Assessing Girls' Interest and Confidence in Computing: Results for Globaloria West Virginia

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To date, girls and women are particularly underrepresented in technology — one of the fastest growing fields in the U.S. economy (U.S. Dept. of Labor, 2010a). Technology job opportunities are predicted to grow at a faster rate than all other jobs in the professional sector, or up to 22 percent over the next decade. Technology is also increasingly essential in the daily operation of other STEM fields and to the success and competitiveness of the overall U.S. economy. The persistent underrepresentation of girls and women in this rapidly growing and economically essential field results in costly consequences for women, the global economy, and society (Ashcraft & Blithe, 2010). First, underrepresentation of women in technical fields inhibits innovation by ignoring the diverse perspectives and life experiences women and other underrepresented groups bring to invention and problem-solving. Second, disregard for girls' and women's participation perpetuates, and even exacerbates, existing economic disparities for women.

To reverse the current tide, the National Center for Women & IT aims to identify and promote technology programs with promising evaluative evidence for increasing girls' interest and confidence in technology and computing. As part of this effort, we have partnered with the World Wide Workshop to conduct a number of analyses of the effects of Globaloria curriculum on girls' attitudes and abilities in computing: 1) analyses of pre- and post- test data from participants in Globaloria classes, 2) enrollment data and patterns in Globaloria electives, and 3) qualitative interviews with teachers and students.

The questions we seek to answer through these various analyses are as follows:

1) To what extent do girls enroll in voluntary (that is, non-mandatory) Globaloria courses and how does this compare to the national average for computing/computer science courses?
2) Among Globaloria participants, are there gender differences in computer usage, computer knowledge/skills, computing interest, computer attitudes, computer confidence, future aspirations in or plans for computer education and careers?
3) Are there differences between pre- and post- tests among girls in terms of computer usage, computer knowledge/skills, computing interests, computer attitudes, and computer confidence?
4) How do girls describe their experience in Globaloria and what are the implications of this for future curriculum development and efforts to increase girls' participation in technology?

This report addresses questions 1-3 above and summarizes the findings for both the analysis of Globaloria enrollment data and the pre- and post-test analyses. We conclude with initial findings from enrollment data and next steps. The next stage of this evaluation, the qualitative stage, will address question 4.

Methodology

Enrollment Data

We collected enrollment data for all Globaloria classes during the 2010-11 and 2011-12 school years. We took the enrollment numbers by sex for all *elective* classes during these two years and calculated the total percentage of girls enrolled in these courses. Because one would expect enrollment in mandatory courses in co-ed high schools to be approximately 50% girls and 50% boys, determining enrollment in elective classes is important for understanding if these courses are attracting girls at rates higher than the national average (approximately 20-25%).

We also identified the individual elective classes that had the highest female enrollments. We are currently in the process of interviewing some of these teachers to elicit the reasons for these higher enrollments and to determine what, if anything, might distinguish them from Globaloria courses with lower enrollments of girls.

Pre- and Post-Test Analysis

For this analysis, we focused on Year 4 West Virginia participants because the questions in Years 1-3 differed significantly from Year 4 and focused less on computing and technology competencies. In year 4, 1075 students participated in the Globaloria classes in West Virginia. 976 of them completed the classes and took the surveys. After excluding the students who were not at middle or high schools and who didn't take either the pre-survey or post-survey or both, the final sample size was reduced to 539. In addition, we only examined the survey questions or items related to computing.

Two statistical analyses were conducted to investigate the following two areas:

1) Paired T-tests were conducted to examine the changes of students' computing confidence, interests, and computer activities participation at home and at school before and after they took the Globaloria classes. We further examined the changes based on school levels (separating middle school students from high school students) and gender.
2) One-way ANOVAs were conducted to examine gender differences in computing confidence, interests, and computer activities participation at home and at school before and after they took the Globaloria classes. We also further examined the gender differences based on school levels (separating middle school students from high school students).

