Wise Guys and Gals (WGG)
Interim Evaluation Report Update
(2019)

Background

WISE Guys and Gals – Boys & Girls as *WISEngineering* STEM Learners (WGG) is a five-year Advancing Informal Science Learning project funded by the National Science Foundation (NSF). WGG introduces informal, blended STEM engineering design challenge activities to middle school aged youth who attend Boys & Girls Clubs (B&GCs.) As B&GC youth work through their design challenges, they engage in engineering design thinking and learn about engineering careers. These youth, typically underrepresented in STEM areas, also enhance their STEM knowledge through WGG activity participation. A main objective is to pilot and revise these activities so that they can be implemented in other B&GC or other informal STEM settings. As B&GC youth work their design challenges they practice engineering design thinking and learn about engineering careers. These youth, who are typically underrepresented in STEM areas, also enhance their STEM knowledge through WGG activity participation. The project developed and is studying brief (75-minute) and long (up to three-hour) blended (virtual and hands-on) engineering design challenges and enhancing *WISEngineering*, the online platform used to deliver the activities.

Project Goals and Objectives

WGG has three major project objectives:

1) Develop blended (both virtual and hands-on) WGG engineering design challenges and enhance the computer host platform *WISEngineering*
2) Pilot and revise the WGG design challenges based upon what is learned, and
3) Evaluate project materials, and model

WGG Evaluation Approach

The WGG evaluation is documenting and assessing progress meeting the project goals including the development, delivery, and outcomes of the WGG activities. During 2018-2019, WGG continued to study the WGG informed design engineering activities at partner clubs. The evaluation team:

1. Attended all major project meetings
2. Continued to review WGG created materials (e.g., dissemination efforts, new activities, etc.)
3. Collected and analyzed WGG evaluation data
4. Created a STEM Video for the NSF Video Showcase
5. Worked with project team on alternative dissemination efforts and development of sustainability efforts

This evaluation update describes what has been learned from the data analyses to date. Although data review and synthesis has been ongoing, the major data collection period for WGG was late spring through the summer (i.e., at the end of the program year allowing for reflection about the overall experience).

Data Sources and Analytic Approaches

Data collection has been ongoing from a number of sources, namely:

Notes from meetings: The project evaluator attended all project meetings (team meetings, advisory board meetings, informal discussions, etc.). Notes were kept from meetings and these are used to inform the evaluation results.

Review of activities and project work: The evaluation team reviewed all project materials, including activities, training materials, dissemination reports, etc. to assure their alignment with project goals and accuracy in relation to what has been learned. Feedback was provided for enhancement before materials were shared broadly.

WGG Youth Survey: B&GC youth currently completing WGG activities and youth who had previously completed WGG activities answered survey questions designed to assess student learning and engagement. Their responses were reviewed and reoccurring themes identified.

Facilitator Feedback within WISEngineering. Following each activity Facilitators answer several questions about how they prepared for the activity. They then answer three to four open-ended outcome questions pertaining to outcomes. These questions address youth learning, youth engagement, or personal engagement and vary across activities. The open-ended responses were summarized and common themes identified within and across questions.

Figure 1. Structure of Facilitator Questions within *WISEngineering*

WGG Activity	Facilitator asked to reflect about
High Five	….. **preparing youth** for WGG
Optimal Potato chip	….. **youth engagement** in WGG
Design for sound	..... **youth learning** in WGG.
Slime engineering	….. **youth engagement** in WGG
Prostatic Challenge	..... **youth learning** in WGG.
Hoover above it all	….. **YOUR personal learning.**
Need some support	….. **youth engagement** in WGG
Design your path	..... **youth learning** in WGG.
Kaleidoscope Design	….. **youth engagement** in WGG
Dance party	….. **Dance Party** activity**.**
WuGGs to the rescue	..... **youth learning** in WGG.
Designing Rockets	….. **YOUR personal learning.**
Shark Tank	…. **about the activity**
Solar Cooker	..... **youth learning** in WGG.
Splash Down	….. **youth engagement** in WGG

Facilitator Interviews: B&GC facilitators were asked to participate in semi-structured interviews that lasted approximately 20 minutes. The interviews allowed for deeper exploration of topics related to delivery and impact. Common themes were identified.

Boys and Girls Club - WGG Annual Program Reports: Every six months the clubs submit data about their involvement in WGG, the number of youth engaged, and other questions related to program planning and delivery. In 2019, reports were submitted in March and will again be submitted in June. The reports are required to receive payment from the project. Each time the survey is administered, it is modified slightly to reflect different areas of investigation. Responses are then summarized and answers to open-ended questions coded by theme.

