Minority (Multicultural, Hispanic, Black, Native Am.)				
Construct	Item		n	Mean[1]	Std. Dev.	t-test	Effect Size	n	Mean[1]	Std. Dev.	t-test	Effect Size
Creativity	14. I am able to be expressive and creative while doing computing.	Pre	446	4.17	.81	.197	.12	344	4.02	.94	.004**	.32
		Post	446	4.22	.78			344	4.17	.89		
	15. I enjoy solving problems in computing.	Pre	440	3.79	.96	.233	.11	343	3.59	1.02	.040*	.22
		Post	440	3.84	.96			343	3.70	1.05		
	16. Using computing to help people is very important to me.	Pre	439	3.79	.89	.002**	.30	336	3.66	.99	.002**	.35
		Post	439	3.92	.89			336	3.82	.99		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+ (n)=negatively worded statements.

IV. Additional Research Questions

A. Which event(s) produces statically significant increases in students' computing attitudes?

Table 24. Student Attitudes- Event Analysis

Constructs		Animation/ Storytelling	Apps	Blender	GameMaker	General: CS[8]	Robotics & Animation/ Storytelling	Multimedia	Robotics	Robotics & apps
	n	*166*	*49*	*7*	*83*	*47*	*274*	*13*	*155*	*15*
Confidence	Pre	3.97**	4.13	3.86	4.12	3.96	4.07**	4.58	3.93	4.27†
	Post	4.20**	4.18	3.86	4.16	4.07	4.20**	4.38	4.02	4.67†
Enjoyment	Pre	3.87	3.76	3.36	3.83†	3.78	3.88**	4.08	3.76**	3.97
	Post	3.95	3.80	3.57	3.72†	3.85	4.01**	4.08	3.87**	3.97
Importance and Perceived Usefulness of Computing	Pre	4.06	4.29	4.21	4.29	3.94**	4.18	4.63	4.08	4.33**
	Post	4.08	4.32	4.36	4.27	4.28**	4.23	4.54	4.12	4.60**
Motivation to Succeed in Computing	Pre	3.95*	3.98	4.00	4.12	3.66	4.04	4.35	3.95	4.14
	Post	4.08*	4.01	4.00	4.00	3.82	4.09	4.38	3.92	4.36
Computing Identity Belongingness	Pre	3.52	3.25**	3.57	3.70	3.36*	3.51**	3.92	3.38*	3.93
	Post	3.61	3.65**	3.43	3.71	3.70*	3.66**	3.92	3.57*	4.07
Gender Equity	Pre	4.22	4.33*	4.07	4.37	3.91†	4.27	4.54	4.08**	4.33*
	Post	4.25	4.56*	4.00	4.38	4.19†	4.32	4.58	4.23**	4.63*
Intent to persist	Pre	3.57	3.76	3.50	3.80	3.16**	3.61**	4.08	3.45*	3.87†
	Post	3.61	3.83	3.71	3.88	3.81**	3.75**	4.08	3.56*	4.07†
Creativity	Pre	3.85†	3.80*	3.52	3.94	3.64**	3.87*	4.28	3.78	4.04*
	Post	3.93†	3.99*	3.71	3.89	4.10**	3.96*	4.38	3.82	4.33*
# of Constructs with significance/ approaching significance		3/8	3/8	0/8	0/8	5/8	5/8	0/8	4/8	5/8

Note. Scale=1, strongly disagree to 5, strongly agree. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

Overall, Robotics, Animation/Storytelling (Scratch/Alice), and General Computer Science camps were most effective in increasing students' attitudes towards computing.

[8] General CS camps were conducted at the Boys & Girls Club and Tri-Cities High School. General CS camps introduced students to general computing concepts, basic programming skills, and internet essentials.

B. How do Seeded Summer Camps perform in relation to Georgia Tech (ICE) camps in terms of enhancing students' computing attitudes?

