Sisters Rise Up 4 CS: Helping Female Students Pass the Advanced Placement Computer Science A Exam

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ABSTRACT

Female students are underrepresented in computing careers and in computing majors at the college or university level. This underrepresentation starts in high school. Only 20% of Advanced Placement (AP) Computer Science (CS) A exam takers in 2014 nationally were female. In addition to being underrepresented, female students tend to have a lower pass rate on the exam than male students. Failing the exam could reduce interest in computing as a career. Sisters Rise Up 4 CS was created at the Georgia Institute of Technology (Georgia Tech) to help more female high school students pass the AP CS A exam. It offers help sessions, near-peer role models, exposure to a college campus, and a community of learners. Sisters Rise Up 4 CS is based on Project Rise Up 4 CS, which was also created at Georgia Tech to help increase the number of African-American students that pass the AP CS A exam. However, Sisters Rise Up 4 CS does not include the financial incentives offered by Project Rise Up 4 CS. Project Rise Up 4 CS has resulted in statistically significant positive changes in attitudes for participants and a large increase in the participants' perception of their ability to pass the exam. Even students who did not pass the exam have reported positive benefits from being in Project Rise Up 4 CS. This paper summarizes the findings from Project Rise Up 4 CS from 2013-2015 and presents the findings from the pilot of Sisters Rise Up 4 CS from 2014-2015. We used a mixed-methods approach to evaluate the project and to judge the effectiveness of the project elements. →

Keywords

Advanced Placement Computer Science; Near-peer mentors; Gender Issues; Underrepresented Minorities; Financial Incentives

1. WOMEN IN COMPUTING

The percentage of women in earning bachelor's degrees in computer and information science in the United States grew quickly from 16% in 1973-1974 to 37% in 1983-1984. Since then it declined to 18% in 2010-2011 [2]. This underrepresentation in computer science can be seen in high school as well. Women were only 20% of Advanced Placement

(AP) Computer Science (CS) A exam takers nationally in 2014 [1].

Female students pass the Advanced Placement (AP) Computer Science (CS) A exam at a lower rate than male students both nationally and in our state [1]. The AP CS A course is intended to be equivalent to a college level CS1 course for majors. Scores on the exam range from 1 to 5 with a 3 as the threshold for passing. In 2014, the national pass rate for female students on the exam was 57% and the male pass rate was 68%. In 2014, the female pass rate in Georgia on the exam was 42% while the male pass rate was 47%. Failing the exam may not be a problem if you weren't really trying to pass it, but it could discourage those who were trying to pass the exam from considering a career in computing. Research has shown that belief that you can succeed in a field is a critical factor in choosing a career [10]. Additionally, when girls fail they tend to blame themselves and lose confidence in their ability whereas boys tend to blame external factors, so failure can have a more debilitating effect on females [9].

2. PROJECT RISE UP 4 CS

We created Project Rise Up 4 CS at Georgia Tech to help more African-American high school students pass the Advanced Placement (AP) Computer Science (CS) A exam in Georgia [12]. African-Americans have the lowest pass rate on the AP CS A exam of any racial group both in Georgia and nationally [1]. Project Rise Up 4 CS offers twice a week webinars, once a month in-person hands-on sessions, near-peer role models, exposure to a college campus, competitions, and a community of learners. It has also offered a financial incentive for passing the exam (offered the last 3 years) and for attending the required number of help sessions (offered in the 2nd and 3rd year).

We created a free ebook to help prepare high school students for the AP CS A exam and have added content to it each year [11]. Participants in Project Rise Up 4 CS always have access to the most recent version of that ebook and we make the new version publicly accessible after the exam. The ebook contains information about what is on the exam, common mistakes, worked examples, and lots of practice problems. Research on worked examples shows that they are an efficient and effective way to learn [17]. Research also highlights the importance of worked examples and practice to build skill [18].