WISEngineering embedded data: As part of each WGG activity, youth answer a variety of questions and their responses are recorded in *WISEngineering*, the online platform that hosts the WGG activities. Questions are designed to scaffold youth learning as they engage in the design challenge. The questions are intentionally written to be answered correctly by most youth rather than to differentiate among youth. Each activity includes a different set of questions relevant to that activity. As a result, there is variability across activities. However, most activities include questions to assess youth understanding of specifications and constraints, the embedded STEM knowledge, testing of the design, and ways to improve the design. Additionally, youth can record narratives about their work and upload pictures. The questions assess youth's understanding and engagement in engineering design thinking as evidenced through the WGG design cycle. However, since each activity has questions specific and meaningful for that particular activity, the number of questions, answer formats (e.g., matching, open-ended, multiple choice, rank-ordering, etc.), and even whether all parts of the design cycle are present varies. *WISEngineering* data from 2018-2019 are still being collected and will then be cleaned. (As described in prior reports, cleaning of *WISEngineering* data presents numerous challenges, in part, because the data were extracted at the page level rather than question level. Data cleaning will commence shortly and will yield over of nearly 100,000 individual entries.) The results discussed in this report describe *WISEngineering* data collected during 2017-2018.

National Youth Outcomes Initiative (NYOI) Survey: In 2016, Boys and Girls Club of America (B&GCA), the national organization, added STEM-related items to the NYOI survey, their annual survey administered at approximately 2,700 B&GCs to more than 170,000 youth. The STEM questions ask about interest, identity, efficacy, and career knowledge. B&GCA shared the responses of youth to each STEM based question. However, these data are incomplete since participation in the NYOI survey was voluntary and different clubs participated each year. B&GCA also shared national frequencies for each of the questions for the three years.

Review of participating B&GC websites: Each participating B&GC website was reviewed for evidence of WGG, other STEM programming, size, grant support and other relevant variables. A database is being created to help with interpretation of the data.

Observations at B&GCs: Observations were conducted at several clubs and the observers kept detailed notes. During spring 2019, a structured observational protocol was created. Since many clubs are not local or easily reached by public transportation, the WGG team needed a way to have club Educational Leads observe and document WGG youth

engagement level. (The hypothesis is that increased engagement will be correlated with increased learning.) A pilot observational protocol was developed and proof of concept work has begun to assess its usefulness by the clubs and by the evaluation team.

Project Activities and Administration

WGG's *Management and Organizational Structure is Effective*

The WGG organizational structure continues to effectively promote not only project delivery but also engages team members and participants in meaningful ways. This structure has been adapted to best meet the changing needs of the program. For example, as the team moved from providing direct support to clubs, the club Liaisons began exploring and testing innovative ways to disseminate WGG. An important reason for the WGG management success has been a willingness to engage all partners based by listening to their interests and helping direct their particular expertise in ways that benefit WGG.

WGG Makes Adjustments Based on Evaluation

WGG continued to respond to the evaluation results and advice of the Advisory Board and to enhance and improve the work. *WISEngineering*[1] was further revised and refined based on what was learned during delivery at the clubs. As a result the number of clubs with technology problems was greatly reduced. Similarly, when there was a need to revise a WGG activity (e.g., simplify the language), the team was able to address user concerns and improve the activities. STEMgineering was created in response to requests to provide additional support to new or continuing users who did not want or could not host the *WISEngineering* platform,

WGG Continued to Complete Project Activities within Proposed Timelines

During 2018-2019, WGG was again implemented at B&GCs. Clubs engaged the required 10 youth in each activity. Despite some variability, more clubs successfully engaged youth in multiple activities by using a cohort approach to recruitment and delivery. Clubs also reported fewer problems recruiting youth and fewer technical problems during the past year.

WGG Data findings about delivery and outcomes

WGG data collected the previous year were analyzed to more deeply understand outcomes and to develop hypotheses for investigation with the 2018-2019 data set. Data from all data sources were reviewed and synthesized. In most cases, the findings were consistent across data sources. This section presents the key findings. The evaluation and program team are currently writing several manuscripts intended for publication about what has been learned.

[1] *WISEngineering* is built off of the Web-based Inquiry Science Environment (WISE), developed at Berkeley University. WISE is an open-source computer-based learning management system that allows educators to author inquiry based science projects. It was also designed as a research tool for gathering of student data in schools. WGG worked with the Hofstra Computer Science department to enhance the *WISEngineering* platform.