Table 25. Student Attitudes- Event Analysis

Constructs		Georgia Tech-ICE	Seeded Summer Camps											
			Boys & Girls Club	Brookwood High School	Columbus State University	Georgia Gwinnett College	Georgia Tech-Savannah	Lanier High School	Mercer University	North Gwinnett High School	Southwest Atlanta Christian Academy	Spelman College	Tri-Cities	Valdosta State University
	n	*163*	*37*	*39*	*176*	*60*	*115*	*25*	*84*	*15*	*13*	*34*	*41*	*15*
Confidence	Pre	4.08**	4.04	3.89*	3.92	4.14	4.09	4.20	4.22	3.30	3.81	4.06	3.96	4.27†
	Post	4.30**	4.17	4.23*	3.99	4.22	4.16	4.24	4.31	3.47	3.77	4.17	4.01	4.67†
Enjoyment	Pre	3.93*	3.89	3.76†	3.72	3.68*	3.94*	3.94*	4.01	3.57	3.73	3.63	3.80	3.97
	Post	4.05*	3.79	3.92†	3.79	3.89*	4.05*	3.68*	4.10	3.43	3.96	3.59	3.93	3.97
Importance and Perceived Usefulness of Computing	Pre	4.19	3.88	4.10	4.08	4.18	4.18	4.24	4.36	3.67	4.25	4.29	3.99†	4.33**
	Post	4.26	4.11	4.22	4.03	4.18	4.25	4.34	4.44	3.47	4.11	4.28	4.22†	4.60**
Motivation to Succeed in Computing	Pre	4.09†	3.85	4.01	3.93	3.86	4.10	4.04	4.19	3.37	3.69	4.00	3.74	4.14
	Post	4.20†	4.06	4.10	3.86	3.97	4.10	3.96	4.23	3.57	3.58	3.97	3.80	4.36
Computing Identity Belongingness	Pre	3.55*	3.36	3.70†	3.48	3.39	3.48*	3.80	3.69†	2.60	3.79	3.03†	3.35**	3.93
	Post	3.73*	3.48	3.92†	3.49	3.41	3.67*	3.88	3.88†	3.07	3.86	3.30†	3.85**	4.07
Gender Equity	Pre	4.38	4.21†	4.44	4.01*	4.38	4.13**	4.34	4.32	3.70	4.39	4.44	3.94*	4.33*
	Post	4.40	4.47†	4.54	4.17*	4.33	4.28**	4.42	4.25	3.50	4.32	4.50	4.29*	4.63*
Intent to persist	Pre	3.67	3.07*	3.71	3.45	3.50	3.64*	3.72**	3.86	3.33	3.68	3.49	3.53*	3.87†
	Post	3.76	3.58*	3.77	3.51	3.61	3.79*	4.06**	3.96	3.20	3.57	3.66	3.95*	4.07†
Creativity	Pre	3.94**	3.66*	3.76*	3.78	3.69	3.88	3.89	4.01	3.53	3.96	3.75	3.76†	4.04*
	Post	4.07**	3.99*	3.98*	3.79	3.79	3.94	3.86	4.10	3.56	3.79	3.84	4.05†	4.33*
# of Constructs with significance/ approaching significance		5/8	3/8	4/8	1/8	1/8	4/8	2/8	1/8	0/8	0/8	1/8	5/8	5/8

Note. Scale=1, strongly disagree to 5, strongly agree. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance.

The results suggest that the following seeded summer camps performed on par with Georgia Tech (ICE) camps: Tri-Cities High School and Valdosta State University. Brookwood High School and Georgia Tech-Savannah closely approached the performance of Georgia Tech (ICE) camps. However, Columbus State University, Georgia Gwinnett College, Mercer University, North Gwinnett High School, Southwest Atlanta Christian Academy, and Spelman College may need additional assistance in ensuring that their students maximize their psychosocial growth in computing; the aforementioned seeded summer camps may be underperforming in relation to their counterparts.

C. Who perceives more computing encouragement at baseline: Females or Males? Minority students or majority students?

Table 26. Differences in perceived encouragement

Encouragement: My family encourages me to use computers (Pre only)						
		n	Mean[1]	Std. Deviation	t-test	Effect Size
Gender	Female	244	3.48	1.21	.005**	0.19
	Male	703	3.23	1.14		
Race/Ethnicity	Majority (White, Asian)	545	3.27	1.14	.274	n/a
	Minority (Multicultural, Hispanic, Black, Native American)	406	3.36	1.19		

Note. Paired samples t-tests assess significant changes from pre to post; *p<.05; **p<.01; approaching significance at † p<.10. Only students with matched pre and post scores were analyzed for significance. [1]Reference lines at 3.5 and 4. Effect size= Small: 0.0 to 0.2; Medium: 0.21 to 0.5; Large: 0.51 to 2.00+

Contrary to our initial hypothesis, female students perceive significantly (p<.01) more encouragement by their families to use computers than male students. This gender difference may suggest that female students who choose to participate in summer computing camps may need more encouragement and support than their male counterparts because they are engaging in an activity in which a) they are the minority gender and b) negative gender stereotypes towards females abound[9]. Research suggests that parent and faculty support may reduce stereotype threat— the stress or anxiety of being perceived as conforming the stereotype that females are not good in computing[10]. Likewise, a 2003 study indicates that early childhood encouragement in STEM is a key factor in pursuing a STEM related career[11]. In this way, relationships with STEM mentors as well as parental support may be a first step toward increasing girls' confidence by preventing beliefs in stereotypes. No differences were found between minority and majority race/ethnicity students.

[9] Nosek, B.A., Banaji, M.R., & Greenwald, A.G. (2002b). Math=male, me-female, therefore math = me. *Journal of Personality and Social Psychology, 83,* 44-59.

[10] Creswell, J.D., Welch, W.T., Taylor, S.E., Sherman, D.K., Gruenewald, T.L., & Mann, T. (2005). Affirmation of personal values buffers neuroendocrine and psychological stress responses. *Psychological Science, 16*, 846-851.

[11] Packard, B.W., & Nguyen, D. (2003). Science career-related possible selves of adolescent girls: A longitudinal study. *Journal of Career Development, 29,* 251-263.

D. What psychosocial constructs impact students' intentions to persist in computing? Are these predictive constructs different across genders?

