Evaluation of the AgSTEM Summer STEM Educator Workshop

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Educational Dynamix
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Description of the Evaluation Plan

The evaluation of the AgSTEM Summer STEM Educator Program supports the objective of the project, which was to engage STEM educators in a summer professional development experience that focused on integrating aquaponics and computer science into the curriculum. The experience included two major components:

- A four-week aggrotech and computer science virtual workshop hosted by Mercer University's STEM Education Innovation Lab
- Support for capacity-building and social entrepreneurship projects to be implemented during the 2020-21 school year.

The program content, surveys completed by participants, and focus group discussions with team leaders and principals were analyzed to determine the effectiveness and efficiency of the project.

Evaluation of this project included an examination of perspectives of the topics covered during the professional development, which were:

- Tying aquaponics and computer science to the curriculum
- Designing authentic assessments that integrate aquaponics and computer science
- Using real time data in the classroom
- Incorporating authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis
- Sustainable maintenance and use of an aquaponics system as an educational tool
- Coding for the STEM classroom
- Creating social entrepreneurship projects with AgSTEM
- Making aquaponics a value add for your school

The data were used to ascertain the effectiveness of the AgSTEM Summer STEM Educator Program.

There were 31 participants in the program shown by grade level in Figure 1.

Figure 1. Participants in AgSTEM Summer STEM Educator Program by Grade Levels.

Grade Level	*Number of Participants*
Grade K	2
Grade 1	3
Grade 2	4
Grade 3	3
Grade 4	3
Grade 5	3
Grade K – 5 Special	4
Grade 6	2
Grade 7	1
Grade 8	2
High School	4
Total	31

The evaluator collected data using uniform and consistent questionnaires and protocols and content materials designed to understand the AgSTEM professional learning.

Content Analysis Data

Analysis of content was performed to triangulate the purposes with the intent of the professional learning.

Focus Group of Team Leaders

On July 16, 2020, a virtual focus group was held with the team leaders from the participating schools related to their perception of the professional development. The intent of the focus group was to ascertain how well the program objectives were met.

Focus Group of Administrators

On July 20, 2020, principals of the participating schools joined in a virtual focus group to discuss the ongoing support of the program.

Survey/Questionnaire of Professional Development Activities

Questionnaire surveys were completed at various stages of the professional learning with a final survey given at the end of the session. The surveys included a demographic and initial interest survey, an AgSTEM Professional Development Debriefing Survey, and the Mercer University AgSTEM Summer STEM Educator Workshop Survey.

Data Analysis and Reporting

Analyses of the impact of the AgSTEM Summer STEM Educator Program are reported by the level of involvement. Statistical analysis was performed to understand the differences and significance of effectiveness. Full descriptions of the research and analysis methodologies are included in this report.

The information that follows provides an examination of each of the components including content analysis, focus groups, and survey questionnaires. All information was then synthesized for commonality and differences. Finally, data were aligned to the purpose of the AgSTEM Professional Development.

In summary, the program was evaluated on how its implementation carried out the purpose and intent of the STEM professional development.

Content Analysis Data

The content and structure of the AgSTEM professional development are included to provide context to the evaluation process (modified from the AgSTEM Summer STEM Educator Workshop description).

The objective of the project was to engage STEM educators in a summer professional development that focused on integrating aquaponics and computer science into the curriculum. This experience included two major components:

- A four week aggrotech and computer science virtual workshop hosted by Mercer University's STEM Education Innovation Lab

- Support for capacity-building and social entrepreneurship projects to be implemented during the 2020-21 school year

The implementation of AgSTEM included the involvement of various organizations collaborating to support educators:ions: Mercer University's S.E.I. Lab in partnership with Gwinnett Soil & Water Conservation District, Clemson University's Call Me MISTER® Program, Clark Atlanta University's (CAU) Center for Innovation and Entrepreneurial Development, University of Georgia Fisheries Science, the Time2Give Foundation, and the Georgia Aquarium. This experience was designed to expose STEM educators to tools and resources for integrating aquaponics and computer science in the classroom. Participants attended a four-week online professional development workshop. The workshop was composed of four modules:

- Module #1 – Introduction to AgSTEM
- Module #2 – Connecting AgSTEM to Teaching and Learning Standards
- Module #3 – Service Learning/Social Entrepreneurship with AgSTEM
- Module #4 – AgSTEM Curricular Unit Development Design

Each module was composed of two asynchronous units that participants completed independently. One live synchronous session allowed them to interact with experts receiving additional instruction and asking questions to assist with the integration of AgSTEM into the curriculum at their schools. The sessions for this professional development series were conducted by faculty from Mercer University's College of Education, Clark Atlanta University's College of Business, University of Georgia's Fisheries Science Department, and industry professionals. Participants received coaching and support for incorporating AgSTEM project-based learning activities into the curriculum from Mercer faculty and experts from STARBASE. This interaction provided educational and technical support resources to STEM educators to support agriculture and computer science in the classroom.

Topics that were covered during the course of this professional development included:

- Tying aquaponics and computer science to the curriculum
- Designing authentic assessments that integrate aquaponics and computer science
- Using real time data in the classroom

- Incorporating authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis
- Implementing sustainable maintenance and use of an aquaponics system as an educational tool
- Introducing coding for the STEM classroom
- Creating social entrepreneurship projects with AgSTEM
- Making aquaponics a value add for your school

Participants were asked to complete surveys and join focus-group interviews related to their engagement with AgSTEM and project-based learning. All contributors were elementary, middle, or high school in-service or pre-service educators with an interest in incorporating aquaponics into their educational setting.

