

Evaluation of GEMS Infusing Computer Science

August 30, 2016

Laura Reasoner Jones

Lrjones806@gmail.com

A report to the CS Open Project

Evaluation of GEMS Infusing Computer Science

Introduction

Eight after-school GEMS clubs in elementary and middle schools in a rural Appalachia western Pennsylvania county serve over 175 girls. Elementary and middle school teachers are the leaders, with funding provided by a local community grant. The project funded by CS OPEN developed a model for infusing CS into the existing STEM clubs by training leaders and exposing girls to basic computer science. This model included choosing simple CS lessons and modelling the teaching of these lessons to the GEMS leaders. Lessons were videotaped and analyzed for evidence of engagement and interest in the girls.

Staff:

- Laura Reasoner Jones, GEMS Founder – Irjones806@gmail.com
- Angela Harriett, GEMS leader, middle school leader ahariett@mail.ocasd.org
- Sara Black, GEMS leader, elementary school leader sblack@mail.ocasd.org
- Kristen Sutley, GEMS leader, middle school leader ksutley@mail.ocasd.org

Delivered Programming

- Number of participants served—about 175
- Number of female participants—about 175 100%
- Race/Ethnicity—reflective of the makeup of this rural Appalachian county
 - White—98%
 - Black—2%
- Age range—8-14
- Number of contact hours per person—about 3

Evaluation Capacity Building Summary

Our evaluation looked at these areas:

GEMS members: Level of engagement with CS lessons

Understanding of CS concepts taught

Understanding connections to careers and people in CS

GEMS leaders: Comfort level with CS concepts in lessons taught

Interest in learning more about CS

Interest in teaching GEMS members about CS

GEMS outreach: Improvements in use with existing GEMS resources—

GEMS web page and Facebook page

Develop database of current and former GEMS members for outreach

Continue to increase CS resources for leaders, parents and girls

Google tools used:

- Prior to starting the project, the logic model was extremely helpful in delineating where GEMS is now and where it should be going. This helped us to identify areas of strength and areas of need. It also helped us to clarify our goals and plan for the grant period.
- The slides from the original grant webinar were helpful in organizing the project, as were Jason's evaluation worksheets.
- Sample interview questions would have been helpful, but later we shared them among the grantees and will be able to use them for future evaluations.

Collaboration:

- Webinars were helpful in hearing what other groups were doing. The grantees are such a diverse group with varied levels of programming and purpose.
- As mentioned before, interview questions were shared and this was very helpful.
- Cathy Law and I used the NCWIT conference to discuss and collaborate on robotics plans.
- I met Jason at the NCWIT conference—always good to see the guru in person.
- We shared evaluation forms.
- It would have been nice to know a little more about the other organizations and their programs. Will we be able to see final reports and see results?

Overall assessment:

- Our task was two-fold—to learn more about CS so that we could infuse it into GEMS, and to learn to better evaluate our efforts in GEMS. I believe that we have improved our capacity to reflect on our work and to value the importance of evaluation in planning.
 - Knowledge/skills: We have looked carefully at how we choose or develop activities and are becoming more skilled in tailoring them to our individual clubs. We have also worked to develop a more effective student evaluation tool to be used at the end of each 8-week session.
 - Changes made: GEMS leaders have come to understand the importance of saving time in the lesson for girls' reflection and discussion. This has led to deeper understanding on the part of the girls. The leaders also have been much more diligent about conducting the end of session evaluations, realizing that the information these provide is very useful.
 - Most valuable support: Having the evaluator (Kathy Haynie) available to us for questions and support was invaluable. She helped us focus on what was important to the purpose of the grant and supported us through each phase of the project. By working with me and one of the other GEMS leaders, she made us feel as though our work was significant.

Role of CS Open:

- Some of the evaluation would have happened without the CS OPEN project. We always ask the girls to complete a short evaluation of the sessions, and we always debrief as a group of leaders.
- With our evaluator, we created an observation form for use during the CS lessons. This would not have been used unless we were in the CS OPEN project.
- We also definitely would have not delved into CS in the consistent manner that we did. GEMS clubs are run on a club level. I do not dictate what lessons the clubs leaders design. But the grant was to infuse CS into the content, so the evaluation team provided two full CS lessons to each club during their spring sessions. That would not have happened at all. In addition, we would have not videotaped the lessons, as we normally do not have time to review or analyze the tapes. The grant provided a mechanism for reviewing the tapes, and it was very helpful.