Table 27. Regression Analysis, Overall

Regression Analysis: Outcome Variable= Intention to Persist (Post)						
		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
(Constant)		-.299	.178		-1.681	.093†
Predictors (Post)	Confidence	.058	.038	.046	1.544	.123
	Enjoyment	-.056	.038	-.041	-1.485	.138
	Importance and Perceived Usefulness of Computing	.241	.038	.200	6.352	.000**
	Motivation to Succeed in Computing	.060	.038	.046	1.563	.118
	Computing Identity & Belongingness	.226	.028	.256	8.134	.000**
	Gender Equity	-.016	.033	-.015	-.500	.617
	Creativity	.365	.043	.297	8.578	.000**
Covariate	Encouragement (Pre)	.007	.019	.008	.349	.727
Controls (Pre)	Confidence	-.012	.035	-.010	-.352	.725
	Enjoyment	-.001	.040	-.001	-.035	.972
	Importance and Perceived Usefulness of Computing	.022	.039	.016	.572	.568
	Motivation to Succeed in Computing	-.047	.037	-.035	-1.281	.200
	Computing Identity & Belongingness	-.018	.027	-.020	-.655	.513
	Gender Equity	.030	.031	.028	.973	.331
	Intent to persist	*.350*	*.032*	*.347*	*10.914*	*.000***
	Creativity	*-.167*	*.043*	*-.130*	*-3.904*	*.000***

* p<.01, **p<.05, †p<.10 (approaching significance). Note: **R^2 = .685**, p< .01**

Regression Analysis Explanation:

An R^2 of .685 indicates that 68.5% of the variation in how students responded to the "intent to persist" construct at post test is accounted for by the predictor variables. R^2 denotes the overall "fit" of the regression model (Field, 2009).

The table above indicates that, controlling for baseline measures, **three psychosocial constructs predict a student's intent to persist: Importance and Perceived usefulness of computing, Computing identity & Belongingness, and Creativity**. See Figure 7. Computing identity and Belongingness and Creativity are the two strongest constructs in predicting intent to persist.

Glossary:

- **R^2**: the R^2 indicates how much variability in the outcome variable, in this case "Intent to persist", is accounted for by the predictor variables (Field, 2009).
- **Unstandardized B:** the unstandardized B indicates the individual contribution of each predictor to the model. Multiple regression analysis often takes the form of an equation. The unstandardized B values tell us about the relationship between intent to pursue and each predictor. If the value is positive, we can tell that there is a positive relationship between the predictor and the outcome, whereas a negative coefficient represents a negative relationship.
- **Standard Error of B**: Each of the B values has an associated standard error, indicating to what extent these values would vary across different samples, and these standard errors are used to determine whether or not the B value is significantly different from zero.
- **Standardized β**: The standardized β-value indicates the number of standard deviations that the outcome will change as a result of one standard deviation change in the predictor. The standardized β-values also provide information regarding the "importance" of a predictor in the model.

Table 28. Regression Analysis, By Gender

Regression Analysis by Gender: Outcome Variable= Intention to Persist (Post)									
		Females R^2 = .635**, p< .01				**Males** R^2 = .713**, p< .01			
		Unstandardized Coefficients		**Standardized Coefficients**	**Sig.**	**Unstandardized Coefficients**		**Standardized Coefficients**	**Sig.**
		B	**Std. Error**	**Beta**		**B**	**Std. Error**	**Beta**	
(Constant)		-.072	.442		.871	-.438	.194		.025*
Predictors (Post)	Confidence	.195	.077	.164	.012*	.002	.044	.001	.966
	Enjoyment	-.251	.079	-.189	.002**	.015	.043	.011	.722
	Importance and Perceived Usefulness of Computing	.231	.079	.196	.004**	.225	.043	.184	.000**
	Motivation to Succeed in Computing	-.103	.090	-.080	.251	.120	.041	.094	.004**
	Computing Identity & Belongingness	.196	.060	.231	.001**	.239	.031	.268	.000**
	Gender Equity	.242	.085	.168	.005**	-.085	.035	-.082	.014*
	Creativity	.383	.097	.312	.000**	.375	.047	.307	.000**
Covariate	Encouragement (Pre)	-.020	.040	-.026	.623	.025	.022	.030	.268
Controls (Pre)	Confidence	-.043	.075	-.033	.573	-.021	.040	-.016	.609
	Enjoyment	.057	.086	.038	.504	-.051	.045	-.035	.260
	Importance and Perceived Usefulness of Computing	-.017	.080	-.014	.831	.040	.045	.029	.368
	Motivation to Succeed in Computing	-.138	.076	-.113	.071†	-.013	.043	-.010	.758
	Computing Identity & Belongingness	-.001	.059	-.001	.984	-.018	.030	-.019	.564
	Gender Equity	-.045	.086	-.032	.604	.072	.033	.070	.029*
	Intent to persist	.470	.073	.449	.000**	.323	.036	.319	.000**
	Creativity	-.202	.102	-.165	.050*	-.165	.047	-.126	.001**

* p<.01, **p<.05, †p<.10 (approaching significance).

Table 28 and Figures 8 and 9 suggest that Importance and Perceived Usefulness of Computing, Identity and Belongingness, and Creativity are three essential psychosocial constructs that predict intention to persist across both females and males, after controlling for baseline attitudes. However, several differences are notable. First, confidence plays a more important role for females than males in term of increasing their propensity to pursue computing in the future. Likewise, perceptions of gender equity have conflicting implications for females and males. For females, perceiving gender equity in computing significantly *increases* intent to persist; among males, gender equity curiously *decreases* their inclination to pursue computing in the future. That is, perceiving females as being as good as males in computing has a positive effect on females and a negative effect on males. One possible explanation for the negative effect on males may be that they may perceive females' social gains in the domain of computer science as a threat to their performance; more females in the field may signal additional competition.