The following describes the four modules that were included in the program:

Intro to AgSTEM Participants received introductory instruction related to the use of AgSTEM in the classroom, using aquaponics as a platform. The goal of this module was to help participants gain a conceptual understanding of the function of an aquaponics system and how data from apps can be used to monitor and maintain homeostasis within this closed ecosystem. Faculty from UGA's Fisheries Science Department and Computer-Coding Instructors from Montis.Edu supported instruction for this module.

Connecting AgSTEM to Teaching & Learning Standards Participants worked with faculty from Mercer University's College of Education to engage in project-based learning exercises to identify ways of connecting AgSTEM to teaching and learning standards to create engaging classroom environments that support the development of STEM literacy skills.

Social Entrepreneurship /Service-Learning in AgSTEM Participants worked with Clark Atlanta University's (CAU) Center for Innovation and Entrepreneurial Development to develop service-learning/social entrepreneurship projects that the participating schools are interested in implementing in their communities.

AgSTEM Curricular Unit Design Participants worked with faculty from Mercer University's College of Education to develop standards-aligned curricular units that incorporated AgSTEM into the curriculum at their schools. Teachers are expected to implement these units during the course of the school year and will receive follow-up support from faculty members to further develop the units they create.

The partners working collaboratively were assigned particular responsibilities:

Mercer S.E.I. Lab Facilities access, faculty instructor(s), graduate students support, mileage/travel funds, media/marketing support, housing for teacher education interns, technology access for participants, technical support for student projects, Canvas platform access

CAU STEM Innovation Center Facilities access, faculty instructor(s), graduate students support, technology access for participants, technical support

UGA Fisheries Sciences Facilities access, faculty instructor(s), graduate students support, technology access for participants, technical support

Gwinnett – Soil & Water Conservation District Program funding, technical expertise, consultation

Georgia Aquarium Technical expertise and field trip location

Focus Groups Analysis

Focus groups were held with team leaders and administrators. A review is provided for both groups below. Finally, the last section provides an integration and summary of all focus groups.

Focus Group of AgSTEM Leader Participants

The purpose of the focus group was to debrief the implementation of the AgSTEM professional development. Of the five participants, three supported elementary schools; one supported middle school; and one supported high school. The discussion was video and audio recorded and transcribed. The script was analyzed and coded, where the six topics were drawn from the text. The six topics provide an explanation and description of participants' perceptions.

They are: Activating Interest in AgSTEM, Structure of Professional Learning, Meeting Objectives of AgSTEM, Implementation (Integrating AgSTEM in the Curriculum), Student Achievement, and Overall Perception.

Activating Interest in AgSTEM Comments

- Some of the leaders' interests were triggered by attending STEM conferences. For example, one participant shared, " And that was my first experience with aquaponics . . . I jumped on board pretty quick because it covers so much and it's so great." Another participant indicated that one of the professional development sessions on AgSTEM had an emotional connection for her. She saw the 'good connections to the real world.'
- Other of the participants followed the leadership and suggestions of their principal.
- Another participant transferred her learning from another school to her present school.
- One participant appreciated the opportunity to vertically align across grade levels.

Structure of Professional Learning

- *General*
  - Having to transition from in person to a digital format, the participant liked how the modules were divided. Because participants were not in person, some were frustrated about 'having to figure something out and sending an email,' although the responses were 'fast.'
  - The variety of pictures were appreciated.
  - Communication was 'amazing' and well executed.
- *Teamwork*
  - Appreciated the opportunity to work together. "We really enjoyed each other working together."
  - Thought it was great to have it all on the Google site because it made it easy to access everything.

- *Learning Environment*
    - Consider 'condensing' the reading and the quantity of videos; but 'a lot of good information.' Struggled with the amount of learning required to use the apps, e.g. Glogster, Animoto, Facebook. 'That's just a lot of work.' "I didn't know the amount of time and the effort that was going to happen."
    - Appreciated how the professional development was 'spread out' and 'piggybacked off' each other.
    - Gave participants a common language to have the same starting point.
    - Grateful for the website structure.
    - Thankful for the responsiveness of the facilitators.
    - The speakers were good.
- *Preplanning and Understanding*
    - Participants did not care for the badges. They did not understand and suggested was more direction on scheduled dates.
    - Participants were not readily able to keep track of what they turned in.

Meeting Objectives of AgSTEM

- *Tying aquaponics and computer science to the curriculum*
    - Teachers appreciated connecting the Academic Knowledge and Skills (AKS).
    - Teachers took lessons and tied aquaponics in the unit.
- *Fostering a strong cluster relationship for AgSTEM implementation*
    - "I think that cluster relationship is a good thing because the parents see some continuity across the clusters."
- *Designing authentic assessments that integrate aquaponics and computer science*
    - The participants believe that they did not 'get to authentic assessments.' "I think there is some formative assessments planned, but I don't think there was anything . . . tied to the Aquaponics created at our school, elementary level. . ." "Assessment was not a big focus." The contributors suggested

changing pictures to relate to aquaponics on assessments, e.g. the life cycle of living things using aquaponics.