Analytic approach

The following data steps were used to study WGG outcomes related to delivery, engagement, and learning:

- Each data source (e.g., surveys, interview transcripts, etc.) was reviewed and cleaned. When necessary, as in the case of *WISEngineering*, macros and data transformations were created and applied. Meaningless responses were deleted.
- The final data sets were studied. Descriptive statistics (frequencies, means, standard deviations, etc.) were examined for survey and other quantitative data. When appropriate, other statistical approaches were used to interpret the quantitative data. Qualitative data were analyzed using qualitative coding software. Common themes were identified based on hypotheses about the data (e.g., youth were engaged) and allowed to emerge. When appropriate quantitative indicators were created based on the qualitative codes. These were then added to the WGG youth level and club level data sets.
- Consistent and disparate findings within and across data sources and data types were interpreted.

The WGG Materials Supported Successful Delivery of WGG Activities:

Facilitators, even those with limited STEM experience, were able to successfully use the WGG support materials, including the written facilitator guides and WGG video guides to implement the WGG activities with minimum or no support from the Liaisons. Although facilitators varied in how they prepared for WGG, the importance of organizing the needed materials, reviewing the written guide and/or videos, and generating excitement among the youth were themes common across clubs and facilitators.

Table 1. How facilitators prepared for WGG activities

How Facilitators Prepared	Frequency								Weighted Average
	Never		Only for a few activities		Sometime/if needed		Always, for all activities		
	n	%	n	%	n	%	n	%	
Read the facilitator guide	1	7.14%	1	7.14%	4	28.57%	8	57.14%	3.36
Watch the facilitator video	2	14.29%	2	14.29%	6	42.86%	4	28.57%	2.86
Review the activity in WISEngineering	0	0.00%	2	14.29%	2	14.29%	10	71.43%	3.57
Complete the activity myself	0	0.00%	4	28.57%	7	50.00%	3	21.43%	2.93
Talk to someone who facilitated the activity before	7	50.00%	3	21.43%	3	21.43%	1	7.14%	1.86
Call the WGG project team/liaison	7	50.00%	2	14.29%	5	35.71%	0	0.00%	1.86

Many facilitators spent time engaging the whole group in discussion about the activity before youth began working on the challenge.

> *"We talked about the next activity at the end of the current activity... what it is, how/why it is a STEM activity, what makes it fun/interesting, etc."*

Frequently Facilitators discussed with youth how the design challenge relates to their everyday knowledge (or lack thereof.) For example, they might discuss how a speaker works and then introduce the challenge of designing a speaker for their smart phone. The reliance on Liaisons for training and support continued to be low, even when the facilitator was unfamiliar with WGG. Instead, the virtual and video guides were the key resource to support delivery.

> *"I would provide real life examples of that project in the news. Ex: For Prosthetic leg, I found an article about a teenager who designed an arm out Legos."*

Table 2. Ways youth were prepared for the WGG activities

Ways youth were prepared	Frequency								Weighted Average
	Never		Sometimes		Always		Just for a few activities		
	n	%	n	%	n	%	n	%	
We talk about the activity as a group	0	0.00%	0	0.00%	14	100.00%	0	0.00%	3
I show them something designed last year	2	14.29%	12	85.71%	0	0.00%	0	0.00%	1.86
We talk about the STEM careers	0	0.00%	5	38.46%	8	61.54%	0	0.00%	2.62
Youth watch the facilitator video	7	50.00%	4	28.57%	2	14.29%	1	7.14%	1.79

WGG was Successfully Delivered:

The data showed that B&GC management and organization was not always aligned with the WGG project anticipated design. Clubs were often inconsistent about completion of activities, consistency of youth participating, and order of delivery, resulting in varied response rates within and across clubs. Many clubs allowed youth to "drop in" and "drop out." Although each club met the required participation numbers, in some cases different youth participated each week. Additionally, clubs often adapted activities to meet the needs of their youth and their club culture. For example, the order in which activities were delivered, or the way they were presented to youth often varied. Sometimes clubs included youth who were not part of the WGG group, such as a younger youth. The evaluation searched for patterns to explain the choices made but these patterns were unique to the club or the facilitator. The data showed that WGG was able to allow for such adaptations and clubs were able to make the program meaningful within their own club context.