Figure 7. Overall Regression Analysis

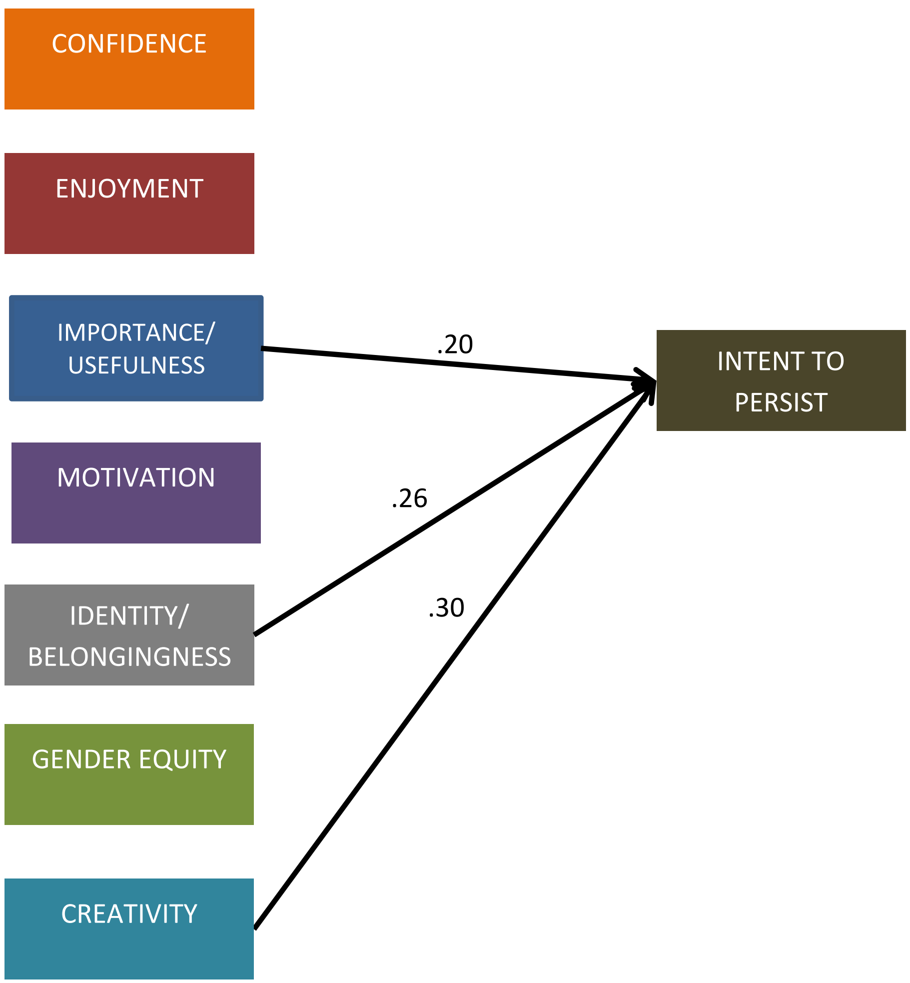


Figure 8. Females- Regression Analysis

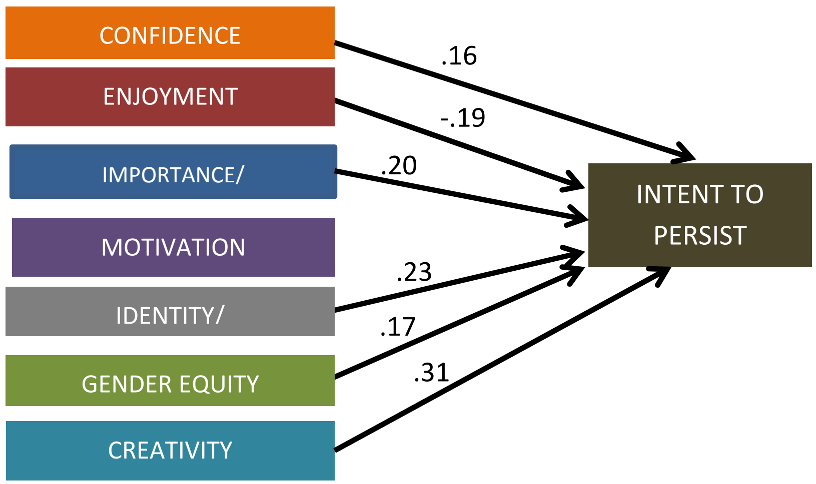
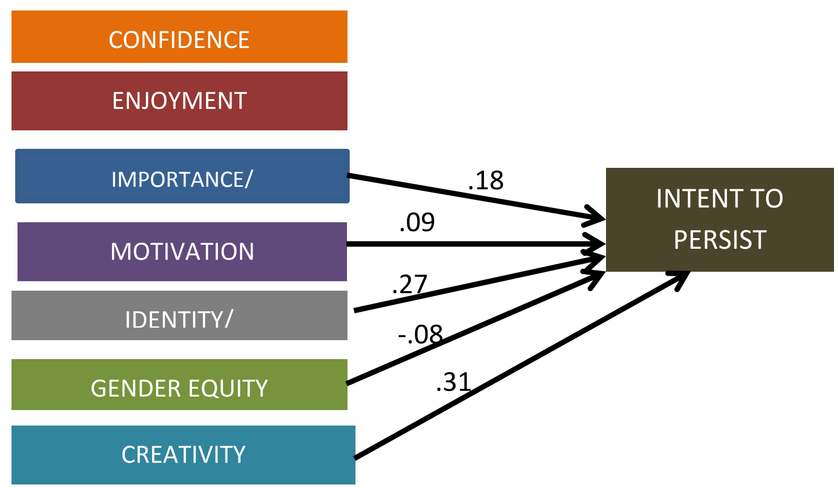


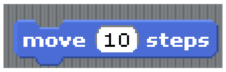
Figure 9. Males- Regression Analysis



Note. Directed paths signify statistically significant relationships between predictor constructs and the outcome variable (Intent to persist). Numbers reflect Standardized Beta coefficients. Omitted paths reflect non-significant relationships.