GEMS CS Evaluation

Evaluation Questions:

- o At the beginning, our evaluation question for the project was “How can we infuse more CS into our STEM clubs? Sub-questions included “How can we help the GEMS leaders to teach CS concepts when they have no training or experience with these concepts?” and “How can we stimulate interest in CS with our club members—elementary and middle school girls?”
- o After the semester of club meetings and intervention, the questions became more refined:
 - Did modelling and teaching CS lessons change the GEMS leaders’ perceptions of and interest in infusing CS into GEMS?
 - Did CS lessons engage the girls and stimulate their thinking about CS concepts and careers?

Evaluative Measures/Tools:

- o Videos of each of the CS lessons
- o Rubric for analyzing videos --Appendix A
- o Classroom Observation protocol, completed by leader and girls, and by GEMS leaders—Appendix B
- o Leader questionnaire about future of CS and GEMS—Appendix C
- o Leader discussion
- o Student evaluations/survey responses--Appendix D and notes from discussions

Choosing the Lessons:

We decided to use lessons from CS Unplugged and CS Principles because they teach basic concepts without the expectation that schools or children will have sophisticated computer equipment. The eight schools where the clubs are held vary widely in their computer availability. Right now, we have clubs in two of the seven school districts in this rural county. One elementary school in one of the districts has one non-functioning computer cart, while another elementary school in the same district has three fully-equipped computer labs.

I selected eight lessons from the two curricula and shared them via Basecamp with the GEMS leaders who volunteered to be part of the project. They reviewed the lessons and chose two for the elementary school clubs and two for the middle school clubs:

Elementary school (grades 3-4)-- Binary Numbers and Sorting

Middle School (grades 5-8)—Algorithms and Image Compression

I rewrote the lessons with the age levels and leader background in mind, and shared them again. I also modelled the lesson for the leaders by teaching them first to one club, with the expectation that they would teach the lessons to another club.

Data Collection Focus:

We conducted 16 lessons, two in each club. The evaluation questions were broken down as follows:

Level of girls' engagement:

- Asking and answering questions
- Talking with each other about the lessons
- Trying new things/taking risks
- Excitement and persistence in the face of challenges

Understandings of the concepts taught:

- Solving the problem or challenge presented
- Completing the activities successfully
- Relating concepts learned to other learning

Connections to careers and people in the CS field

- Sharing who they knew in CS
- Discussing how what they learned could be used
- Showing a desire to learn more

Data Collection Process:

- Kathy Haynie developed the Classroom Observation form, and we used this after every session to document the success of the lesson and record the girls' interest and comments. (Appendix B) As we presented each CS lesson, we involved the girls from the beginning, telling them that we were videotaping to help us learn and become better GEMS leaders, and that we would be asking their opinions at the end of the session. We did this to reinforce that the videotaping was not being done for entertainment, and we found that the girls quickly became accustomed to the presence of the camera. Each of the videos was placed in a shared Google Drive folder so that other leaders could view it if they chose.

- After each CS lesson, we tried to save club time to go through each question on the Observation Form, reminding the girls that we were trying to improve our teaching, and telling them that we wanted their honest opinions. Responses to the questions of what worked and what didn't were always informative, with the girls being very clear about portions of the lessons which were not well-explained, or suggesting a different order of activities. I did not get forms back from all of the leaders afterward, and will be sure to ask them to fill them out during the lesson in the future. The most important component of this measure was the opportunity for the girls to participate in the lesson evaluation—they really felt as though their opinions mattered.
- We videotaped each lesson with the intention of using the videos to help other leaders. But they became much more useful than that. The videotapes clearly showed the level of engagement of the girls during all phases of the lessons, and caught many comments and interactions that were not visible or perceived by the leader who was intent on delivering content. They also showed distinct differences in teaching styles and room arrangements that could be used later for discussion on group management. Although reviewing videotapes is extremely time-consuming, it proved very worthwhile and will be enlightening as we move forward. This review is summarized in Appendix E.
- At the end of the semester, we always meet as leaders to debrief and discuss the previous sessions and plan for the next semester. The addition of the CS lessons required that we discuss these lessons in more depth, and we used a structured discussion to discover similarities and differences in the experiences. The leaders also completed a form to indicate their interest in continuing to infuse CS and the support/training needed to do so, as shown in Appendix C1. It is interesting and gratifying to note that while it was difficult to recruit among the GEMS leaders for the initial project of teaching the lessons, every single GEMS leader indicated an interest and a willingness to learn more about CS and share this in GEMS. This will be used to plan training for the next school year.
- All of the girls complete evaluations at the end of the semester, indicating their preferred activities and what they liked and disliked. We also ask them their plans for the future. We use their comments for planning, but have found that they are not particularly predictive. We find that even though we ask them not to discuss their answers with their friends, many answers are exactly the same, meaning that they shared opinions. At this time we do not have time or resources to do online evaluations or conduct extensive interviews, though this could be explored in the future. Appendix D is attached, and the findings will be summarized for the final report.

