Gender Analysis of a Large Scale Survey of Middle Grades Students' Conceptions of Computer Science Education

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ABSTRACT
This paper summarizes findings from a Student Motivation Survey (SMS) developed to monitor students' dispositions toward CS education. This survey was administered as part of the iDREAMS project, which involved creating in-school computer programming opportunities for middle school students. The analysis reported here is based on survey responses collected over 3.5 years from 2,473 girls and 3,247 boys. Results include students' use of technology, computer courses completed, and dispositions towards CS education. Our findings reveal several significant differences between boys and girls regarding their use of technology and dispositions toward CS education.

Categories and Subject Descriptors
• Social and professional topics~Student assessment • Social and professional topics~Gender *• Social and professional topics~K-12 education • Social and professional topics~Race and ethnicity*

Keywords
Computer science education; student dispositions; gender

1. INTRODUCTION
In a recent report summarizing participation in STEM fields, computer science was found to have the largest discipline attainment gap by gender with women earning only 17% of all CS degrees [9]. This situation is reminiscent of a similar participation gap by gender in the physical sciences over 40 years ago [11]. However, the same historical trends also show that the current percentage of women earning CS degrees in the United States is less than half the peak CS degree attainment in 1983 of 37.1%. That is, there was a time in which CS drew in, proportionally, more women but those fundamentals have shifted dramatically since 1983. These downward trends in the participation of women in computer science are also observed internationally [10].

GenderIT'15, April 24-25, 2015, Philadelphia, PA, USA.
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Women's pursuit of and participation in computer science is likely due to the confluence of a complex milieu of social, cultural, and economic phenomena. One critical issue is the interaction between students' emerging self-concept, perceptions of a given discipline, and future career paths. This situation is likely exacerbated further when there are limited opportunities to engage in computer programming in K-12 education until high school or beyond. When educational priorities shift, computer science is often displaced by more recognizable options since it is typically offered as an elective course that competes against mainstream core curriculum in mathematics, science and language arts. To better understand the situation from the students' perspective it is important to review their at home and in school experiences related to CS education.

2. CONCEPTUAL FRAMEWORK
Gender studies have the particular challenge of attempting to illuminate the interests, motivations, and dispositions of different groups of students towards particular activities, while at the same time recognizing that such attempts may reify stereotypes and give greater attention to differences between boys and girls rather than point out the similarities [6]. Mindful of these cautions, we recognize that the use of computers among girls as presented in scholarly literature is not deterministic. Rather, such findings reveal potential influences that are mediated culturally and socially as individual students develop a sense of self and their world. Just as gender is socially constructed, so is technology [2].

2.1 Computer Use
Research documenting the use of technology by gender has found comparable rates in the use of computers and the Internet between boys and girls, with girls exceeding boys in the use of email and some forms of social media [6]. Differences, however, are often observed in how boys and girls use technology, especially during the middle grades years. "Throughout those crucial years of development, girls increasingly tend to use digital technologies for communication, such as for email and instant messaging, while they are less likely than boys to engage in IT practices associated with entertainment and recreation, such as playing games or downloading music and videos" [6]. This pattern has also been observed elsewhere, as "use of the Internet for educational purposes is equal until college, at which point females use it more than males; non-Internet computer use for school purposes is equal until college, at which point males use it more" [10].

2.2 Dispositions toward technology
In a review of research by Snyder [11], multiple studies up to that time had found that interest in computers for boys and girls

decreases, as they get older, with a more rapid decline for girls. However, this finding should be considered with caution as the use of computers (e.g., video streaming, telecommunications, social media, etc.) has expanded dramatically over the past decade. With respect to confidence, multiple studies have also found girls' comfort level increases with experience [11]. Girls more often than males underestimate their computer ability, even when those same girls demonstrate higher achievement in the same course [5]. In general, the trend of IT education research internationally suggests a confidence gap between girls and boys, with attributions pointing to differential parental support, contemporary perceived and overt masculinity in the field (e.g., discourse, visuals, etc.), and economic priorities.