"Club member K (a fourth grader) took an invested interest in the WuGGs to the Rescue WGG project when he visited the Tech Lab and witnessed the project being run first hand. K laughed as he saw middle school members testing out their duct tape designed shoe, but was steadfast in his commitment to construct one of his own. Working 1:1 with K supplying him with the steps, materials, and assistance to create a pair of shoes of his own, caught the attention of other, also younger Club members as well. Giving them a brief glimpse in a program they will one day be able to participate in is a great incentive. After three days of finding a little time here, a little time there, K. was able to complete the pair of shoes which he even proudly wore to school to show off to his class."

However, the B&GCs often focused on "activity delivery and outcomes" (building the design or model) than the "activity process" (planning and redesign) despite feedback and encouragement from the WGG team. That is, Facilitators and youth often described the activity and its delivery in terms of "what was created" rather than the processes used to create the design. This finding was consistent across different data sources and across clubs. To explore this further, facilitators were asked to reflect on the strengths of WGG. Analysis of their responses revealed six themes, with multiple themes sometimes appearing in the same written reflection.

Strengths of WGG Reported by Facilitators
(Responses could be coded into multiple themes)

- The WGG activity itself - 44.1%
- Use of informed design and testing of a design - 43.3%
- Group Work involved - 11.8%
- Youth presenting and sharing about designs - 7.9%
- Brainstorming 7.1%
- Clear steps of administration - 3.1%

As expected, the most common strength was reported to be the activity itself (44% of Facilitators) or clear steps of administration (3%), responses that appear focused more on the challenge. While not conclusive, this result was interpreted as aligned with the observation that clubs often focused on the model building. However, almost the same percentage of facilitators (43%) described a strength in terms use of informed design and testing of a design, a strength more aligned with the WGG intended focus on process and thinking. Other themes related to the interpersonal and social components of WGG (group work, sharing ideas, brainstorming, etc.) Proof of concept work with *WISEngineering* had suggested a strong social/youth development aspect of engaging youth in the activities. This seems to be evident in this response.

"…allowed them to learn how to work together. It's allowed them to try new things. We do have a couple new kids, and some of the older kids who've done it have helped the new kids... A lot of the older kids really stuck with the new kids and they were saying oh I did this last year maybe we should try this again."

Based on feedback from B&GC leadership this shift in thinking, from completing a design to creating the design, requires continued scaffolding and reminders. To address this focus on creating something Shark Tank was amended in 2018-2019 and Facilitators were encouraged to not only have youth describe a design challenge but also actually build a model.

Youth Engagement was High

Evidence of youth engagement was evident across all data sources. Facilitators reported youth liked the activities and youth were engaged. Observations at the clubs showed youth involved and engaged. Youth reported the activities are fun and at some clubs youth request to "do the activity again." Although facilitators sometimes struggled to balance providing direction with allowing youth to seek their own solutions, most were able to successfully support youth taking a leadership role in their designs. It was also found that building youth anticipation and interest was key to success and clubs took a variety of approaches. For example, some clubs discussed with youth the activities to be completed the week before they were delivered while other clubs posted pictures of designs from prior years. The result was similar, youth typically described the activities as fun and engaging, as evidenced by what a facilitator shared:

> *"…having members asking me day after day: what are we going to be doing for science today? I can see the excitement in their eyes because they really look forward to being a part of science class. WGG focus on many STEM careers and concepts instead of one particular theme. This makes STEM more engaging for members because they are doing something totally new for each activity." (facilitator)*Youth also shared a similar sentiment:
>
> *"Because it inspires" (youth)*
>
> *"It is fun and you can learn a lot of thing new." (youth)*

There is Evidence of Youth Learning

> *"You watch them, and they figure something out, and it's like 'Yeah you know, how hard was that guys? You just need to think a little.' They're really used to being handed too many quick answers. So this was a real a real challenge for them, and me, to not just immediately give them those answers."*

Facilitator perceptions of learning: Facilitators reported that youth were learning about STEM and the engineering design. They reported an increased interest in STEM and an interest in working together. Some students who had previously shown little interest in STEM were engaged and looked forward to participating in the WGG activities.