Implementation (Integrating AgSTEM in the Curriculum)

Computer Science Comments:

- " . . . Creating assessments and working on the computer science piece. . . at the elementary level." For example, scratch coding. Another participant shared that scratch is something that can be used at the high school level in a virtual setting. When teachers practice the coding and become successful then it can be connect to temperature probes and climate tags. Participants suggested a mini-staff development on how to use the basics of scratch would be very helpful. The participants discussed how they can enhance learning virtually by providing cameras, TVs, YouTube, etc.

Challenges to implementation:

- Knowing if teaching will be in person or virtual.
- Professional development on Project Based Learning (PBL).
- Buy-in from the principals.
- AgSTEM curriculum needs to be brought back in schools.

Integrating measurement unit:

- "We don't just have to measure the objects in our classroom; we probably would be measuring all year long and how are our plants growing so . . it makes out of the box" learning.
- "So we are able to use some of that data we collected in August all through the year."

Teacher Engagement:

- "If I'm not engaged in it, I'm not going to do it well. So same thing with the kids, if they're not engaged."
- The aquaponics holds the students' attention.

- **Student Achievement**

- Students are returning and discussing what they are doing at home: "I had my dad build me a raised garden." With digital learning, "the kids would get on ZOOM and show us their gardens that they have planted from what they've learned at school." "We have more kids wanting salad for lunch and snacks, because of the tower gardens in schools."
- Improvement: "We've looked at our data . . . we found that the more of PBL and real world focus, our test scores are higher."
- "If we ever come back to normal, we will have higher level kids in Level 2 and Level 3 engineering who do community service projects."

Overall Perception

- The participants were thankful or the opportunity to learn and to 'grow as a learners.' They appreciated taking the time to integrate AgSTEM with the standards and to teach in a different way.
- "The collaboration with the culture and knowing when our fifth graders go to middle school next year they will have Apple products there.
- "I think . . the way our cluster works together is so fantastic." It makes us community."
- The participants appreciated working with the cluster.
- "And my favorite thing . . ." I like the connection to the community. We get to know our parents and pull those people into what we're doing."

Focus Group of Administrators

Five school leaders participated in the focus group: three elementary, one middle school, and one high school. Conversation with the principals was audio recorded and transcribed. Next, the conversation was analyzed for themes and topics. The focus group discussion is summarized below in three areas: implementation, virtual learning, and communication.

- **Implementation**
  - One principal emphasized that here has been a shift of focus from STEM to reading and mathematics. Is there a gap that needs bridging to incorporate STEM?

- One leader indicated they would need guidance of how we continue this work digitally, e.g. advice on resources that will be available for teachers and students to access and use.
- One question discussed was what is the level of consistency in using Google?
- Principals indicated that they would engage their school teams in incorporating STEM strategies in their planning sessions to build team capacity.
- Principals want to see the STEM strategies spread to others in their schools.

- **Virtual Learning**
  - One of the concerns is the inability to do hands-on learning. The hands-on-learning for students was the driving force. The digital platform can be an obstacle.
  - A huge concern is not being able to use the equipment as planned in face-to face learning.
  - The principals are not sure if the technology available will serve the needs of the students in a digital environment.
  - The principals appreciated the lead time to set up digital learning.
- **Communication (Messaging and Buy-In)**
  - One principal suggested that the messaging on implementation at the schools should begin with the administration. They should meet monthly to review implementation with team leaders.
  - Leaders believed that the relationship and excitement of the STEM school administration will help with buy-in.
  - As principals, "if we do our jobs and establish expectations then most teachers will buy-in." For some teachers, it may take more time.
  - Some principals did not see buy-in as an issue.
  - The principals were in agreement of AgSTEM staff providing a small segment to add to the schools' monthly newsletters. Photographs of the students engaging in learning can be shared in the newsletter to parents with approval.
  - The principals voiced that press releases should be shared with the Executive Director so that she has knowledge of media inquiries.

Analysis of All Focus Groups

Data from the focus groups were accumulated in a table to examine commonalities and differences as shown in Figure 2. The three categories of implementation, virtual learning, and communication from the principals' focus group summary are aligned with the leaders' dialogue from their focus group in the figure. Overall, team leaders and administrators perceived that the AgSTEM program was important to their schools. Each focus group discussed professional learning (academies) through the school year and incorporation of AgSTEM in school meetings. All team leaders believed the program benefited teachers and students. With the unanswered question of in person or virtual learning, how to approach AgSTEM in the school setting was unknown. Common needs included ongoing professional development and training in computer apps.

Figure 2. Focus Groups: Summary of Comments by Audience

Category	Team Leaders	Administrators
Implementation	• " . . . Creating assessments and working on the computer science, e.g. scratch coding." • More PD on scratch coding. • Enhance learning virtually by providing cameras, TVs, YouTube, etc. • Professional development on Project Based Learning (PBL). • Buy-in from the principals. • AgSTEM curriculum needs to be brought back in schools. • Teacher engagement equates to student engagement.	• Shift of focus from STEM to reading and mathematics. • Need guidance on how we continue this work digitally. • What is the level of consistency in using Google? • Engage their school teams in incorporating STEM strategies in their planning sessions to build team capacity. • Spread to others in their schools the STEM strategies.
Virtual learning	• Enhance learning virtually by providing cameras, TVs, YouTube, etc. • Challenges to implementation is	o Inability to do hands-on learning. The hands-on-learning for students was the driving force.