2.3 Academic preparation

Course taking patterns in middle and high school are often lead indicators of interest in computer science as a career pursuit [1]. In the United States, the opportunity to take computer courses is often constrained by school, district and state priorities that have increased the requirement of core subjects and limited opportunities to pursue electives. Computer courses are generally offered in non-core departments such as business or applied technology, and come and go based on available teacher expertise and student enrollment in the course. Within the scope of the iDREAMS project we have observed instances of increased student (and parent) demand for such opportunities in the middle grades, resulting in rapid reallocation of teaching loads and the development of new courses (within the same school year!). We would argue that differences in academic preparation in CS education in the middle grades are inextricably tied to the opportunities created within schools. How can one examine differences in course taking, if those opportunities are not even present in schools? Monitoring students' interest in taking such courses could provide evidence of interest in spite of limited opportunities.

2.3.1 Future pursuits

In addition to K-12 academic opportunities to explore computer programming, it is important to consider students' intentions to pursue CS related majors and/or careers. Students' future intentions in the middle grades are unstable and quickly amenable to change, but they are also indicative of the extent to which media, mentors, parents and peers have presented a cultural milieu suggesting that computer science is inviting, intriguing, and rewarding. How middle school girls and boys perceive computer science careers likely reflects a combination of opportunity, identity, and culture.

2.3.2 Social construction of gender and technology

Just as gender is socially constructed, so is technology. Feminist studies of digital technology provide some insight into how technology is gendered both in its design, and in its use [13]. While technology was originally viewed as "shaped by men to the exclusion of women" [12], these views are changing based on increased usage of technology for women, as well as the affordances of technology in women's lives [12]. Wajcman argues that "gender relations can be thought of as materialized in technology, and gendered identities and discourses as produced simultaneously with technologies" [12].

Feminist perspectives have recognized that the use of technology is socially shaped, and likewise shaped by social constructions of gender. To use Faulkner's terms, for boys, the role of computer programming is considered highly 'gender authentic' in that it embraces technology and traditionally masculine roles [3]. For girls, on the other hand, computer science may be perceived as being 'gender inauthentic' creating a tension between being feminine and embracing technology (and particularly technology design activities).

3. METHOD

The iDREAMS project (Integrative Design-based Reform-oriented Educational Approach for Motivating Students) investigated ways to stimulate interest in computer science at the middle school level through a curriculum based on an approach called Scalable Game Design. The main goal of this project is to integrate computer science education in middle school curricula through instructional activities that motivate student programming of games and STEM simulations. To maximize the opportunity for all students, SGD units are included as part of existing required courses such as exploratory wheels offered at many middle schools (e.g., a series of six 6-week elective courses over a school year). Middle schools are excellent places for increasing and broadening participation in computer science during a time of emergent identify formation of students' educational and career goals. The integration of curriculum into the regular school day is particularly important for those students who do not enroll in extracurricular options (e.g. after-school programs, summer camps) due to financial constraints or other time commitments.

The primary research objective for the iDREAMS project was to monitor the impact of the Scalable Game Design experience on students' attitudes and dispositions towards computer-based design experiences, computer classes, and related future pursuits. The Student Motivation Survey was developed by a team that included an industry volunteer and faculty from computer science, STEM education, research evaluation, and the learning sciences. Student interpretation of the prompts was validated using think aloud protocols with middle grades students with varied English fluency. Factor analyses were completed on a pilot version of the survey to suggest items that should be included and discarded, resulting in the survey used with this study. Data were collected before student experiences with the SGD unit and toward the completion of the unit, using pre and post-unit online student motivation surveys. For this paper, we report only the pre-survey results to summarize findings on a large sample of middle school students' computer use, dispositions and course taking.

3.1 Characteristics of student population

The pre SGD-unit survey was administered to students who were enrolled in classrooms of 62 participating teachers in the iDREAMS project from August 2009 to December 2012. The majority of participating teachers served rural, urban, suburban and Native American tribal schools in Colorado, with other teachers working in schools in Connecticut, Massachusetts, South Dakota, Texas, and Wyoming. Even though teachers were recruited to participate in the iDREAMS project, students who participated in this study were based on course enrollment and parent consent. That is, students were not recruited into this study so any recruitment bias should be minimal. However, there may some positive bias present in some of the pre-survey disposition data if teachers discussed the game design units with students prior to completing the pre-SGD unit survey; the consenting process may have involved some communication to students about the purpose and content of the consent form.