Findings

Enrollment Data

Exact numbers on girls' enrollment in middle or high school computing courses are difficult to find. Some proxy measures, however, do help us fill this gap in order to come up with a rough understanding of national patterns. In 2011, approximately 19% of CS AP test takers were girls (College Board, 2011), and approximately 18% of 2010 undergraduate Computer Science degree recipients were female (NCES, 2010). In general, female enrollment in undergraduate CIS courses ranges from 18-25% (NCES, 2010). As a result, it is reasonable to consider computing courses with enrollment levels above 25-30% female as exceeding the national average (U.S. Dept of Labor, 2010b).

In total enrollment in elective courses, Globaloria exceeded the national average, with 33% female enrollment in 2010-11 and 37% female enrollment in 2011-2012. This picture becomes a bit more complicated when looking at individual elective courses.

- In 2010-2011, 31 out of 55 elective Globaloria game design courses enrolled girls at percentages higher than the national average. These percentages range primarily from 32-100% (9 courses = 32-39%; 7 courses 40-47%; 4 courses 50-57%; 4 courses 60-67%; 1 course = 78%; 1 course = 80%; 5 courses enrolled 100% girls, but these classes only had 1 or 2 students total).
- In 2011-2012, 21 out of 70 elective Globaloria game design courses enrolled girls at percentages higher than the national average. These rates range from 31-78% (9 courses = 31-39%; 3 courses = 40-44%; 4 courses = 50-57%; 3 Courses = 62-69%; 2 courses = 75-78%)

As is evident, the range of female enrollment varies substantially across different elective courses, with some courses being substantially above and some substantially below the national average. This raises interesting questions for future research into the characteristics that contribute to these differences. Another interesting finding is that the number of courses with female enrollment fell substantially (-10 courses) from 2010-11 to 2011-12; however, overall female enrollment in all courses increased 4%. Teasing out some of the factors that contribute to these trends is also an interesting area for future research. To begin this effort, we plan to conduct interviews with teachers whose courses had higher female enrollment. Meanwhile, we conclude that the overall higher female enrollment in Globaloria electives overall warrants the development of an NCWIT promising practice sheet.

Pre- and Post-Test Data

Boys' and Girls' Levels of *Interest* and *Confidence* in Computing Activities

Students' computing interests were examined in three areas: computer programming, software development, and game design. Overall, boys' and girls' interest in these three areas decreased after taking Globaloria classes. This finding is true at both middle and high school levels.

Students' computing confidence were examined regarding the following six aspects: "learning computer programming", "learning game design", "using software to create a game", "designing graphics for a game", "finding help with a technology problem online", and "learning game design using online tutorials". Overall, boys' and girls' confidence in learning programming and in game design decreased from pre- to post-surveys, while their confidence in the following activities remained constant: using software to create a game, designing graphics for a game, and finding help with a technology problem online. This finding is true for high school participants. It is

mostly held for middle school participants except that middle school boys' and girls' confidence in learning computer programming remained constant before and after taking Globaloria classes.

While decreases in confidence and interest may seem like a negative result, such decreases are quite common in introductory experiences in a number of fields. This is usually due to the fact that students learn more about what it really means to, in this case, "do computing" and they become more aware of all of the things they need to learn. This can function as a sort of "reality check" that can temporarily decrease confidence and interest. Research into what happens in future classes is necessary to determine whether these are lasting or temporary decreases.

Boys' and Girls' Computing Activities at Home and School

Globaloria courses did appear to increase some students' participation in computer activities at home and at school. This is also true when we examined the data by gender and school levels for computer activities participation at school.

When looking at the middle school level, taking Globaloria courses did not change middle school boys' frequencies of participation in computer activities at home, but it did appear to have a positive impact on middle school girls' participation in computer activities at home, including:

1) making graphics or animation on a computer

2) making computer games

3) making digital music, video on a computer

4) programming on a computer

5) using online tutorials to help with digital design projects

Meanwhile, taking Globaloria courses appeared to increase boys' and girls' participation in several computer activities at high school level, including:

1) making graphics or animation on a computer

2) making computer games

3) programming on a computer

4) using online tutorials to help with digital design projects

In general, these increases in computer activities seem a positive result. Because these increases in computing activities including activities like programming and making graphics or animation, they may potentially influence students' abilities and plans to pursue further technology education. However, we also know that computer activity does not always translate to plans to pursue education and careers in technology. Further research is needed to determine the nature of these increases in computer activity.