The design of Project Rise UP 4 CS was based on two successful projects: The Advanced Placement Incentive Program and Glitch. The Advanced Placement Incentive Program (APIP) started in Texas and has offered financial incentives for both students and teachers as well as additional help sessions for students in order to increase the number of students who take and pass AP exams [14]. The Glitch Project at Georgia Tech

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was created to increase Black male high school students' interest in studying computer science by paying them to be game testers and also teaching them computing concepts.[8]. Glitch featured near-peer role models, instruction in computing, and exposure to a college campus. Near-peer role models are “near” to the target population in some way: age, ethnicity, gender, and/or interests. Bandura’s social learning theory posits that people learn by observing, imitating, and modeling what they learn from other people and are more likely to imitate those that they feel are “similar” to them [3]. The majority of Glitch participants continued studying computer science after high school graduation even though only 20% were originally interested in a career in computing [8].

2.1 First Year – Jan 2013 to May 2013

Originally Project Rise Up 4 CS offered a \$100 financial incentive if the participants attended at least four help sessions and passed the exam with a score of 3 or higher [12]. That year 27 students enrolled in the project at Georgia Tech and 14 (52%) students completed four or more help sessions as shown in Table 1. Thirteen of the 14 students who completed four or more help sessions took the exam. Nine of the 13 passed the exam for a pass rate of 69%. The pass rate for all African-American students in Georgia that year for AP CS A was 22%. A total of 28 African-American students passed the exam in Georgia in 2013, which was a record number. Twenty-two students had passed the exam in Georgia in 2012, which was the prior record. We cannot know how many students would have passed without Project Rise Up 4 CS, but at least some of the students told us that they didn’t think that they would have passed otherwise.

Table 1. Summary of Project Rise Up 4 CS: 2013 - 2015

Year	Num	# Sessions Required	Completed	Took Exam	Passed
2013	27	4	14 (52%)	13	9 (69%)
13-14	33	6	15 (45%)	15	6 (40%)
14-15	21	4	16 (76%)	15	5 (33%)

2.2 Second Year – Oct 2013 – May 2014

In response to participants’ suggestions, we started the second year of Project Rise UP 4 CS in October of 2013. Since we started earlier, we required that participants attend six help sessions rather than four to be considered as completers. Thanks to a Google RISE grant, we offered participants \$100 if they attended six help sessions and an additional \$100 if they passed the exam. Our hypothesis was that this additional financial incentive would encourage more students to attend the minimum number of help sessions. That year 33 students enrolled at Georgia Tech and 15 (45%) attended the minimum number of help sessions, as shown in Table 1. Six of those 15 participants passed the exam for a pass rate of 40%. The pass rate for all African-Americans in Georgia that year was 23%. A total of 35 African-American students passed the exam in 2014 in Georgia, which was also a new record. Contrary to our hypothesis, the completion rate actually fell from 52% in year one to 45% in year two. However, this decrease in the completion rate could have been due to our increasing the required number of help sessions from four to six. While one of the participants mentioned the financial incentive as a reason why he joined the project during a focus group, some of the students who earned the \$100 didn’t even fill out the paperwork to receive the money.

2.3 Third Year – Oct 2014 – May 2015

In 2015, we went back to requiring participants to complete four help sessions rather than six to assess if that would result in a higher completion rate. Due to the need to spend out the Google RISE grant before the end of 2014, we offered prizes worth at least \$100 if students attended the required number of help sessions and a prize worth at least \$100 if the student passed the exam. Twenty-one students enrolled at Georgia Tech and 16 (76%) of them attended four or more help sessions as shown in Table 1. Fifteen students took the exam and 5 passed (33%). The completion rate did increase when we required four help sessions (76%) versus six (45%) and it was also above the original completion rate without the additional \$100 financial incentive (52%). This supported our hypothesis that the additional financial incentive for attending the required number of help sessions would improve the completion rate. However, three of the students didn’t pick up their prizes. In addition, the pass rate for completers decreased. While the financial incentives were mentioned by some of the students in a focus group as part of the motivation for joining the project, they didn’t seem to be important to others.