Appendix A. Content Knowledge Assessment Items- Scratch

Note. Correct answers are underlined.

1) In what category is the  block?

   a. Control
   b. Motion
   c. Sensing
   d. Variables
   e. Looks
   f. I don't know

2) What is the following an example of?

   a. Conditional execution
   b. Handling an event
   c. Sending a message
   d. Loop – repeated execution
   e. Modifying a variable
   f. I don't know

3) What is the following an example of?

   a. Conditional execution
   b. Handling an event
   c. Sending a message
   d. Loop – repeated execution
   e. Modifying a variable
   f. I don't know

4) What is the following an example of?

   a. Conditional execution
   b. Handling an event
   c. Sending a message
   d. Loop – repeated execution
   e. Modifying a variable
   f. I don't know

5) What is the following an example of?

a. Conditional execution
b. Handling an event
c. Sending a message
d. Loop – repeated execution
e. Modifying a variable
f. I don't know

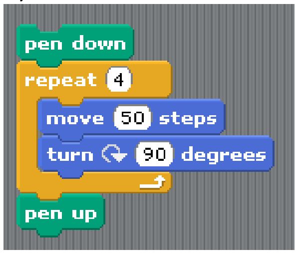
6) What is the following an example of?

a. Conditional execution
b. Handling an event
c. Sending a message
d. Loop – repeated execution
e. Modifying a variable
f. I don't know

7) What does the following code do?

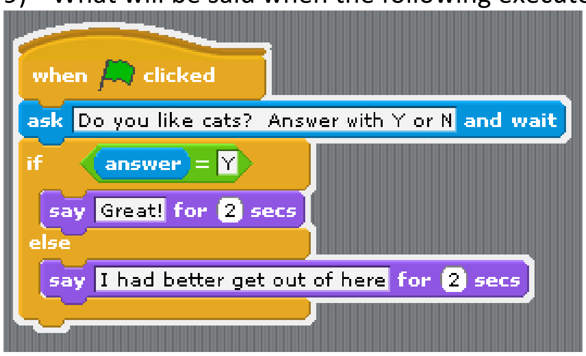
a. Repeat a simple animation
b. Draw a square using the pen
c. Make a ball fall
d. Increment the score
e. Stamp the current costume at the current mouse location
f. I don't know

8) What does the following code do?



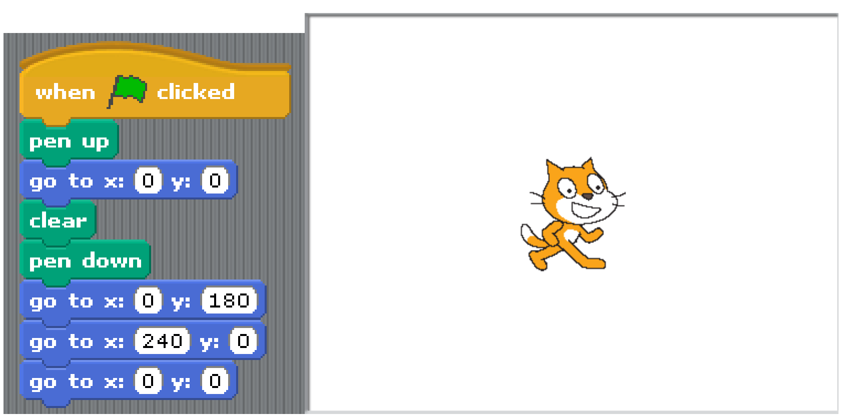
a. Repeat a simple animation
b. Draw a square using the pen
c. Make a ball fall
d. Increment the score
e. Stamp the current costume at the current mouse location
f. I don’t know

9) What will be said when the following executes and the user answers with No?



a. Great!
b. I had better get out of here
c. I don't know
d. It won't say anything
e. You will get an error message
f. I don’t know

10) Draw the result of executing the following script when the cat is in the center of the stage.

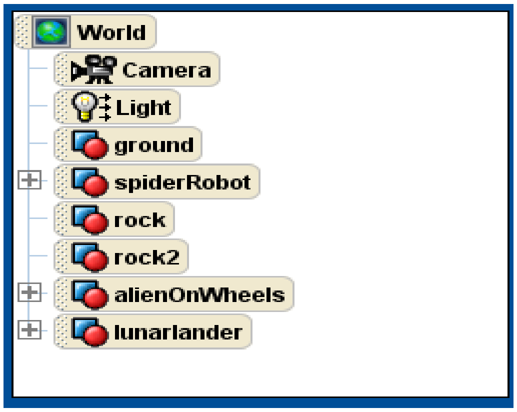


a. Square
b. Circle
c. Rectangle
d. Triangle
e. I don’t know

Appendix B. Content Knowledge Assessment Items- Alice

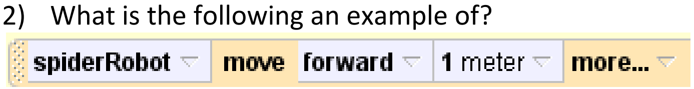
Note. Correct answers are underlined.