Category	Team Leaders	Administrators
	knowing if teaching will be in person or virtual.	o The digital platform can be an obstacle. o Not being able to use the equipment as planned in face-to face learning. o Does the technology available serve the needs of the students in a digital environment? o The principals appreciate the lead time to set up digital learning.
Communication	• Students are returning and discussing what they are doing at home: "I had my dad build me a raised garden." With digital learning, "the kids would get on ZOOM and show us their gardens that they have planted from what they've learned at school." We have more kids wanting salad for lunch and snacks, because of the tower gardens in schools. • "We've looked at our data . . . we found that the more of PBL and real-world focus, our test scores are higher." • "If we ever come back to normal, we will have higher level kids in Level 2 and Level 3 engineering who do community service projects." • The participants were thankful for the opportunity to learn and to 'grow as they are learning.' They appreciated taking the time to integrate AgSTEM with the standards and to teach in a different way. • The collaboration with the culture and knowing when our fifth graders go to middle school next year they will have Apple products there. • The participants appreciated working with the cluster.	• The message on implementation at the schools should begin with the administration. • The relationship and excitement of the STEM leaders will be help with buy-in. • As principals, if we do our jobs and establish expectations then most teachers will buy-in. • AgSTEM staff provides a small segment to add to the schools' monthly newsletters. • Press releases should be shared with the Executive Director so that she has knowledge of media inquiries.

Category	Team Leaders	Administrators
	• Connection to the community. "We get to know our parents and pull those people into what we're doing."	

Survey Questionnaires

Three surveys were completed by participants. The first was a demographic survey from May 6, 2020. The second was the AgSTEM Professional Development Debriefing Survey. The final survey was the Mercer University AgSTEM Summer STEM Educator Workshop Survey.

The following discussions detail the information from the three different surveys and then provide analyses of information across surveys.

Demographic/Need Analysis Survey

The demographic/need analysis survey was completed by six team leader participants, representing Archer High School (2), McConnell Middle School, and Cooper, Harbins, and Lovin Elementary Schools. When asked 'How many teachers will participate from the school you represent?", the response in total was 29 teachers. The team leaders were asked about their preferred start date and time. The grade bands of expected participants were K – 5, 6 – 8, and 9 – 12. The content areas of the respondents were Math (1), Science (4), Second Grade (1), STEM (1), Engineering (1) and Principal (1). The response to the question, 'What is your preference for Curricular Unit focus?' was science by everyone. Three participants suggested mathematics and one indicated the integration of engineering (See Figure 3.).

Figure 3. What is your preference for curricular unit focus?

MATH, SCIENCE, ELA	*1*
Math, Science, Science/Math and integrate LA and SS when appropriate	1
Science, Engineering	1
Science	2
Math, Science	1

All participants believed that the overall focus should be science with the possible integration of other content areas as shown in Figure 4.

Figure 4. Is there a specific area of focus you would like our curriculum developers to focus on?

SCIENCE AND MATH INTEGRATION, ELA IF POSSIBLE...READING AND WRITING	*1*
Science in all grade levels K-5. We have a google doc we can send you with the specific AKS. Please let me know who to send it to.	1
Science and Engineering	1
Life science	

The demographics survey provided an appreciation for who participated in the project and what their needs and desires were.

AgSTEM Professional Development (PD) Debriefing Survey

The AgSTEM PD Debriefing Survey provided input from the participants during the implementation of the professional development. On a Likert scale of 1 – 5 (where 1 = Poor and 5 = Excellent), the Ag STEM PD was rated 4 out of 5 with four respondents providing a score). The following responses reflect those of the four individuals who participated in the survey.

What are 3-5 strongest aspects of the AgSTEM PD implementation in your opinion?

- Website - One stop shopping Orientation - Giving participants a detailed overview of what to expect Presentations - Having the experts present and available for questions Team Meeting - Focused planning Dream Team - The strength that the Graduate Researchers added to the team under Outstanding Leadership.
- Strong implementation of asynchronous each week that supported the synchronous lessons, badges for motivation for teachers, strong support from team and experts. Open communication between participants and experts, great dialogue and supporting specific needs of each school.
- Live sessions, AgSTEM to AKS module, teachers' accessibility to Mercer SEI Lab members.

- Variety in each of the modules, Leader Board strategy to incite competition and growth, Shark Tank.

What are 3-5 aspects of the AgSTEM PD implementation that need to be improved in your opinion?

- Berger - Redesigning Social Entrepreneurship /Service-Learning; Probes - Separate session; Temperature Checks after each session.
- Having asynchronous lessons prepped at least a week in advance, meeting with each expert for a run through a week prior to their lesson, setting expectations once the AgSTEM sessions begin, as having each team member in charge of something specific, having systems delivered about a week before the workshop begins.
- Clear expectations for guest lecturers/partners, clarity on MantisEDU devices, all materials completed prior to orientation meeting.
- More lead time, and content for social entrepreneurship synchronous session should have aligned with the asynchronous curriculum.

Please add any additional comments that would be useful for supporting future implementation.