3. SISTERS RISE UP 4 CS – 2014 - 2015

Georgia Tech created Sisters Rise Up 4 CS in the fall of 2014 to help more female students pass the AP CS A exam. We retained the same components as Project Rise Up 4 CS *except for the financial incentives*. Participants were entered into a raffle for a prize worth \$150-200 if they sent us their scores on the AP CS A exam before the end of July. This was to encourage students to send us their scores in a timely fashion. Our research questions were 1) *Would we see similar results in terms of attitude changes in Sisters Rise Up as we had seen in Project Rise Up?* and 2) *Would we see similar completion and pass rates without a financial incentive?*

3.1 Recruitment and Application

We sent emails to our mailing list of AP CS A teachers in our state and asked them to notify their students about the project. Students had to fill out an online application that asked for their contact information, grade, gender, ethnicity, the computing courses they had taken, school name, teacher name, computing experience such as summer camps and robotics teams, textbook, development environment, how they got interested in computer science, and why they wanted to be part of the project. Thirty students applied.

3.1.1 Themes from the applications

Eighteen (60%) of the applicants said that they became interested in computer science because of a family member, teacher, or friend. “*I got interested in computer science because my brother would often show me some of the cool things he could do with Python and MATLAB as a student at Georgia Tech.*” “*My computer science teachers at [my school] encouraged me.*” Thirteen (43%) talked about how interesting and valuable the field was. “*I first got interested when I realized the career fields out there involving computer science.*” Four (13%) became interested because of a summer camp or prior computing course. “*(The) Introduction to programing class, specifically working with Python Program, motivated me to be involved in computing.*” Four (13%) of them said that they became interested at a young age.

These themes are not surprising given recent research from Google on the factors that influence women in computing [19].

In particular, researchers “found that encouragement and exposure are key controllable indicators for whether or not young women decide to pursue a computing-related degree. [19]” The research also showed that encouragement from both family and non-family (peers, teachers, role models) sources had more of an effect on girls than on boys.

3.2 Enrollment

Of the 30 students who applied, 21 completed the required parent consent and student assent forms to enroll in Sisters Rise Up 4 CS at Georgia Tech. Eight students enrolled in November of 2014. Thirteen students enrolled in February of 2015. At the enrollment session students took a pre attitudinal survey and completed a 20-question multiple-choice content knowledge pretest. We gave parents and students a presentation on the breadth of research being done by women in computing at Georgia Tech. Parents attended a session on computer science at Georgia Tech while the participants were taking the pre attitudinal survey and pretest. Our goal was to encourage the parents to support their daughters’ interests in computer science.

Of the twenty-one enrolled students, one (5%) was in 9th grade, eight (38%) were in 10th grade, three (14%) were in 11th grade, and nine (43%) were in 12th grade. Of the twenty-one enrolled students one (5%) was Latina, three (14%) were African-American, four (19%) were Caucasian, and 13 (62%) were Asian.

The enrolled students came from nine different schools as shown in Table 1. Most of the students came from highly ranked schools (with 1 as the highest and 399 as the lowest).

Table 2. School Information for Sisters Rise Up 4 CS

School	% Free/Reduced Lunch	Rank of 399	Num Students	Num ≥ 4 Help Sessions	Num Passed Exam
1	13%	5 th	5	4	2
2	11%	9 th	2	1	1
3	8%	13 th	7	2	3
4	5%	14 th	1	1	1
5	28%	25 th	1	0	1
6	41%	53 rd	1	0	0
7	55%	201 st	1	1	0
8		Private	2	2	1
9		Private	1	1	0
		Total	21	12	9

3.3 Program Details

We hired two Caucasian female undergraduate students and one male Caucasian high school senior student to serve as near-peer role models and to lead the webinars and in-person help sessions. The high school senior had previously passed the AP CS A exam with a 5. One of the undergraduates was a junior and one was a senior. In the spring, one of the female role models acquired another position; to fill her spot, we moved one of the Asian male undergraduate students who had been working with Project Rise Up 4 CS to Sisters Rise Up 4 CS. Prior research has shown that both males and females can serve as role models for female students provided that they do not reinforce or promote stereotypes about computer scientists [6].