> "*As a facilitator I have noticed a change in the way children view science over the past few years of WGG programs. In the earlier stage of this program, members were frustrated and had no interest in doing science after school. Today, the younger children cannot wait to do STEM and the members who participate are excited for the next experiment.*"

Youth also learned how to work collaboratively and persisted with their tasks:

> *"During our experience with the Hover Above it All experiment, members were diligently working to build their hover boards in an effort to competitively see whose board would propel the furthest when faced against the fan. In this competition, they were acknowledging the efforts made by their peers but were hyper-focused on following their own set of tasks to create the best board possible"*

Youth perceptions of learning: The evaluation team was well aware the youth are unlikely to respond in meaningful ways if asked "*what did you learn*?" Such questions result in a specific topic (e.g., to build a speaker), or a general "*a lot*" response. Therefore, the evaluation team asked youth "*Do you think teachers would like WGG?*" With only a few exceptions, youth reported teachers would like WGG. However their reasons for liking were varied. The most common reason "*WGG is fun*" (30%) or "*You learn something*" (23%). Youth also reported teachers would like WGG because "*WGG is about STEM*" (10%) and WGG is hands-on and involves building (10%). The remaining responses could not be coded into themes as they were quite diverse

> *"because it's talking about that subject which is science and this program WGG can show many examples of making activities to middle or elementary school."*
>
> *"Because it's a fun activity that helps kids focus better. (Because they want to listen a lot so they can make cool things.) Also you can learn how to make things and learn about technology."*
>
> *"My science teacher loves to do hands on activities. I told him about the projects."*

Youth were also asked to "*write a commercial for WGG*." Their responses also demonstrated youth learning and engagement

> *"I think that WGG is good because it stimulates the brain and helps with critical thinking"*
>
> *"Do you want an interesting and educational program to help provide your kids with the necessary skills to do well in school. WGG can help."*

Analysis of data extracted from *WISEngineering* showed evidence of learning: The *WISEnigneering* dataset represents an effective way to assess youth learning. However, the dataset is complex and requires significant transformation before it can be imported into a database. After the data are downloaded, each data cell requires a macro to transform the data to a usable format. Once the database was created, each variable is identified by its corresponding engineering design concept: specification and constraints, knowledge development, solution ideation, testing and evaluation, reflection and redesign. In many cases, two scorers evaluated the youth responses for evidence of understanding or application of the engineering design concept. Questions were coded as:

1 :	Clear evidence of understanding
.5:	Partial understanding
0:	Lack of understanding or no response

Means were then computed for each of the five engineering design concepts (specification and constraints, knowledge development, solution ideation, testing and evaluation, reflection and redesign) such that means ranged from 0 to 1. An overall engineering design concept construct mean was then computed for each by averaging the five individual scores construct.

In summary, for each activity six scores were computed ranging from 0 to 1.

- Understanding of specification and constraints,
- Understanding of knowledge development,
- Understanding of solution ideation,

- Understanding of testing and evaluation,
- Understanding of reflection and redesign
- Overall understanding of engineering design (average of above

What was learned from *WISEngineering*

Although it was expected that the youth would complete multiple WGG activities (i.e., as a WGG cohort at each club), during 2017-2018 many youth completed only a small number of activities. Nineteen percent of the youth completed only one activity, and 16.3% completed only two activities. Furthermore, clubs were inconsistent about the order of delivery so it was not possible to do any type of time series analysis (i.e., some youth might complete the potato chip as the first activity in September, while others might complete it as the fifth activity in January).

Evidence of Deep Understanding

An understanding score (ranging from 0 – no evidence of understanding to 1 evidence of deep understanding) was assigned to each construct for each activity. As noted above, youth varied in the number and specific activities completed. Looking across all activities completed by an individual youth, youth who demonstrated high understanding of a construct for at least one activity were identified. For example, a student had a construct score of "1 – evidence of deep understanding" in at least one activity. Using this criteria, at least half the youth demonstrated high understanding of each construct.

- Specifications and constraints - 72% of youth demonstrate high understanding
- Knowledge development – 57% of youth demonstrate high understanding
- Solution ideation – 69% of youth demonstrate high understanding
- Testing and evaluating – 82% of youth demonstrate high understanding
- Reflection and redesign – 87% of youth demonstrate high understanding

Facilitators also reported youth were learning about the engineering design process. This is illustrated in the following quotes:

> *"The success of the WGG was the exposure to these activities, learning about following a process, probably most importantly solving problems on their own using each other, logic, and trial and error."*
>
> *"As trials and experiments began, it was evident that they started to see what other people did differently or how certain factors altered the propulsion of the boards. After the experiment was completed, in groups they began to work together to create the ULTIMATE prototype. Watching our middle school members challenge each other to take the activity further was not only inspiring but a great acknowledgement to their own personal learning process."*
>
> *"As they designed, tested, re-designed, and re-tested, the group was really getting excited about how well they were doing. Their excitement caught on to the other groups and now the other groups were trying to better that design. It was really fun to watch the kids use critical thinking skills, along with friendly competition."*