- Overall, an excellent professional development for teachers. Future implementation should include a virtual component.
- None.
- Now that we have completed the pilot, I think we can create a clear overview design of the entire AgSTEM PD.
- Nothing at this time.

In summary, the AgSTEM PD Debriefing Survey provided a method where participants could indicate what was going well and what needed to improve during the implementation.

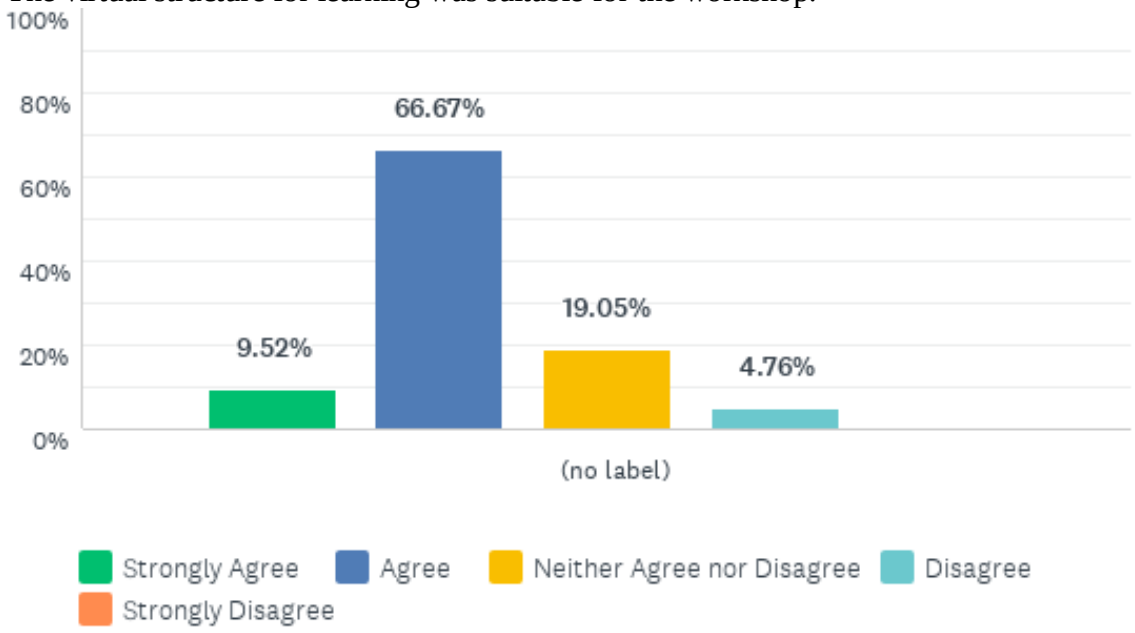
Mercer University AGSTEM Summer STEM Educator Workshop Survey

Finally, the Mercer University AgSTEM Summer STEM Educator Workshop survey was given at the end of the professional development and examined the overall program. The figures

that follow provide a visual representation of the responses and a table of number of respondents with weighted averages, which corresponds to the information in the graph. Also included are the basic statistics including range, median, mean, and standard deviation. The Likert Scale indicator (strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, strongly disagree = 1) was used for each item. Of the 31 participants in the professional development, 21 completed the survey.

In Figure 5, when responding to the statement, "The virtual structure for learning was suitable for the workshop." Two participants strongly agreed, 14 agreed, 4 neither agreed nor disagreed and one person disagreed with a weighted average of 3.81. One factor that may have influence the participant response was the level of confidentially with using technology.

Figure 5. The virtual structure for learning was suitable for the workshop.

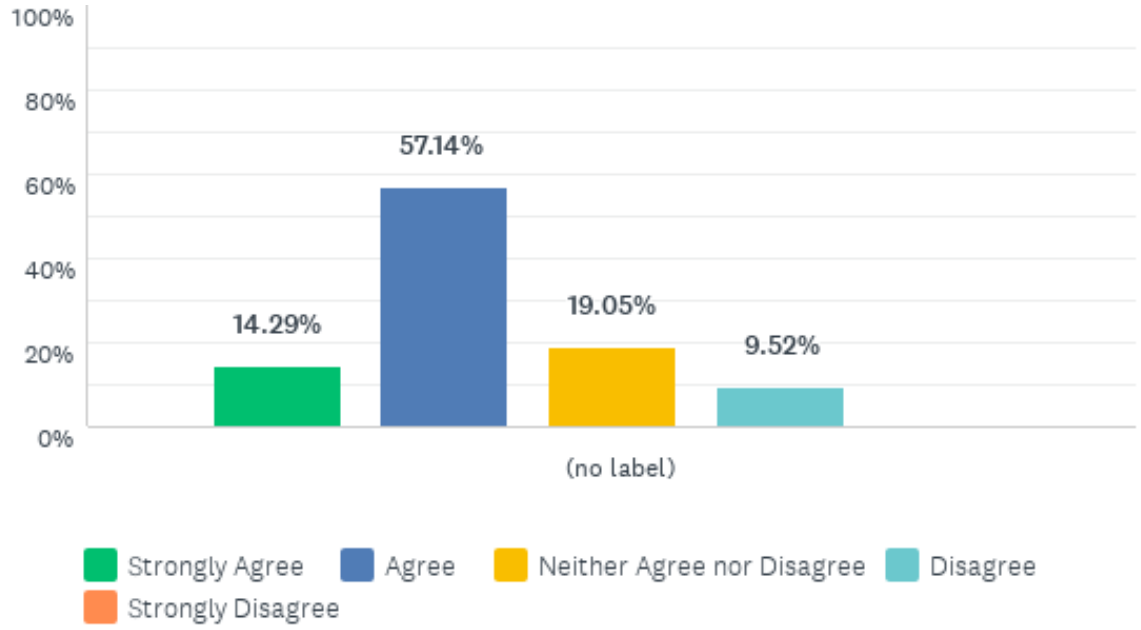


	STRONGLY AGREE (1)	AGREE (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	9.52% 2	66.67% 14	19.05% 4	4.76% 1	0.00% 0	21	3.81