1) How many objects are in this object tree?



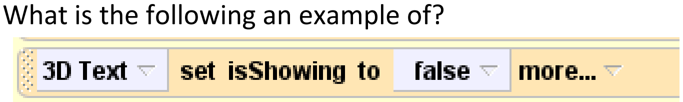
a. 5
b. 8
c. 9
d. 0
e. 4
f. I don’t know

2) What is the following an example of?



a. Executing a method
b. Changing a field
c. Executing a function
d. Changing a variable
e. Creating an object
f. I don’t know

3) What is the following an example of?



a. Executing a method
b. Changing a field
c. Executing a function
d. Changing a variable
e. Creating an object
f. I don’t know

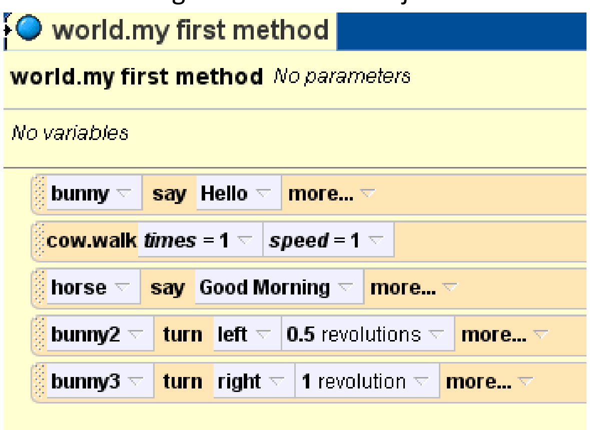
4) How many objects can you make from a class in Alice?

a. None
b. 1
c. 20
d. 100
e. As many as you want
f. I don’t know

5) What is the following an example of?

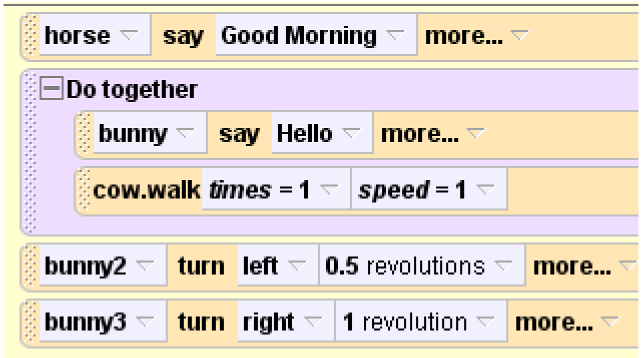
a. Executing a method
b. Setting a property
c. Executing a function
d. Changing a variable
e. <u>Creating an object</u>
f. I don't know

6) In the following method which object will turn around 180 degrees?



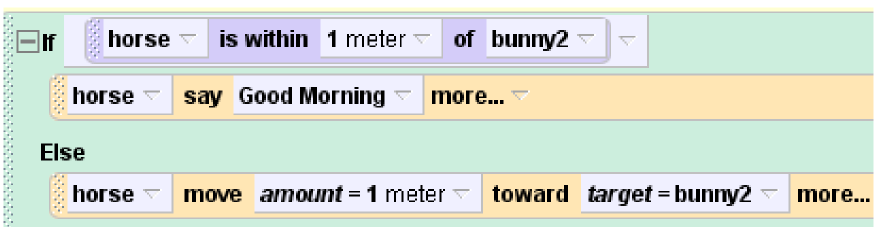
a. bunny
b. cow
c. horse
d. <u>bunny2</u>
e. bunny3
f. I don't know

7) Which two things will happen at the same time?



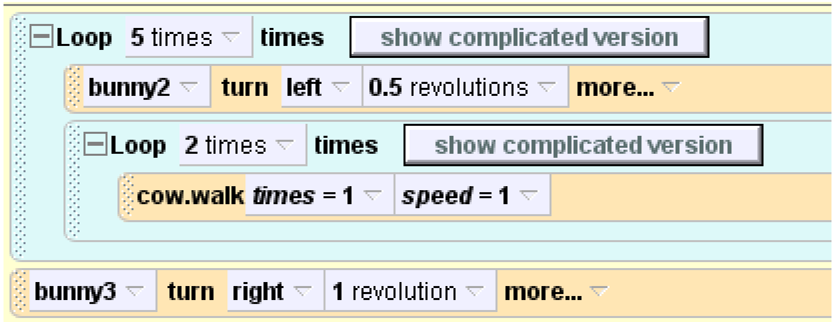
a. The horse will say "Good Morning" and the bunny will say "Hello".
b. The bunny will say "Hello" and the cow will walk one time
c. The Cow will walk 1 time and bunny2 will turn half way around
d. The bunny2 will turn half way around and bunny3 will turn all the way around
e. The horse will say "Good Morning" and bunny3 will turn all the way around
f. I don't know

8) What will happen with the horse is 3 meters away from bunny2 when the following executes?