Teachers administered the survey to students who had secured parental consent. From the original data set, we removed any student data that: a) did not include student assent as indicated by a response to an assent prompt, b) did not include a response to the gender prompt, c) did not indicate a grade level between 5th and 9th grade, and d) did not include responses to all survey prompts. After this filtering process, the data set included a total of 5,720 responses, with $n_{girls} = 2,473$ and $n_{boys} = 3,247$. The demographic and grade level distributions by gender in this data set are described below.

	White	Afr Amer	Hisp Latin	Native Amer	Asian	Multi
Boys *n*=3247	44%	7%	28%	4%	4%	13%
Girls *n*=2473	41%	7%	30%	5%	3%	15%

Table 1: Pre-survey data demographic distribution

The race and ethnicity categories used in the survey were drawn from U.S. Census categories. Over 50% of the students represented in the 5,720 responses self-identified as non-white. While the respective percentages of racial and ethnic groups were quite similar between genders, there were some differences with a slightly lower percentage of white girls, compared to white boys, and slightly higher percentages of Latinas and multi-racial girls.

	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
Boys *n*=3247	2.3%	31.6%	31.8%	32.6%	1.7%
Girls *n*=2473	1.9%	36.1%	32.1%	28.9%	1.0%

Table 2: Distribution of grade level data for each gender

The distribution of data across grade levels was also approximately the same, with relatively small samples in grades 5 and 9 and the majority of data in grades 6, 7 and 8. Table 3 illustrates the distribution of gender for each grade level and the size of the sample for each grade.

	Grade 5 *n*=121	Grade 6 *n*=1919	Grade 7 *n*=1826	Grade 8 *n*=1775	Grade 9 *n*=79
Boys	61.2%	53.5%	56.6%	59.7%	68.4%
Girls	38.8%	46.5%	43.4%	40.3%	31.6%

Table 2: Distribution of gender for each grade level

In Tables 2 and 3, there is a noticeable year-to-year decline from 6th to 8th grade in the percentage of participating girls or a slight increase in the percentage of participating boys. What are explanations for this trend? One explanation involves a general trend in school policy in which 6th grade "elective" classes are often required (i.e., forced electives) but 7th and 8th grade classes are more akin to true electives. So as opportunities to enroll courses shift to student interest, this may reduce opportunities for students to experience computer programming (or activities in other disciplines) with which they are unfamiliar or unaware.

Other characteristics of the sample include computer access and primary language. When students were asked, "Do you have a working computer at home?" 83.9% of girls and 85.8% of boys responded yes. When asked, "What is the primary language you speak at home?" 96.6% of girls and 96.7% of boys responded with English. The other prompts that are examined in this paper addressed student use of technology (11 prompts), prior technology courses (7), and dispositions towards CS education (12). The first two categories were presented as a list of options in which students could select multiple responses and included an option to write in other options. The dispositions category was administered using a four point Likert scale.

4. FINDINGS

We have restricted our analysis to pre-SGD unit data to provide a contemporary portrait of student use of computers and interests in computer education, without attributing results or shifts to the effects of a particular program. That is, even though the iDREAMS project was the context for this research, its only influence in the findings presented here was in the sample of teachers and their students who participated in iDREAMS.