BASIC STATISTICS				
Minimum 1.00	Maximum 4.00	Median 2.00	Mean 2.19	Standard Deviation 0.66

The majority of participants (15) agreed or strongly agreed that "The content and strategies were relevant to what I need to know to do my job better." (See Figure 6.) Four participants neither agreed nor disagreed and two disagreed, indicating they did not perceived relevancy in the content and strategies.

Figure 6. The content and strategies were relevant to what I need to know to do my job better.



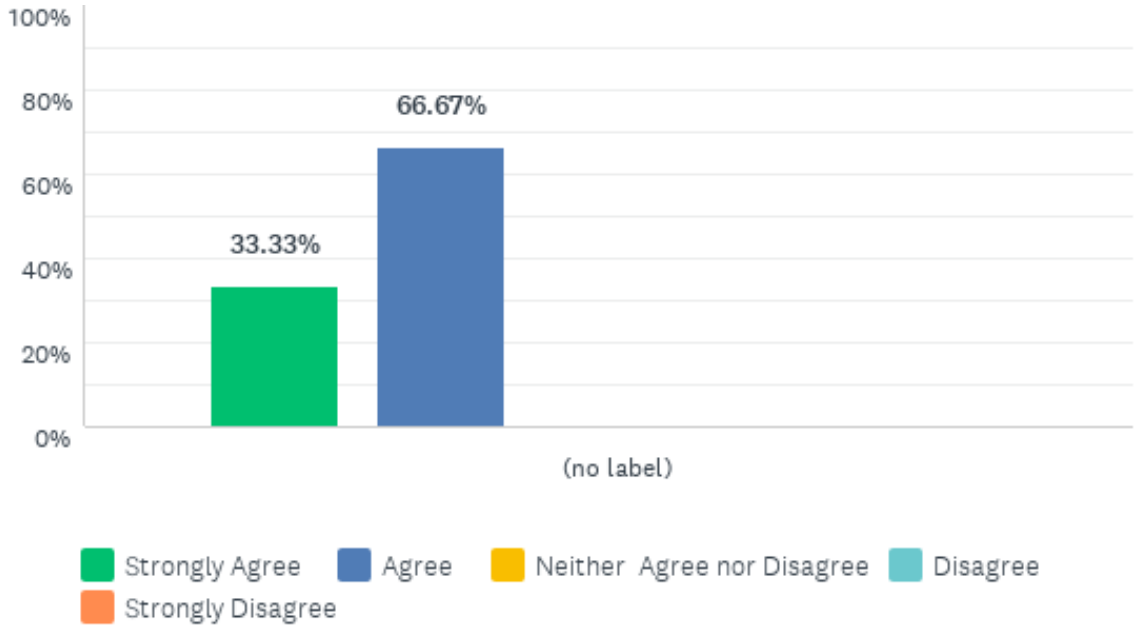
	STRONGLY AGREE (1)	AGREE (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	14.29% 3	57.14% 12	19.05% 4	9.52% 2	0.00% 0	21	3.76

BASIC STATISTICS				
Minimum 1.00	Maximum 4.00	Median 2.00	Mean 2.24	Standard Deviation 0.81

As indicated in Figure 7, all 21 respondents indicated that they strongly agreed (7) or agreed (14) that "Personnel conducting professional learning exhibited qualities essential to a

successful professional learning experience, i.e. knowledgeable, creative, appropriate written and oral communication, effective interpersonal skills, and the like."

Figure 7. Personnel conducting professional learning exhibited qualities essential to a successful professional learning experience, i.e. knowledgeable, creativity, appropriate written and oral communication, effective interpersonal skills, and the like.