Data Review and Analysis —Lessons Learned and Challenges:

- Video rubric—Appendix A: this turned out to be too unwieldy in its present form, but it was very useful in determining what to look for in the videos. Reviewing video is always a very time-consuming method of evaluation, but as mentioned before, it gave us very useful information

that would not have been noted by an observer, and it provides a record and an example for leaders who want to teach these lessons.

- Classroom Observation Form—Appendix B: The leaders who completed this after the lesson was finished gave us a great deal of information that we used to refine our teaching immediately and can use in the future. It also served as an excellent discussion guide as we asked the girls to reflect on the lesson. We will probably change it a little for the fall.
- Leader questionnaire—Appendix C: This gave us exactly what we need to plan for the future in GEMS and CS.
- Student evaluations—Appendix D: always a weak link in GEMS. Over the years we have tried adapting the surveys from AWE <https://www.engr.psu.edu/awe/misc/about.aspx> but have never felt that they really got at the heart of what we wanted to know. Appendix D is the latest iteration of our survey, and we are pleased with the questions, but feel that the girls do not spend enough time and thought on it. We continue to explore different methods of evaluation.
- Notes from video review—Though it took over 26 hours to review and annotate the videos from the CS sessions, the time was well-spent. We were able to see evidence of the evaluation questions and really document engagement and interest. We also were able to immediately change portions of the lessons that did not work well and share the changes on Basecamp.

Key Evaluative Results:

- Did modelling and teaching CS lessons change the GEMS leaders' perceptions of and interest in infusing CS into GEMS?
 - As evidenced by the end-of-semester evaluations and discussions with the leaders, the answer is yes. All eight of the leaders expressed strong interest in pursuing more training in the principles of CS, and in adding more CS activities and content to the GEMS curriculum. During our 2016 fall planning meeting, each of the leaders talked about how she could learn more about teaching CS, and we shared stories and plans for the fall.
 - The three evaluation team leaders and an additional GEMS leader participated in a summer camp we held for middle and high school girls. They expressed that they were looking forward to learning more about programming.
- Did CS lessons engage the girls and stimulate their thinking about CS concepts and careers?
 - Absolutely. The videos show the total engagement of the girls in the lessons, and their discussions during and after the lessons showed that they understood the concepts and thought about careers.
 - I reviewed the girl evaluations after the end of the GEMS sessions and found that out of 98 evaluations returned, 63 of the girls listed the computer science lessons as "things we liked best." There were many comments about the CS lessons such as "Programming was fun" and "it was good for my brain." Other girls said "These

activities make us smarter and stronger” and “The Computer Science activities were awesome—you had to think exactly like a computer.”

- Did these results match your expectations?
 - I did not expect every GEMS leader to be as interested as they are in pursuing adding CS to the GEMS curriculum. But I was pleasantly surprised. I feel that they were concerned that they would not have the support they needed, or perhaps that the concepts, being unfamiliar, were too hard. I think that they could easily learn to teach these concepts, given support and resources, and they are planning to add more CS to their fall and spring sessions.
 - I thought that the girls would like the CS activities, and they did. Some of the comments on the evaluations indicated that the chosen lessons were “too hard” in the girls’ estimation, but in general they liked them very much. There is absolutely no CS taught in these school systems, and many of the girls have no computers at home. I think they liked learning new things, and they very much liked feeling successful.

Implications:

- The implications are obvious. We need to and plan to add much more CS into the weekly GEMS activities. We are well-positioned to do this because the first sessions went so well. The leaders are excited about including CS and are looking for resources to include. I feel certain that the girls in this county will be learning more and more CS concepts in the future.