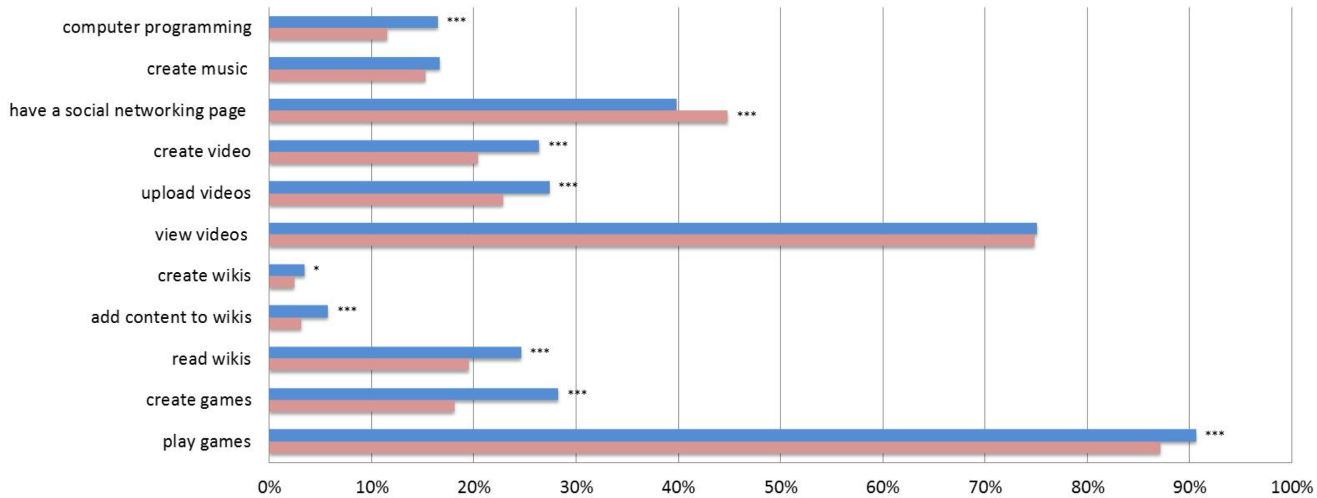
4.1 Student use of technology

The use of technology prompt asked students, "Do you do any of the following activities on the computer? Check as many or few as needed." Included in this prompt were 11 check-box options such as view videos, computer programming and other options shown in Figure 1. Close to 90% of boys and girls reported playing games with computes. Some of the categories show statistically significant differences favoring boys, such as create games ($z = 8.9$; $p < 0.01$), create videos ($z = 5.3$; $p < 0.01$), and computer programming ($z = 5.2$; $p < 0.01$). However, girls are also engaged in the same activities, just at slightly lower rates.

Two categories had no evidence of a significant difference between genders: view videos and create music. And a higher proportion of girls than boys reported having their own social networking page ($z = 3.8$; $p < 0.01$). The two most popular responses in the Other category were email and listen to music.

4.2 Prior Computer Courses

Figure 2 illustrates gender differences in students' responses to the prompt: "Please check all the computer courses that you have you taken." Most of the responses are relatively similar with one exception, game design ($z = 6.2$; $p < 0.01$). There was no evidence of a significant difference with Powerpoint and Internet Safety, perhaps indicating that these courses are "forced" electives at some schools that are actually required courses for all students. Statistically significant differences favoring girls were found for Keyboarding ($z = 2.2$; $p < 0.05$) and Microsoft Applications ($z = 2.3$; $p < 0.01$). Some of the courses described in the Other category included website design, robotics, and graphic design. Overall, 59.5% of girls and 58.9% of boys reported taking more than one of these courses.



	play games	create games	read wikis	add content to wikis	create wikis	view videos	upload videos	create video	have a social networking page	create music	computer programming
Boys	90.6%	28.2%	24.6%	5.7%	3.4%	75.1%	27.4%	26.4%	39.8%	16.7%	16.4%
Girls	87.1%	18.1%	19.5%	3.1%	2.4%	74.8%	22.8%	20.4%	44.8%	15.2%	11.5%