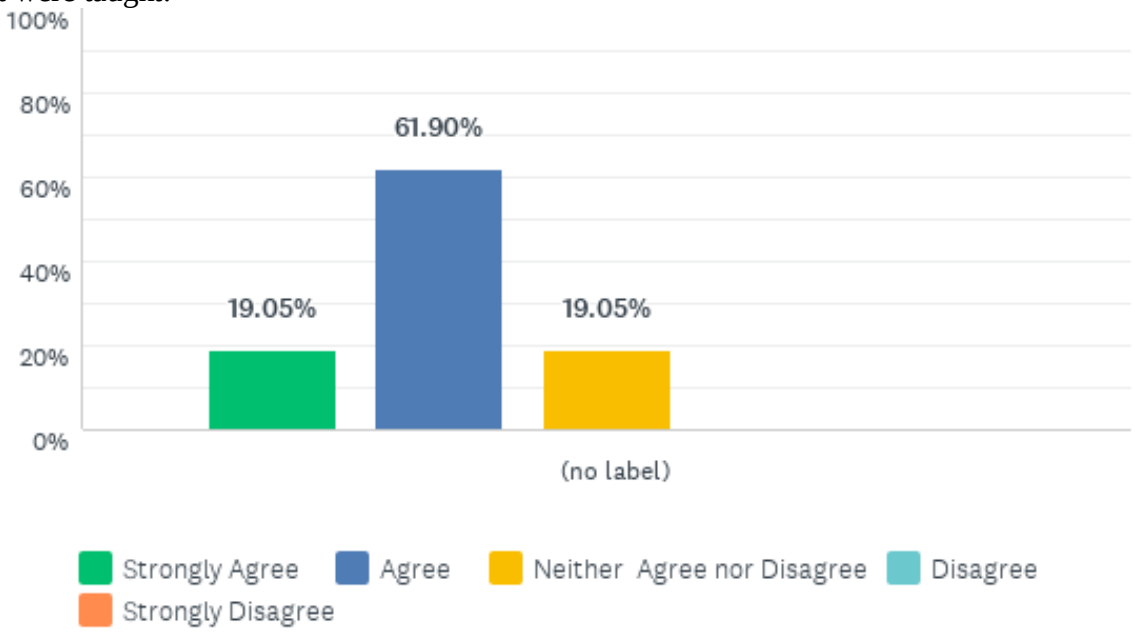


	STRONGLY AGREE (1)	AGREE (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	33.33% 7	66.67% 14	0.00% 0	0.00% 0	0.00% 0	21	4.33

BASIC STATISTICS				
Minimum 1.00	Maximum 2.00	Median 2.00	Mean 1.67	Standard Deviation 0.47

As shown in Figure 8, 17 participants perceived, "Personnel conducting the professional learning effectively modeled the strategies and skills that were taught." On the other hand, 4 participants neither agreed nor disagreed.

Figure 8. Personnel conducting the professional learning effectively modeled the strategies and skills that were taught.

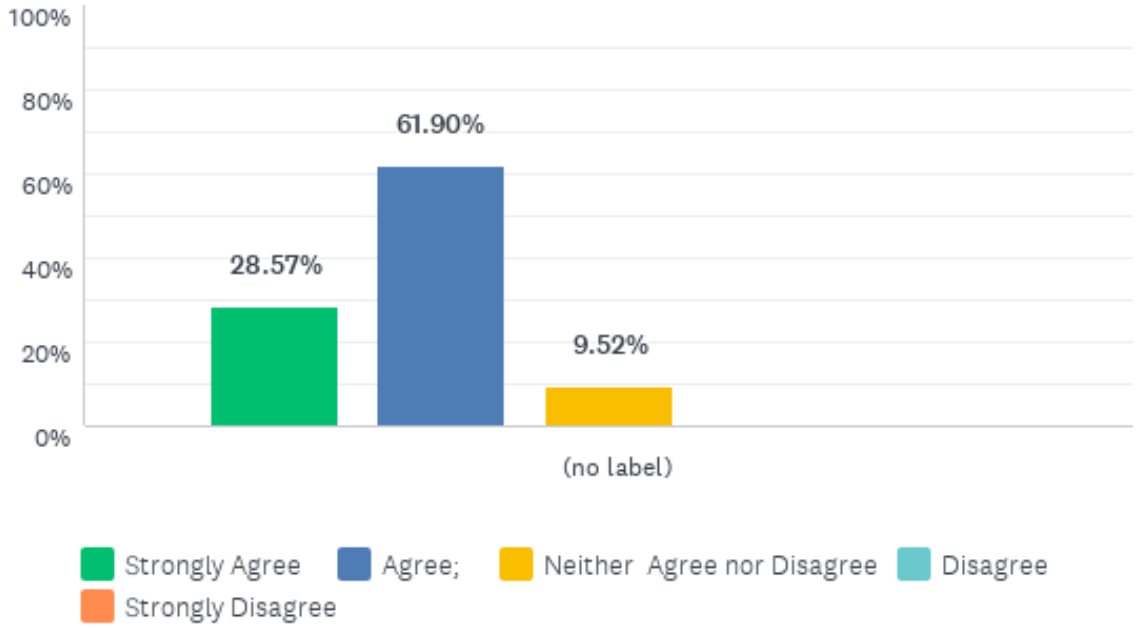


	STRONGLY AGREE (1)	AGREE (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	19.05% 4	61.90% 13	19.05% 4	0.00% 0	0.00% 0	21	4.00

BASIC STATISTICS				
Minimum 1.00	Maximum 3.00	Median 2.00	Mean 2.00	Standard Deviation 0.62

Nineteen participants agreed (13) or strongly agreed (6) that they acquired knowledge and/or skills that can be applied immediately to their specific job setting as shown in Figure 9. Two participants neither agreed nor disagreed with this statement.

Figure 9. I acquired knowledge and/or skills that I can apply immediately in my specific job setting.