Evaluative Reporting:

- Results of this have already been shared with all of the GEMS leaders in the county. The mid-project and final reports will be shared with the funder/fiscal agent Bridge Builders Community Foundations.
- We are preparing a major press release about all of the GEMS programs for the county newspapers and for the STEM Connector and these results will be included.
- We will include a summary with resources on the GEMS web site and on our Facebook page.
- We will report the increased capacity of the leaders and the success of the lessons with the girls.
- We are already using the results by including more CS in our chosen activities.

Next Steps for GEMS with CS

- As discussed at the first meeting with our evaluator Kathy Haynie, I am updating our web site to include more Computer Science resources and lessons for GEMS leaders all over the world. I also have made the Facebook page comment-friendly so that we can become more of a community.
- We are starting to create a database with GEMS members from 20 years of signups. A slow process, but it is coming.
- The summer camp that we held created an exceptional set of personal statements using programming that the girls are using to combat bullying. Please look at it here. <http://tinyurl.com/girlencouragment> or http://gemsclub.org/coding_in_the_cloud_2016
- Most importantly, I have culled all of the enquiries from the GEMS site for the past three years (over 300) and have contacted each of them to find out if they have started or joined GEMS clubs. I hope to find the location of more of the clubs we have inspired.

Appendix A: Rubric for Analyzing Videos

GEMS CS Video Lesson:

School:

Date:

Video number:

Engagement	Time Code	Comments	Time Code	Comments
Asking Questions				
Talking with Other Girls				

Engagement	Time Code	Comments	Time Code	Comments
Trying new things--risks				
Excitement/persistence				

Engagement	Time Code	Comments	Time Code	Comments
Gaining Confidence				
Understanding Concepts Asking questions about the activity that helped them problem-solve				

Understanding Concepts	Time Code	Comments	Time Code	Comments
Problem-solving evidence by talk/discourse and work produced				
Successful completion of activity				

How well did activities work for these girls?	Time Code	Comments	Time Code	Comments
Overall interest and enjoyment				
Follow-up conversations				

How well did activities work for these girls?	Time Code	Comments	Time Code	Comments
Appropriate level of challenge				
Connected to computational thinking				

Persistence/Careers	Time Code	Comments	Time Code	Comments
Desire to go home and show friends and family				
Making connections with computer science as career				

Appendix B: GEMS CS Classroom Observation Form

Site/School: _____	Date: _____
Name of GEMS Club: _____	Your name: _____
Number of Girls: _____	GEMS Leader: _____
Observation start time: _____	Observation end time: _____

Was there another adult engaged in the class session? Yes No If so, who?

Describe the CS activity here (3-5 sentences), including materials used, technical difficulties, and any additional context or other special circumstances (e.g., visitors, emergencies, misbehavior).

What did students think about? What did they learn? Were there any learning difficulties?

What aspects of the activity worked well? Why?

What aspects of the activity did not work well? Why?

Notes on Career Connections

Other Notes, Next Steps, etc.

Appendix C: Leader Questionnaire

GEMS CS project comments/evaluation/feedback

Name: _____

Do you want to learn more about Computer Science and programming to use with GEMS? _____

If so, what do you want to learn more about?

_____ General CS concepts (similar to what we did in those lessons)

_____ Programming for kids: Scratch, Alice, Java, etc

_____ Computer hardware and electronics—this include soldering and robotics

If you are interested in learning more about CS, what kinds of support would be helpful for you to become more comfortable?

Check all that you like, and add more.

_____ Written instructions

_____ Tutorials

_____ You Tube videos

_____ Assistance in teaching—modeling, extra hands during the session

_____ Books

_____ Practice sessions

Appendix D: GEMS Member Questionnaire



Evaluation—Spring 2016

Name: _____

Grade: _____

School: _____

These are the activities we did. Put a ✓ by the ones you like best.

- ___ Army men catapults (snowed out for Tuesday club)
- ___ Computer Science lesson—algorithms with candy bars
- ___ Chromatography
- ___ Computer Science lesson—image compression--squares
- ___ Eyeball dissection
- ___ Bungee eggs
- ___ Rockets and buckets

Why did you like them? _____

Here are the activities again. Put an X by anything you didn't like.

- ___ Army men catapults (snowed out for Tuesday club)
- ___ Computer Science lesson—algorithms with candy bars
- ___ Chromatography
- ___ Computer Science lesson—image compression--squares
- ___ Eyeball dissection
- ___ Bungee eggs
- ___ Rockets and buckets

Why didn't you like them? _____

Do you plan to come back to GEMS? _____

What is your favorite subject? _____

What do you want to be when you grow up? _____