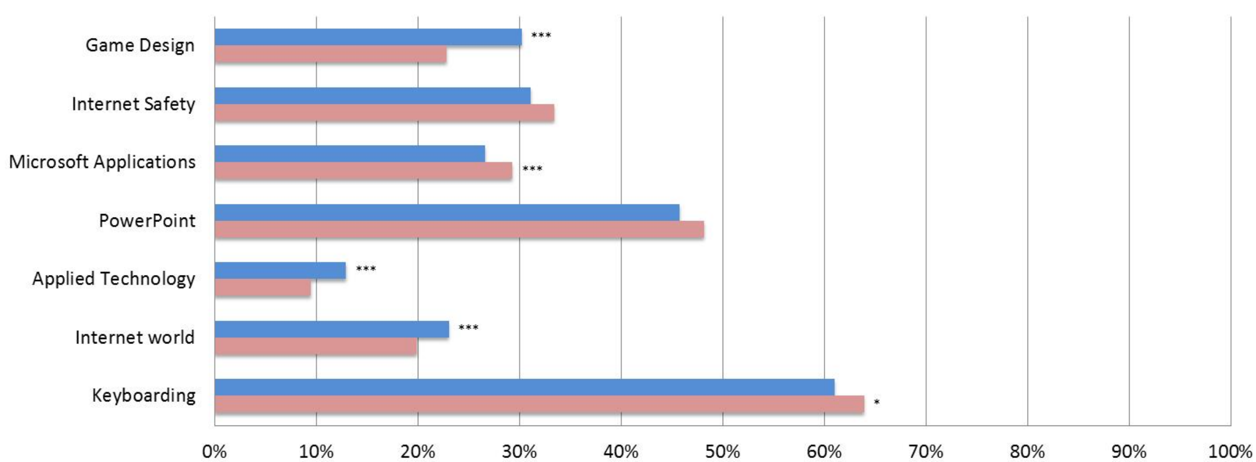
Figure 1: Student use of computers by gender (statistically significant: * = p < 0.05; *** = p < 0.01)

4.3 Dispositions toward CS education

In contrast to the checklist format used with the previously discussed categories, for the 12 disposition prompts students were asked, "How much do you AGREE or DISAGREE with each of the following statements?" using a four-point Likert scale: Strongly Agree (4) Agree (3), Disagree (2) and Strongly Disagree (1). The prompts were developed to address the constructs of self-confidence, attitudes towards computer courses, future pursuits, and perceptions of CS jobs.

4.3.1 Comparison using four-point Likert scale

Our first approach to summarizing these data uses a comparison of means based on values for the four-point Likert scale. A brief glance at Table 3 reveals that all of the means are higher for boys than girls, with all of these differences statistically significant at the $p < 0.01$ level. It is worth reiterating that these are means *prior to* working with any of the SGD related curricular units, although a majority of girls and boys reported completing other computer classes prior to the SGD game design and programming experience.



	Keyboarding	Internet world	Applied Technology	PowerPoint	Microsoft Applications	Internet Safety	Game Design
Boys	61.0%	23.1%	13.0%	45.8%	26.6%	31.1%	30.2%
Girls	63.9%	19.9%	9.5%	48.2%	29.3%	33.4%	22.8%

Figure 2: Prior computer courses by gender (statistically significant: * = $p < 0.05$; *** = $p < 0.01$)

Half of the prompts have means close to or exceeding 3.0 for both boys and girls, suggesting relatively high agreement with many of these prompts. Since the midpoint of the four-point scale is 2.5, any means exceeding this value indicate overall agreement and any means below indicate disagreement. Five prompts had means below 2.5 for one or both genders. The *I design games at home on my computer* prompt had the lowest mean for both girls and boys. The next lowest mean for girls was *I would like to study computers in college*.

Boys and girls, as a group, disagreed with the prompt *I enjoy talking to other people about computers*. This was noteworthy and particularly surprising that girls responded more negatively to the statement than did boys. The negative attribution toward this statement and the difference between genders raises potential concerns about the need incorporate more collaborative work activities in computer education courses so that middle grades students recognize the value of peer interaction and support in the design and problem solving with computer activities.

Survey prompt	Girls	Boys
a) Using computers is easy for me.	3.26 (0.61)	3.35 (0.67)
b) I am confident in my ability to use computers.	3.17 (0.63)	3.29 (0.66)
c) I am good at solving computer problems.	2.42 (0.80)	2.67 (0.84)
d) I usually understand what is being talked about in class.	3.08 (0.61)	3.17 (0.67)
e) I am interested in the work I get to do in my classes.	3.12 (0.72)	3.21 (0.77)
f) Time goes fast when I am solving problems on the computer.	2.95 (0.84)	3.05 (0.89)
g) I enjoy the work I do in class.	3.12 (0.71)	3.18 (0.75)
h) I design games at home on my own computer.	1.64 (0.73)	1.80 (0.89)
i) When I get to high school, I want to take computer classes.	2.71 (0.86)	2.93 (0.90)
j) I would like to study computers in college.	2.14 (0.84)	2.56 (0.96)
k) Computer scientists have fun jobs.	2.47 (0.81)	2.69 (0.88)
l) I enjoy talking to other people about computers.	2.21 (0.86)	2.47 (0.97)