Gender Differences in Interest and Confidence

Overall, boys were more interested in computing and more confident in learning programming and game design than girls both before and after taking Globaloria classes. The one exception surfaced in designing graphics for a game, where boys and girls had similar levels of confidence before and after Globaloria classes.

A few other gender differences also emerged in other areas:

- Interestingly, boys had higher levels of confidence than girls in "finding help with a technology problem online" before taking Globaloria classes. This gender difference disappeared after they finished the Globaloria classes.
- While no gender difference was found in confidence in "learning game design using online tutorials" before taking Globaloria classes, girls became less confident than boys after they finished Globaloria classes.

When looking at middle and high school students separately, some interesting similarities and differences emerged:

- Middle school boys and girls had similar levels of computing confidence before and after taking Globaloria classes.
- Middle school boys had higher levels of interest in computing than girls, but gender differences in computing interests disappeared after students took Globaloria classes. While this appears to suggest that Globaloria classes help minimizing gender differences among middle school students; most of this gap disappeared because of the decline in the boys' interest levels, bringing it closer to the girls' levels of interest.
- For high school students, boys were more interested in computing than girls before and after taking Globaloria classes. For the most part, they also had stronger computing confidence than girls before and after taking Globaloria classes. The only exception to this was that no gender difference showed in confidence in designing graphics for a game in both pre and post.
- Gender differences in confidence in learning game design using online tutorials disappeared from pre to post.

Gender Differences in Computing Activities at Home and School

Gender differences in computer activities at home and at school were also investigated in the analysis. At the middle school level, before students took Globaloria classes, gender differences existed in most *home* computer activities except making graphics or animations on a computer. Three of these gender differences disappeared after they took Globaloria classes: frequencies of thinking up an idea for creative technology project, making computer games, and making digital music, video on a computer. Middle school boys' and girls' *school* computer activities participation remained unchanged before and after they took Globaloria classes. This appears to suggest that Globaloria classes have a positive impact on girls' participation in home

computer activities. Again, this is a positive result that requires further investigation in order to determine the effects of these increases on girls' interest and plans for technical careers.

At the high school level, boys had higher levels of participation in school computer activities than girls both before and after taking Globaloria classes. The only exception to this was that the gender difference in frequency in making digital music, video on a computer disappeared from pre to post. Gender differences were identified in four home computer activities both before and after Globaloria classes: "thinking up an idea for creative technology project" and "thinking up and idea for an interactive game," "making computer games," and "programming on a computer."

Meanwhile, no gender differences were shown in the following three home computer activities before and after Globaloria classes: "making graphics or animations on a computer," "making digital video on a computer," and "using online tutorials to help with digital design project."

Conclusion

The enrollment data for Globaloria is particularly promising. Overall, female enrollment in these courses was 33-37% during the 2 years studied, exceeding the national average. A number of courses were much higher than the national average, making these interesting sites for future research into how this higher enrollment was achieved. At the same time, a number of classes were significantly below the national average; teasing out the nuanced features that contribute to these lower enrollments is also worth attending to in the future.

This pre- and post-test analysis reveals that participation in Globaloria classes did show some positive affect on middle school girls' home computer activities but did not increase middle or high school girls' interest or confidence in computing. In fact, in most instances both boys' and girls' interest or confidence decreased slightly. As we noted earlier, however, small decreases in interest are not uncommon in introductory courses as it may simply reflect the fact that students

are more realistic now about what it means to "do computing" and are more realistic in assessing their abilities. Further study is needed to see how these trends play out over time.

Also, the lack of positive impact in these areas in the pre- and post-test findings are likely due to the fact that the pre- and post-survey were designed as part of a larger study attempting to measure a broader range of variables. As such, while some of the questions addressed technology and computing outcomes, they were not specifically designed to measure these outcomes. In the future, we propose to work with Globaloria to develop more sensitive survey items that can better capture these computing outcomes. We would recommend, however, to switch the focus to the Austin, Texas site so as not to disrupt the current study and survey in West Virginia. The Texas site is also ideal for future analyses because it employs a more comprehensive curriculum over the course of several years, which is likely to increase the opportunities for measuring changes over time.

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