We trained the leaders on how to use Blackboard Collaborate, the webinar software that we used. We instructed them to make the webinars interactive by asking the participants to explain concepts, predict results, and explain why the answers to multiple-choice questions were right or wrong. Prior Project

Rise Up 4 CS students had commented that they enjoyed the interaction on the webinars [13]. We incorporated findings from education research into the webinars and in-person sessions. In particular, we encouraged our role models to use active learning, worked examples and practice, and to encourage learning from mistakes [4; 5; 7].

We spent less than \$3,000 total on Sisters Rise Up 4 CS. We paid the undergraduate students and high school student who led the webinars and in-person sessions, paid for food for the in-person sessions, and bought prizes for the competitions and raffle. We held a practice multiple-choice exam competition, called the AP Bowl, at Georgia Tech in April of 2015 and awarded prizes to the top scorers from Sisters Rise Up 4 CS and Project Rise Up 4 CS. We also entered all of the female students who sent us their scores on the exam into a raffle for a prize worth \$150 to \$200.

3.4 Results

Participants were required to attend at least four help sessions to be considered to have completed the project. Twelve (57%) of the 21 participants attended at least four help sessions. Some participants attended many more than four help sessions as seen in Figure 1. One person attended 14 help sessions, which suggests that she found the sessions valuable.

Figure 1. How many attended each number of help sessions

Of the 12 participants who attended four or more help sessions, 11 took the exam, and 6 of the eleven passed (55%) with a score of 3 or higher. Of the 21 original participants, a total of 9 of the 21 (43%) students passed the exam. However, three of the 21 students did not take the exam. For comparison, the pass rate for females in our state in 2015 on the AP CS A exam was 48%.

As displayed in Table 3 six (67%) of the nine students who passed the exam identified as Asian. Two (22%) identified as White, and one (11%) identified as African-American.

Table 3. Information on students who passed the exam

Id	Grade	Race	Num Help	School	Pre test score	Exam Score
1	9 th	White	10	3	13	5
2	12 th	AA	10	1	9	4
3	12 th	White	4	8	3	3
4	12 th	Asian	2	2	8	4
5	10 th	Asian	6	4	6	3
6	10 th	Asian	4	3	8	5
7	11 th	Asian	3	5	8	4
8	12 th	Asian	4	1	7	4
9	10 th	Asian	1	3	18	4

As shown in Table 4, four (57%) of the seven non-completers who took the exam failed the exam. Five (45%) of the 11

completers, who took the exam, failed the exam. A higher percentage of the non-completers failed the exam than the completers. None of the students at the two lowest ranked schools passed the exam, as seen in Table 2.

The student from school 7, a low ranking school, was actually taking the course virtually, since her school didn't offer the course. She attended 11 help sessions, but still failed to pass the exam. In an email she said, *"I'm sending this score with a good bit of shame as it was my 1st one out of all 10 AP tests I've taken. I do want to clarify that though I did terrible on the exam, I think a lot of it had to do with me learning through (the) GA Virtual School (which was a struggle in itself because it's the only class I've taken online ever). The Sisters Rise Up program definitely taught me a lot (helping me end up with an A in the actual class) and I'm still glad I participated in it despite the outcome. As for the ebook, it was extremely helpful in teaching things in an easier/broken-down way rather than how I was learning it online. I'm planning to major in CM (Computational Media) at (Georgia) Tech this coming Fall, so this program definitely still kept me interested in coding despite my miserable experience with the class."* It is encouraging to see that even though she failed the exam she credited Sisters Rise Up 4 CS with helping her earn an A in her course and for maintaining her interest in a career in computing.