Table 3: Likert scale response means (s.d.) of students' dispositions toward CS education by gender

4.3.2 Comparison using aggregated two-point scale

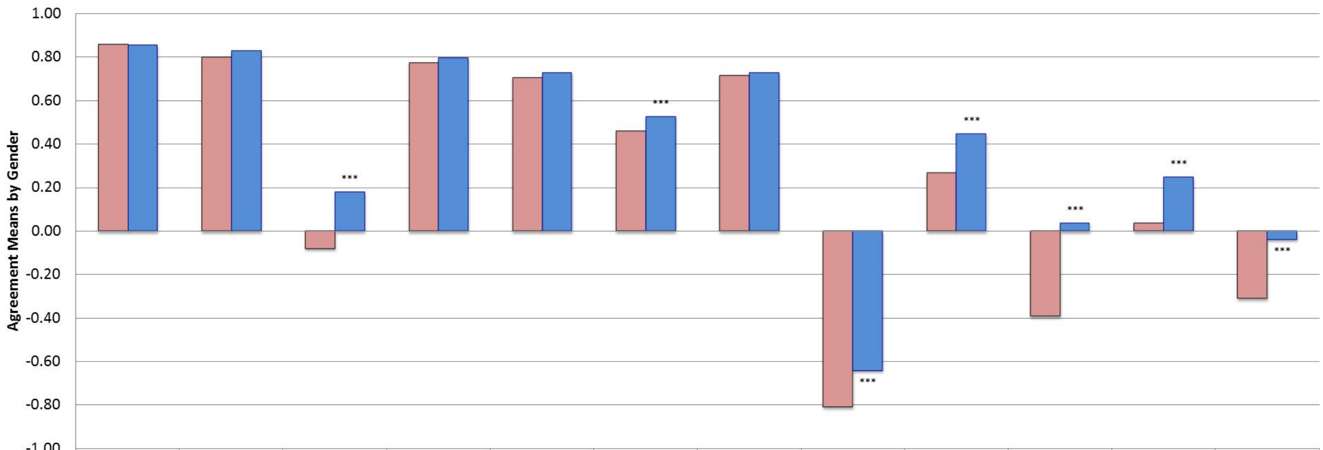
To explore the extent to which the Strongly Agree and Strongly Disagree options may have influenced the differences observed in these results, we collapsed the Strongly Agree and Agree options into one agreement category and did the same for disagreement options. The agreement responses were converted to a value of 1 and the disagreement responses were converted to a value of –1, eliminating the magnitude or intensity of attribution for each of the prompts. Means for each were recalculated for each of the 12 prompts and are illustrated in Figure 3. With the midpoint of the scale now shifted to zero, the visual display of overall agreement or disagreement for each group is more readily apparent both visually and numerically.

A statistical test of means for girls and boys using the two-point scale found no evidence of a significant difference for 5 of the 12 prompts (i.e., prompts *a*, *b*, *d*, *e* and *g*). By eliminating the "strongly" qualifier in the analysis, there are more similarities than differences in students' positive or negative attributions to the prompts. Both girls and boys indicated relatively high agreement with the prompts regarding ease (*a*) and confidence (*b*). However, in spite of this ease and confidence with using computers, when it comes to a perception of being good at problem solving with computers (*c*), girls had a negative attribution toward the statement while boys had a modest positive attribution. The differences between use of technology and problem solving with technology might suggest an opportunity to include more troubleshooting activities earlier in CS education curricula to empower all students with such skills rather than leaving this to individual curiosity [14].

The prompt, *I design games at home,* is predominantly negative for both groups although the mean for boys is less negative. More problematic gender differences are also revealed for the prompts: *When I get to high school I want to take computer classes, I would like to study computers in college*, and *I enjoy talking to other people about computers*. The responses of girls and boys to prompts regarding future pursuits likely suggest more about the social construction of gender and technology in the U.S. and limited awareness of authentic representations of the design, creativity and problem solving involved. We are also somewhat drawn to the differing attributions towards computer science jobs given the limited contemporary attention in U.S. elementary and middle schools toward career awareness. This, perhaps, suggests some degree of messaging from the media and entertainment industry regarding computer science, which are powerful influences on the social construction of gender and technology for young students. We also have observed, over time, how greater attention has been given to core subjects since the 2002 legislation of the No Child Left Behind Act [8] and the extent to which related school accountability requirements have displaced guidance courses and other electives. This reprioritization of public school goals at the federal level has relegated students' school-based exploration of jobs and careers to projects assigned by individual teachers or ad hoc sessions provided by school counselors with exceptionally large caseloads.