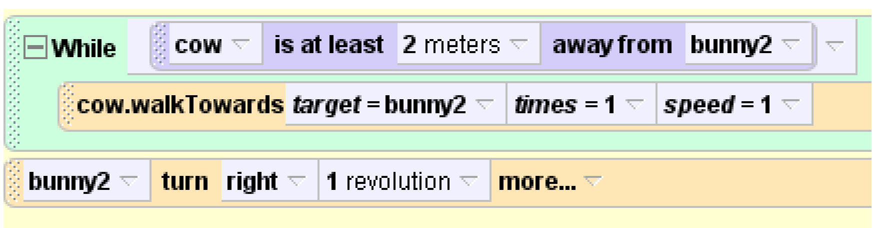
a. The horse will say "Good Morning".
b. The horse will move away from bunny2
c. The horse will move forward in the direction it is facing
d. The horse will move toward bunny2
e. The horse won't do anything
f. I don't know

9) How many times will bunny2 turn and cow walk when the following code executes?



a. Bunny2 will turn one time and cow will walk one time
b. Bunny2 will turn 5 times and cow will walk 2 times
c. Bunny2 will turn 10 times and cow will walk 2 times
d. Bunny2 will turn 5 times and cow will walk 10 times
e. Bunny2 will turn6 times and cow will walk 10 times
f. I don't know

10) If the cow starts out 11 meters away from bunny2 how many times will the cow walk when the following executes if each time the cow walks it moves 1 meter?



a. Cow will walk 1 time
b. Cow will walk 10 times
c. Cow will walk 11 times
d. Cow will walk 9 times
e. Cow will walk 8 times
f. I don't know

Appendix C. Content Knowledge Assessment Items- App Inventor

Note. Correct answers are underlined.

1) In what category of Built-in is the 

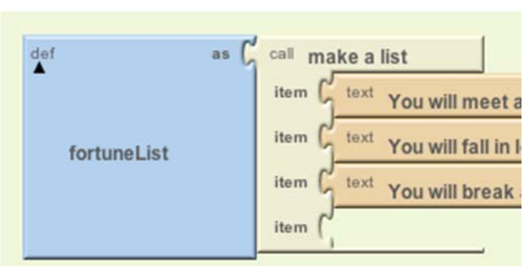
block?

   a. Definition
   b. Logic
   c. Lists
   d. Math
   e. Control
   f. I don't know

2) What is the following an example of?

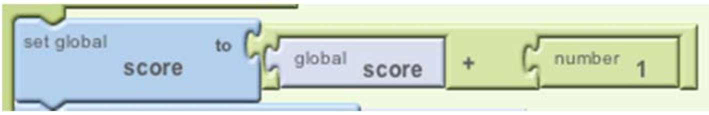
   a. Conditional execution
   b. Handling an event
   c. Creating a list
   d. Defining a procedure
   e. Modifying a variable
   f. I don't know

3) What is the following an example of?



   a. Conditional execution
   b. Handling an event
   c. Creating a list
   d. Defining a procedure
   e. Modifying a variable
   f. I don't know

4) What is the following an example of?

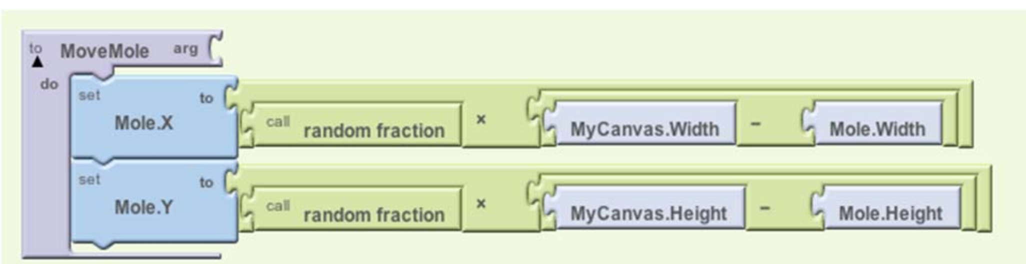


a. Conditional execution
b. Handling an event
c. Creating a list
d. Defining a procedure
e. <u>Modifying a variable</u>
f. I don't know

5) What is the following an example of?

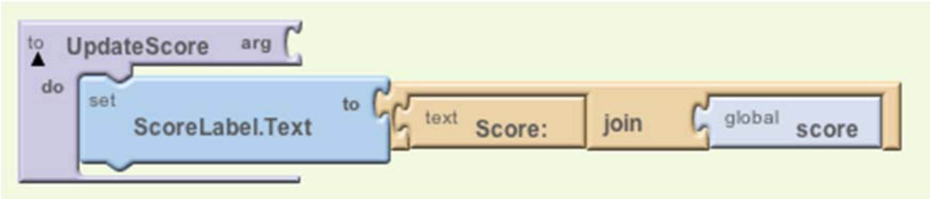
a. <u>Conditional execution</u>
b. Handling an event
c. Creating a list
d. Defining a procedure
e. Calling a procedure
f. I don't know

6) What is the following an example of?