More Exposure Led to Greater Youth Understanding

As noted elsewhere, youth completed activities in different orders and the activities varied to the degree each construct was stressed. The number of activities each youth completed was computed and exposure level was identified as:

- Small exposure (1-3 activities completed)
- Moderate exposure (4-6 activities)
- Strong exposure (7-9 activities)
- Great exposure (more than 10 activities)

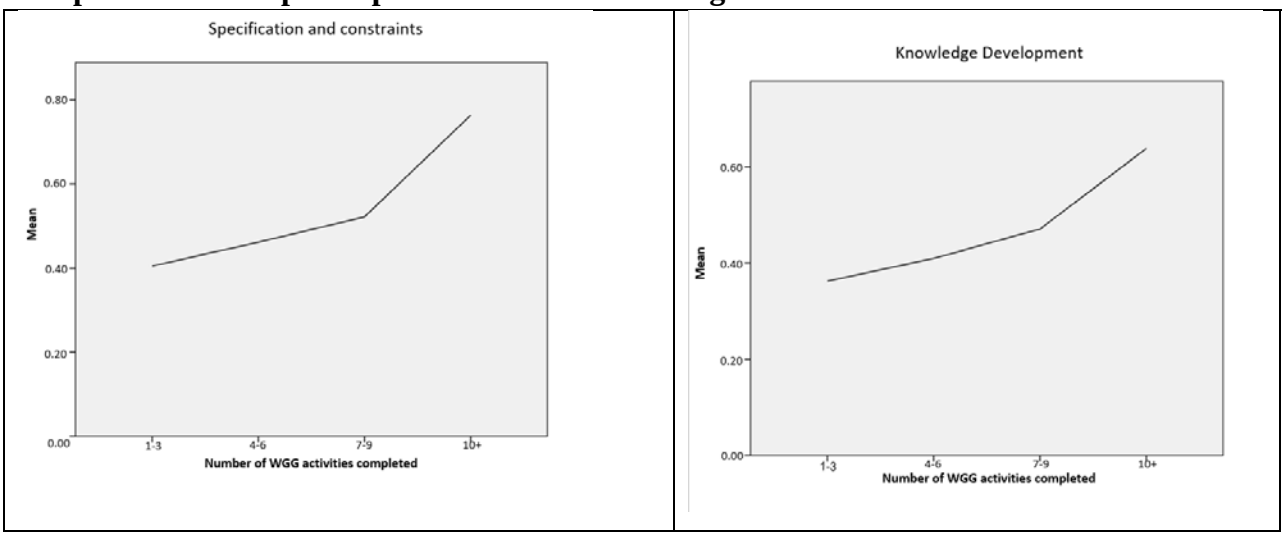
Table 3. Mean (std dev) Engineering Design Process by number of activities completed.