4.3.3 Gender disaggregated by grade level

A further analysis of these results disaggregated by grade level shows a similar pattern for Grades 6 through 8, with a similar attributions for the ease, confidence and school context prompts and statistically significant differences favoring boys for the last five prompts. Given space limitations we devote the rest of the findings to the analysis of the data by ethnic/racial groups.



	Using computers is easy for me.	I am confident in my ability to use computers.	I am good at solving computer problems.	I usually understand what is being talked about in class.	I am interested in the work I get to do in my classes.	Time goes fast when I am solving problems on the computer.	I enjoy the work I do in class.	I design games at home on my own computer.	When I get to high school, I want to take computer classes.	I would like to study computers in college.	Computer scientists have fun jobs.	I enjoy talking to other people about computers.
Girls	0.86	0.80	-0.08	0.77	0.71	0.46	0.72	-0.81	0.27	-0.39	0.04	-0.31
Boys	0.85	0.83	0.18	0.79	0.73	0.53	0.73	-0.64	0.45	0.04	0.25	-0.04

Figure 3: Dispositions toward CS education by gender (statistically significant: * = p < 0.05; *** = p < 0.01)

4.3.4 Gender disaggregated by ethnicity/race

Using the same approach to analyzing the student disposition data using a two-point scale, we organized student data by for each ethnic/racial group as identified by students in the survey. From this analysis we eliminated the responses of 82 students who did not report race/ethnicity, leaving a total of 5,638 responses, with n_{girls} = 2,441 and n_{boys} = 3,197. Students who selected more than one racial or ethnic group were identified as multi-ethnic. To help identify patterns within and across groups, we summarized results for girls and boys for each ethnic/race group for each of the twelve prompts in Table 4.

Whether or not the statistically significant differences illustrated in Figure 3 are consistent for each ethnic/racial group may be due, in part, to the smaller sample sizes for each group. Nevertheless, when data are disaggregated in this way several interesting observations can be made within and between groups. Within each ethnic/race group, even though some of the same statistically differences in future pursuits were found for African American and Asian/PI girls and boys, there was no evidence of a significant difference between genders for Native American students.

All groups show relatively high ease and confidence in the use of computers with Asian/PI girls and multi-ethnic boys having the highest overall mean for ease of use and confidence. With respect to confidence in solving computer problems among girls, Asian/PI and White girls were the only two groups with positive means; African American, Asian/PI, Multi-ethnic, and White boys all have positive means for the same prompt. With respect to future pursuits, the highest mean for taking computer classes in high school were found for Native American girls. Asian/PI boys, Native American boys and girls, and Multi-ethnic boys have the highest means for taking computer classes in college, in that order. Asian/PI, White and Multi-ethnic boys have a positive modest perception of computer science being a fun job.