Table 4. Score breakdown for completers and non-completers

AP CS A Score	# Completers	# Non-completers
1	3 (27%)	3 (43%)
2	2 (18%)	1 (14%)
3	2 (18%)	
4	2 (18%)	3 (43%)
5	2 (18%)	
Did not take exam	1	2

4. EVALUATION

A mixed methods approach was used to evaluate Sisters Rise Up 4 CS. We administered a pre attitudinal survey and a pre content knowledge assessment when the students enrolled. We asked students to complete a retrospective post attitudinal assessment and a post content knowledge assessment in April of 2015. However, very few students took the post-content knowledge assessment, so we are not reporting on that here. The attitudinal surveys are available on request and the pre and post content knowledge assessments are available in the ebook [11]. A focus group was conducted in the spring of 2015 with three members of Sisters Rise Up 4 CS in order to gain deeper insight into the participants' experience. In addition, we conducted individual interviews with several students in the summer of 2015 in order to gather feedback from more of the participants.

4.1 Attitudinal Survey Results

Twelve of the participants in Sisters Rise Up 4 CS completed the retrospective post attitudinal survey. These students showed gains across all eight attitudinal constructs from "before" the program to "now" as shown in Table 5 (top row in each section). This may indicate that the program was effective in enhancing females' positive attitudes towards computing. In particular, students show statistically significant ($p < .05$) gains in their attitudes towards gender equity in computing. Likewise, growth

in their perceptions of the importance and usefulness of computing is trending toward significance at $p = .089$. There was also a significant, positive correlation between the number of sessions that participants attended and growth (from before to now) in "Motivation to Succeed" at $p = .012$ and in "Identity and Belonging" at $p = .008$. This suggests that attending more help sessions increased their motivation to succeed and their feeling of belonging in computing.

Thirteen of the participants in Project Rise Up 4 CS completed the retrospective post attitudinal survey. These students demonstrated statistically significant gains in confidence, enjoyment, and motivation to succeed as shown in Table 5 (second row in each section).

Table 5. Retrospective Attitudinal Survey Results for both Sisters Rise UP 4 CS and Project Rise Up 4 CS participants for 2014-2015

Construct	Sample Item	Before	Now	Paired Sample t-test
Computing Confidence	<i>I can get good grades in computing.</i>	3.58	3.83	0.166
		3.62	4.27	0.005*
Computing Enjoyment	<i>Computers are fun.</i>	3.00	3.27	0.216
		3.38	3.96	0.001*
Importance & Perceived Usefulness	<i>I will use computing in many ways throughout my life.</i>	4.00	4.32	0.089
		4.31	4.38	0.502
Motivation to Succeed	<i>When a computing problem arises that I can't immediately solve, I stick with it until I have the solution.</i>	2.92	3.04	0.674
		3.58	4.12	0.024†
Identity and Belonging	<i>I feel like I "belong" in computing.</i>	2.40	2.50	0.726
		3.69	4.15	0.082
Gender Equality	<i>Girls can do just as well as boys in computing.</i>	4.25	4.63	0.032†
		4.77	4.77	1.000
Creativity in Computing	<i>I am able to be expressive and creative while doing computing.</i>	3.00	3.31	0.266
		3.87	4.08	0.193
Intent to Persist	<i>I see myself working in a computing field.</i>	3.29	3.75	0.183
		4.15	4.54	0.086

* $p < 0.01$, † $p < 0.05$. Sisters Rise Up 4 CS results are shown in the top row in each section and Project Rise Up 4 CS results are shown in the second row in each section (shaded). For Sisters Rise Up $n = 12$ and for Project Rise Up $n = 13$.

It is important to note that the "now" results for the Sisters Rise Up 4 CS participants for only two constructs exceeded 4.0 on a 5-point Likert scale. This is in contrast to the "now" results for Project Rise Up 4 CS in which nearly all averages are above 4.0. Together, these findings indicate that while the attitudinal gains among Sisters Rise Up 4 CS participants are promising, there is still considerable room for further growth.