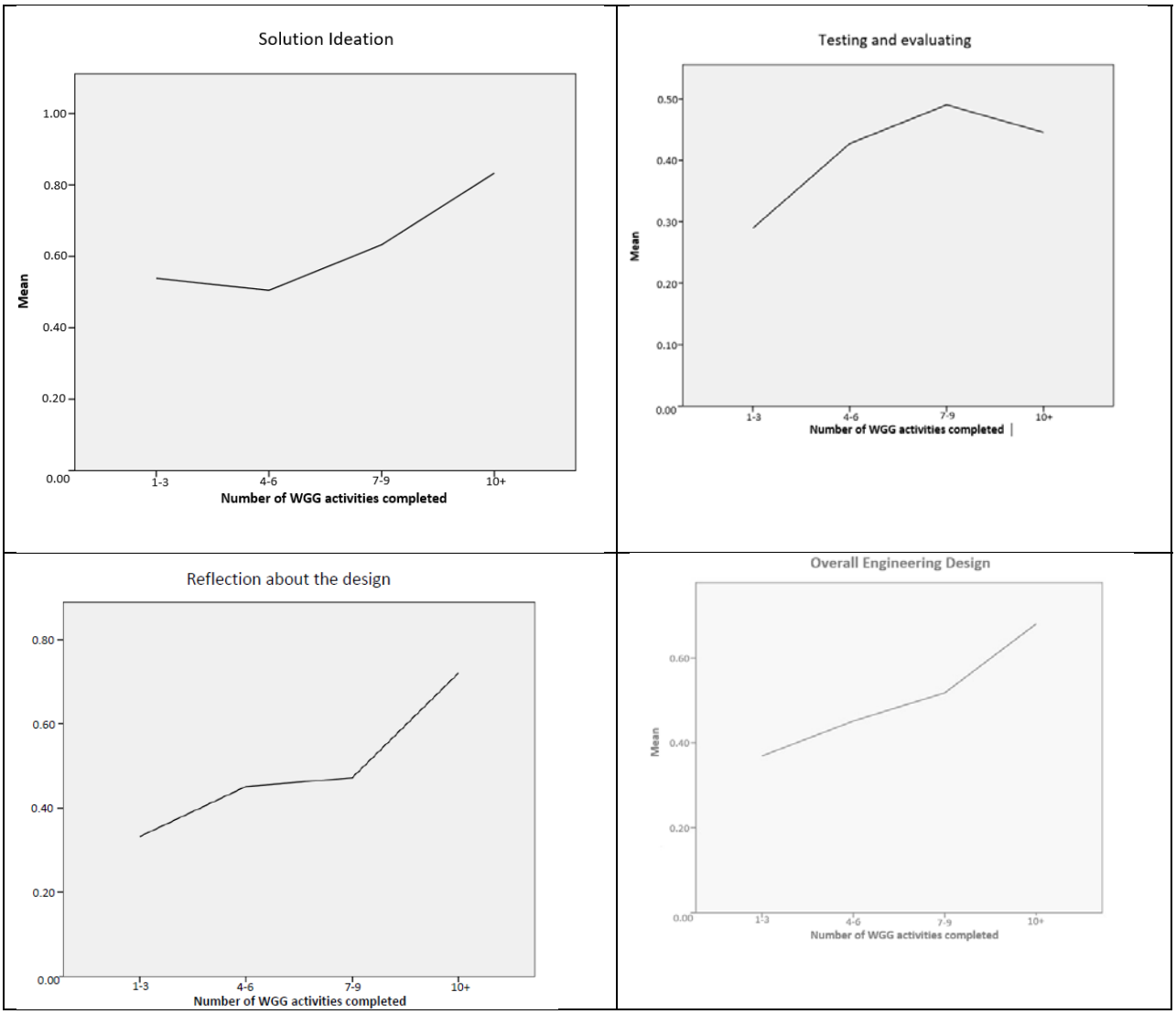
Number of Activities Completed	Engineering Design Process					Overall
	Specifications &Constraints	Knowledge Development	Solution Ideation	Testing & Evaluation	Reflection & Redesign	
1-3 activities	.405 (.393)	.369 (.388)	.539 (.489)	.290 (.238)	.332 (.400)	.369 (.236)
4-6 activities	.451 (.212)	.410 (.322)	.505(.463)	.427 (.218)	.462 (.309)	.451 (.303)
7-9 activities	.522 (.309)	.471 (.298)	.632 (.416)	.490 (.208)	.472 (.276)	.518 (.198)
10 or more activities	.763 (.193)	.638 (.168)	.833 (.225)	.445 (.202)	.721 (.221)	.680 (.122)

Note: means can range from a low of 0 to 1

Means for each construct were then graphically examined over the four time periods. As seen in the following graphs, youth who participated in more activities demonstrated greater understanding of individual and overall engineering design.

Graphs 1-6. Youth participation and understanding.





Possible Variability across Clubs

The data were examined to explore whether potential differences across clubs existed. Table 3 presents the mean engineering design construct score (overall score). As seen in this table the means varied by club. Glen Cove had the overall highest mean and Greenville Baker the lowest. Interpretation of these data should not extend beyond acknowledgement that there may be club differences that need to be explored. Given that the clubs varied in how activities were delivered and the number of youth participating, the means need to be weighted and carefully interpreted. The 2018-2019 data will be examined with this in mind.

Table 3. Mean (standard deviation) for Engineering Design Process by club completed.