	African American		Asian Pacific Islander		Hispanic Latina/o		Multi Ethnic		Native American		White	
	Girls *n*=178	Boys *n*=229	Girls *n*=85	Boys *n*=136	Girls *n*=733	Boys *n*=904	Girls *n*=360	Boys *n*=404	Girls *n*=113	Boys *n*=119	Girls *n*=972	Boys *n*=1405
a) Using computers is easy for me.	0.854	0.747	0.929	0.868	0.820	0.823	0.878	0.903	0.805	0.815	0.887	0.878
b) I am confident in my ability to use computers.	0.730	0.799	0.906	0.794	0.763	0.761	0.822	0.894	0.805	0.731	0.819	0.866 *
c) I am good at solving computer problems.	-0.169	0.039 *	0.200	0.206	-0.252	-0.035 ***	-0.022	0.266 ***	-0.133	-0.076	0.031	0.328 ***
d) I usually understand what is being talked about in class.	0.685	0.721	0.718	0.853	0.730	0.701	0.783	0.874 *	0.770	0.748	0.825	0.841
e) I am interested in the work I get to do in my classes.	0.584	0.686	0.765	0.779	0.662	0.622	0.633	0.783 ***	0.788	0.647	0.776	0.785
f) Time goes fast when I am solving problems on the computer.	0.382	0.389	0.482	0.441	0.495	0.520	0.461	0.425	0.451	0.328	0.451	0.606 ***
g) I enjoy the work I do in class.	0.674	0.651	0.788	0.735	0.697	0.637	0.606	0.758 ***	0.805	0.798	0.761	0.777
h) I design games at home on my own computer.	-0.843	-0.668 ***	-0.694	-0.647	-0.836	-0.743 ***	-0.800	-0.575 ***	-0.735	-0.546	-0.807	-0.591 ***
i) When I get to high school, I want to take computer classes.	0.011	0.328 ***	0.506	0.515	0.299	0.310	0.117	0.459 ***	0.593	0.445	0.278	0.547 ***
j) I would like to study computers in college.	-0.472	-0.118 ***	-0.129	0.309 ***	-0.315	-0.066 ***	-0.467	0.101 ***	0.115	0.210	-0.494	0.059 ***
k) Computer scientists have fun jobs.	0.056	0.118	0.153	0.426 *	0.026	0.124 *	-0.083	0.261 ***	0.204	0.143	0.051	0.331 ***
l) I enjoy talking to other people about computers.	-0.326	-0.240	-0.082	-0.015	-0.337	-0.148 ***	-0.356	0.014 ***	-0.027	-0.042	-0.323	0.045 ***

Table 4: Dispositions toward CS education by ethnicity and gender (statistically significant: * = p < 0.05; *** = p < 0.01)

5. CONCLUSION

Consistent with Hayes' research, we found that with the exception of social media website use, boys were generally more likely than girls to have used computers in a variety of ways. Boys were also more likely to have taken computer classes that promote the use of computers to solve problems, such as Applied Technology and Game Design, than were girls. It is perhaps, then, not surprising that boys were more likely to indicate that they agreed with the statement they were good at solving computer problems and would like to study computers in college. We must also consider the differences in students in their understanding and perceptions of what it means to be "good at computers" where both boys and girls responded similarly and positively, versus what it means to be able to solve computer problems.

Student conceptions about their own beliefs of their ability to use computers and solve problems with computers are likely to feed into their choices of future careers. While the difference between boys and girls beliefs that "computer scientists have fun jobs" was statistically significant, it is important to realize that the agreement of that statement was not particularly strong for either gender. Students' perceptions of career opportunities in computer science are perhaps unknown or narrowly communicated by media and the entertainment industry. Students' perceptions about how rewarding a career may be likely plays into emerging career interests, although perhaps in different ways for boys and girls. Another point to consider here is do students' responses to future pursuit prompts represent what students truly believe about themselves or is this what society is telling them is masculine? The answer likely lies at some intersection of both.

With respect to project outcomes in the post-unit survey data, we have investigated elsewhere [15] the relationship between pedagogy and student motivation to pursue similar programming activities and courses. The findings from these studies suggest that a range of pedagogical styles that include guided discovery approaches may reduce differences in students' dispositions by gender. Studies in have reported similar findings regarding the positive benefits of inquiry-based pedagogy for both males and females with respect to student dispositions and achievement in STEM disciplines [4, 7].

As prior research in computer science education has suggested, there are often more similarities than differences between girls and boys in their use of computers, course taking, and dispositions towards CS education. This summary of a large-scale survey of middle grades boys and girls concurs with these previous findings. With respect to dispositions, we would also add to this narrative that gender differences often have been interpreted as a difference in magnitude, or intensity of agreement or disagreement, rather than as similarities in general agreement towards particular CS constructs as illustrated here. The extent to which these results might inform the design of computer education courses requires additional classroom analyses of how students respond to various opportunities in ways that clarify their understanding of computer programming and careers in computer science.

6. ACKNOWLEDGMENTS

The research reported in this paper was supported, in part, by funding from the National Science Foundation under Grant No. DRL-1312129 and CNS-1138526. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the NSF.

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