There was also a positive correlation ($r = 0.569$ and $p = 0.014$) between performance on the pre content knowledge assessment and performance on the AP CS A exam. One Sisters Rise Up 4 CS participant had a pretest score of three out of 20, yet she still

passed the exam with a score of three as shown in Table 3. Given her low score on the pre content knowledge assessment she appeared to be at risk of failing the exam when the project started, which implies that she made strong gains in her content knowledge during Sisters Rise Up 4 CS.

4.2 Sisters Rise Up Focus Group Interviews

Qualitative data gleaned from a focus group with three Sisters Rise Up 4 CS participants revealed many of the same themes that we had seen in prior Project Rise Up 4 CS focus groups [13]. Participants valued the in-person sessions, the webinars, the near-peer leaders, and the focus on the exam. Some students praised their AP CS A course teachers. Others said that their course teachers made them learn mostly on their own. One participant reported that her teacher didn't cover the material on the exam or help them prepare for the exam. Research suggests that minimally guided instruction is inefficient and less effective than direct instruction [15].

The subsections below highlight comments that we have not encountered before in our prior focus groups.

4.2.1 Computer Science is Different

When asked to elaborate on their reasons for enrolling in the project, one student responded, *"I thought it would be very helpful, because computer science is different. You never learn anything about it before. Unlike biology and chemistry, you have some background knowledge on it. But it's a whole new subject. So, any extra help would be helpful."* Other research has found that boys tend to develop interest in computer science at an earlier age than girls, so girls often have less prior experience [16].

4.2.2 Exam Tips and Tricks

Participants appreciated the exam tips and tricks that they learned from Sisters Rise Up 4 CS, *"They help you go into the problems much faster and save time on the test."* There are 40 multiple-choice questions on the exam and the students only had 75 minutes to answer those questions, so it is important to be able to answer the questions quickly.

4.2.3 Reaction to the webinars

Some students found the webinars more engaging than they originally expected, *"This is actually fun. I want this to be longer."* Some students had trouble attending the webinars, *"for the webinars, that's what we have problems with because time-wise 8:00 to 9:00, I'm studying for tests the next day. So, it's a struggle."* Some students liked that you could watch the recordings of the webinars *"you can go back and watch it, which was really helpful."* Some students reported technical problems with the first webinar. The leaders had problems with their Internet connection during that webinar.

4.2.4 Importance of the College's Prestige

Participants felt that it was important that the program was offered through a prestigious college. *"I think the perception of the name adds more to it. So, you know that you actually get something good from it, rather than being a program that you're not really sure about whether it will be worth your time or no., because the drive is far. So, I think if it wasn't Georgia Tech, then maybe a lot of people wouldn't attend."*

4.2.5 Increased Interest in Computer Science

One student credited Sisters Rise Up 4 CS with increasing her interest in computer science. *"I used to not like computer science at all. The only reason I took the course is because my*

dad told me. Then here, I really like seeing the students and how kind of passionate I guess they are about it and seeing other people that do it, too. So, it made me more interested."

4.3 Individual Interviews

To gather more information on participants' experiences in the program, we conducted remote individual interviews with two additional participants in late summer of 2015. Both interviewees passed the AP CS A exam; however, one attended 10 help sessions while the other attended only 2 help sessions. We were particularly interested in learning why the second interviewee had only attended two help sessions.

We interviewed a ninth grade participant who attended ten help sessions and achieved the top score, a five, on the AP CS A exam. She described Sisters Rise Up 4 CS as *"the place that I could ask questions and get answers."* She valued the responsiveness of the webinar leaders, *"if I asked a question and they didn't know the answer on the spot, they would always answer it a little bit later maybe, and they would definitely find the answer to my questions."* She also valued the exam taking tips and strategies *"They have some good advice there on how to succeed on the computer science exam, like how to get points even (though) you don't understand the problem."* Participating in the program did not further increase her interest in computer science as her interest was high to begin with, *"I always really liked CS and I was really interested in it, so I don't think it can get more interesting for me."* When asked to offer suggestions for improvement, she recommended including more timed exams and additional practice on the free response aspect of the exam. She appreciated the AP Bowl, which was a timed practice exam of 40 multiple-choice questions held at Georgia Tech, *"It was a great practice, it helped me a lot because I didn't know how...like timing plays a big role on the AP exam"*.