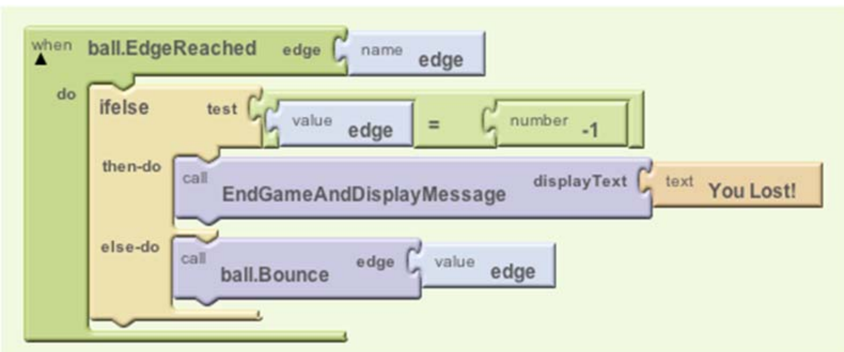
a. Conditional execution
b. Handling an event
c. Creating a list
d. <u>Defining a procedure</u>
e. Calling a procedure
f. I don't know

7) What do the following blocks do?



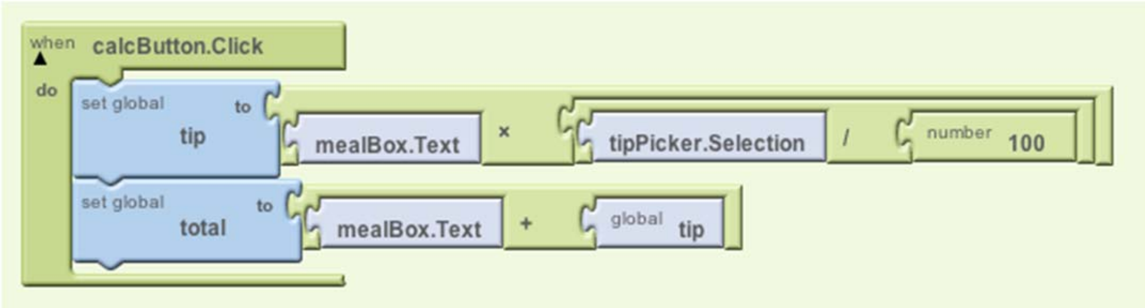
a. Pick a random item from a list
b. Add one to the current score
c. Update the score label to show the current score
d. Respond to a timer firing
e. End the game
f. I don’t know

8) What is the outcome of the following when the value of `edge` is 2?



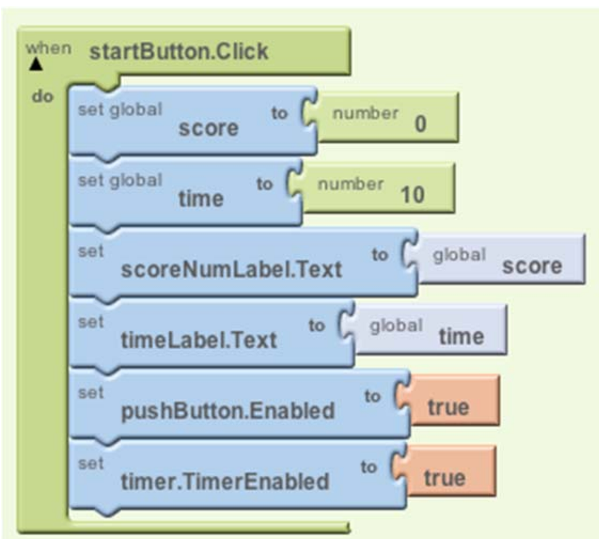
a. It ends the game and displays "You Lost!"
b. It calls ball.Bounce
c. It doesn’t do anything
d. I don't know
e. You will get an error message
f. I don’t know

9) What is the value of total when `mealBox.Text` is 20 and `tipPicker.Selection` is 15?



a. 3
b. 20
c. 4
d. <u>23</u>
e. 24
f. I don't know

10) What is the value of the variable `time` after the following block executes?



a. score
b. 0
c. the value of the global variable time
d. <u>10</u>
e. true
f. I don't know

Appendix D. Statistical Significance Analysis and Effect Size Guide

Paired Samples t-test:
For the current report, a paired samples t-test was utilized to assess statistical significance from pre to post. A paired samples t-test is used when an observation in one data set is directly related to a specific observation in the other data set. Students' assigned identification numbers allowed us to match their data set from the pre survey to their data from the post survey. Only matched samples were used in the current report. The results, thus, do not include students who took only the pre or post survey, or students whose identification numbers could not be matched on the pre and post data sets. In general, the design of the computing camp intervention was a repeated measures design whereby students' post scores were directly compared to their baseline or pre scores.

Advantages of a Paired Samples t-test:
Repeated measures designs where each student is used as his or her own control have the especially important advantage of being more powerful than other designs. Since each person is his or her own control, individual differences can be partialled out of the error term. We thus get a smaller error term and consequently a larger t-value. By using a repeated measures design we can detect significance with a smaller number of participants in a study.

Effect Size:
A statistically significant result ($p<.05$) does not necessarily indicate that the result is practically significant. The effect size gives an indication of whether something is practically significant. The effect size is a measure of the magnitude of an intervention.

For the current report, the effect size was estimated using Cohen's *d*. Cohen's *d* is computed by dividing the mean differences between groups by the pooled standard deviation. Cohen (1988)[12] proposed the following interpretation:

Cohen's *d*	**Interpretation**
<0.20	Small Effect
>0.50 and <0.80	Medium Effect
>0.80	Large Effect

[12] Cohen, J. (1988). *Statistical power analysis for the behavioral sciences 2nd edition*. Hillsdale, NJ: Lawrence Earlbaum Associates.