Boys and Girls Club	Engineering Design Process					Overall
	Specifications &Constraints	Knowledge Development	Solution Ideation	Testing and Evaluation	Reflection and Redesign	
Bellport	.579 (.296)	.419 (.280)	.517 (.431)	.366 (.180)	.480 (.262)	.473 (.181)
Bristol CT	.427 (.349)	.535 (.302)	.467 (.481)	.387 (.226)	.424 (.268)	.442 (.195)
Children Aid Society	.632 (.281)	.496 (.220)	.907 (.275)	.382 (.190)	.578 (.290)	.572 (.193)
Glen Cove	.654 (.250)	.672 (.299)	.776 (.338)	.418 (.251)	.677 (.326)	.630 (.187)
Grenville Baker	.288 (.351)	.241 (.335)	.316 (.442)	.303 (.234)	.119 (.242)	.259 (.195)
Hicksville	.734 (.490)	.417 (.481)	.667 (.000)	.267 (.308)	.444 (.521)	.460 (.316)
Lower Naugatuck Valley	.631 (.311)	.611 (.233)	.722 (.428)	.449 (.240)	.592 (.227)	.572 (.223)
Metro Queens	.726 (.342)	.511 (.169)	.936 (.101)	.453 (.199)	.720 (.326)	.634 (.222)
Mt. Vernon	.670 (.322)	.393 (.311)	.744 (.397)	.441 (.215)	.685 (.319)	.595 (.224)
Oyster Bay	.707 (.353)	.566 (.363)	.725 (.365)	.396 (.253)	.647 (.341)	.595 (.229)
Stamford	.633 (.274)	.457 (.294)	.768 (.354)	.426 (.221)	.541 (.325)	.554 (.197)
VA Jack Jonette	.569 (.403)	.566 (.422)	.750 (.500)	.126 (.199)	.184 (.220)	.440 (.241)
VA Cherry Ave	.518 (.241)	.628 (.204)	.748 (.328)	.323 (.225)	.478 (.259)	.530 (.131)
VA Southwood	.417 (.347)	.564 (.295)	.750 (.427)	.407 (.263)	.418 (.306)	.491 (.202)
Variety	.407 (.391)	.313 (.354)	.305 (.416)	.393 (.263)	.336 (.371)	.370 (.204)
Wakeman	.388 (.276)	.446 (.372)	.540 (.441)	.426 (231)	.561 (.339)	.476 (.203)

Note: Means arrange from 0 to 1.

Differences by Activity

Similarly, the exploratory part of this work also examined difference across activities. As Table 4 suggests there is some variability across activities, but the means ranged from 4.48 to .626. Again, these means need to be more carefully examined taking into consideration when the activity was completed (i.e., how much practice did youth have before this activity) and the activity itself.

Table 4. Mean Total Engineering Design Thinking Score by Activity

Activity	Number of students completing	Mean Overall Score	Standard Deviation
Optimum Potato Chip	162	.601	.190
Design for Sound	254	.484	.246
Slime Engineering	230	.520	.222
Prosthetic Challenge	163	.619	.177
Hover Above it All	216	.506	.221
Need Some Support	219	.516	.225
Design Your Path	215	.498	.224
Kaleidoscope Design	232	.496	.227

Activity	Number of students completing	Mean Overall Score	Standard Deviation
Dance Party	138	.604	.187
WuGGs to the Rescue	127	.626	.164
Designing Rockets	132	.620	.161
Shark Tank	130	.640	.152
Solar Cooker	223	.522	.214
Splash Down! Game Design	206	.510	.227

Conclusions and Recommendations

WGG continues to meet its project goals. The blended (virtual and hands-on) WGG engineering design activities have been created have been successfully delivered. There is strong evidence the program is engaging for middle school age youth and they are learning from the experience. A great strength of the program seems to be its ability to provide an experience that is structured yet allows youth to be creative decisions makers and problem solvers. It helps youth build teamwork and collaboration skills as they develop an understanding of the value of informed design and redesign. A story shared by a club about the prosthetic leg challenge highlights how these brief activities are helping youth connect to one another, along with STEM and with concepts of informed engineering design.

> *"The Prosthetic Leg Challenge: WGG project prompted meaningful discussion amongst Club members. Members showed interest in, and empathized with, dancers and athletes losing limbs- but rooted them on for persevering. Members shared personal accounts of family members. Club member AE reflected on his grandfather who has lost his leg and has/uses two different prosthetic legs depending on if he is spending time sitting or walking. Members did not initially understand why someone would need two different prosthetics, but they were better informed after AE elaborated on the subject. AE was excited to bring his leg home to share with his family (specifically his grandfather) what he had learned about and constructed on his own at the Club that day. MM shared about Leg Length Discrepancy (LLD), and how most people have different length legs, but only by a centimeter or two. MM. was proud that what she shared with the group had been confirmed true, and members found the concept odd and unbelievable, but still interesting."*