We also interviewed a twelfth grade participant who only attended two sessions, but scored a four on the exam. She said that she enjoyed going to the in-person session where she programmed a robot, *"I thought they did a nice job trying to engage the students in learning about computer science in more than like a textbook way."* She wanted to attend more in-person help sessions but she lived too far away, *"It was like 40 minutes to an hour, and I started working, so the hours didn't work out for me."* She tried to attend the webinars, but encountered technical difficulties installing the necessary software, *"I don't know why but my computer wouldn't work with that program."* Even though she only attended two help sessions she credited the sessions with increasing her interest in computer science, *"before I wasn't really thinking about majoring in computer science, but I think because of that those sessions and the class I changed my major to computer science."*

5. DISCUSSION

Our two research questions were 1) *Would we see similar results in terms of attitude changes in Sisters Rise Up as we had seen in Project Rise Up?* and 2) *Would we see similar completion and pass rates without a financial incentive?* Participants in both Project Rise Up 4 CS and Sisters Rise Up 4 CS in 2014-2015 had positive gains in attitudes towards computing. However, the participants in Sisters Rise Up 4 CS started out lower in all categories and ended lower as well (as shown in Table 5), so more can be done to improve the Sisters Rise Up 4 CS participants' attitudes towards computing. The completion rate for Project Rise Up 4 CS (76%) in 2014-2015 was higher than that of Sisters Rise Up 4 CS (57%), but Sisters Rise Up

completion rate was higher than the completion rate for Project Rise Up 4 CS in each of the first two years (52% in 2013 and 45% in 2013-2014). Project Rise Up 4 CS offered participants \$100 for attending the required number of help sessions for the last two years, while Sisters Rise Up 4 CS did not. The pass rate for completers for Sisters Rise Up 4 CS was 50% compared to a pass rate for Project Rise Up 4 CS in 2014-2015 of 33%. The Sisters Rise Up 4 CS completion rate and pass rate indicate that the financial incentives are not necessary for Sisters Rise Up 4 CS to be at least as effective as Project Rise Up 4 CS. More work will need to be done to determine how much the financial incentives matter to the success of Project Rise Up 4 CS.

Qualitative data gleaned from focus groups and interviews show that participants in Sisters Rise Up 4 CS valued the project. Likewise, there is evidence to suggest that several participants were motivated to pursue additional computing courses and/or a college major in computing as a result of participating in the project. Additional research is needed to track participants long-term to see if the impact of the project is sustained through college.

6. CONCLUSION

Women are underrepresented in computing careers and on the Advanced Placement (AP) Computer Science (CS) A exam. Helping more women pass the exam could improve the representation of women in computing. Sisters Rise Up 4 CS is a low cost intervention that resulted in positive changes in attitudes towards computing. It was based on Project Rise Up 4 CS, except that it did not include the financial incentives in Project Rise Up 4 CS. The financial incentives in Project Rise Up 4 CS for the last two years were \$100 for students who attend the required number of help sessions and another \$100 for passing the exam. The completion rates and pass rates for Sisters Rise Up 4 CS were not substantially different from Project Rise Up 4 CS. Given the low cost of this intervention and its success; more colleges and universities should consider starting similar projects at their institutions. Project Rise Up 4 CS has already been successfully replicated at other institutions [13]. Sisters Rise Up 4 CS can also be easily replicated. The materials (ebook, handbooks for the project coordinator, and handbooks for webinar and help session leaders) are freely available. It's a low-cost but significant-impact intervention.

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