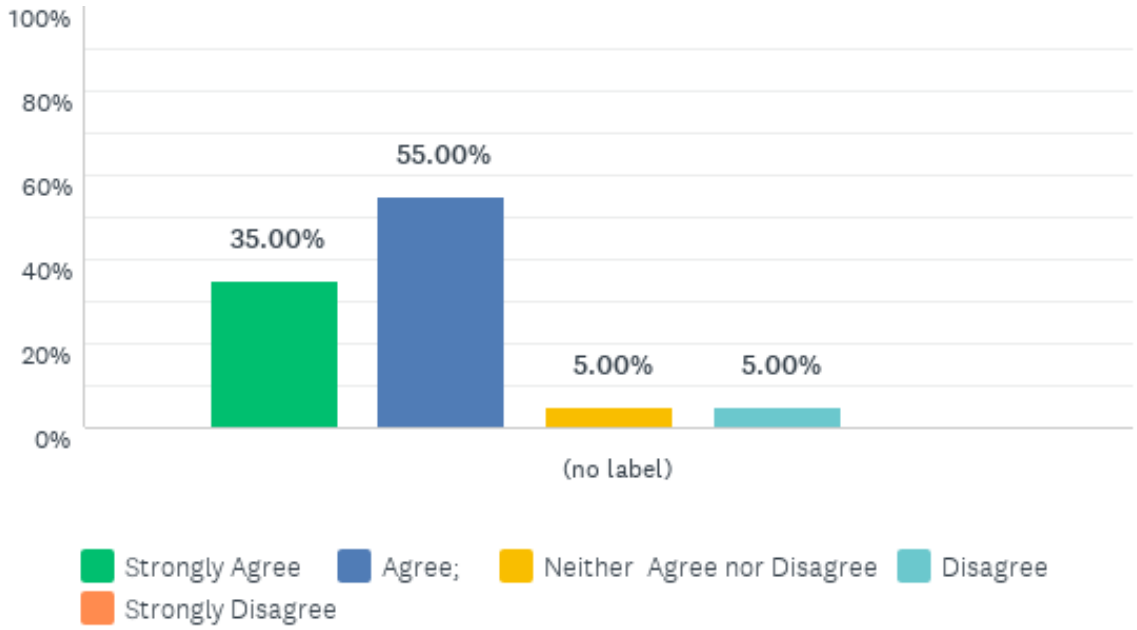


	STRONGLY AGREE (1)	AGREE; (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	28.57% 6	61.90% 13	9.52% 2	0.00% 0	0.00% 0	21	4.19

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	3.00	2.00	1.81	0.59

Twenty respondents replied, with 18 agreeing or strongly agreeing, that the content of this professional learning related to the improvement plan at their job site. One person disagreed and one neither agreed nor disagreed. The weighted average was 4.20 as shown in Figure 10.

Figure 10. The content of this professional learning relates to the improvement plan at my job site.

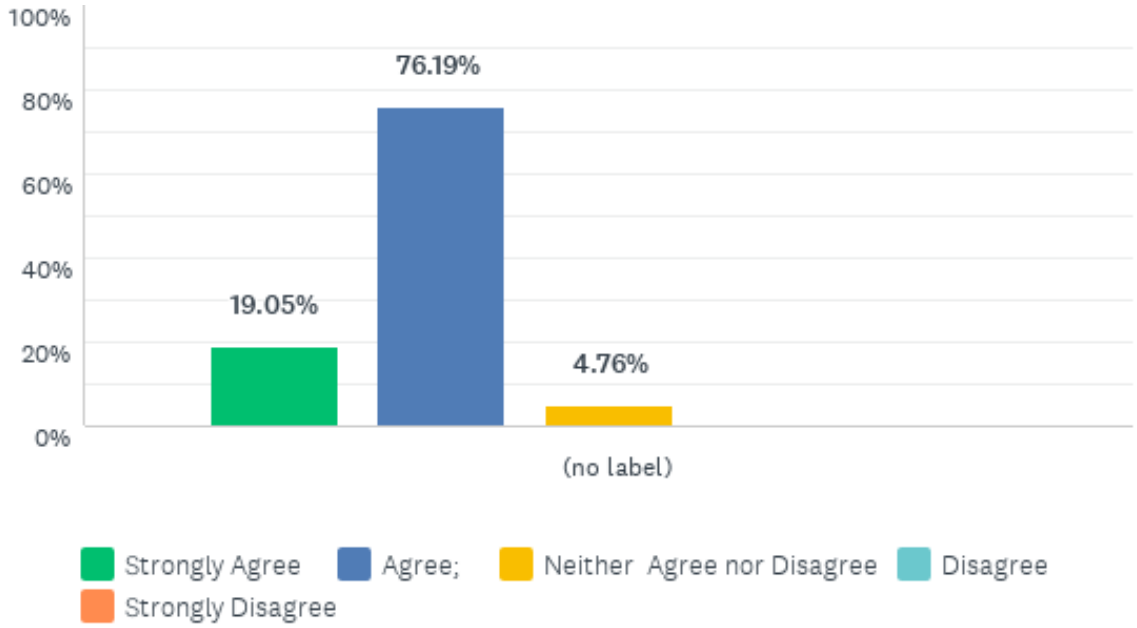


	STRONGLY AGREE (1)	AGREE; (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	35.00% 7	55.00% 11	5.00% 1	5.00% 1	0.00% 0	20	4.20

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	4.00	2.00	1.80	0.75

In Figure 11, ninety five percent of the participants indicated that resources are available at their job site to assist them in applying the content, strategies, and skills they have learned. One person neither agreed nor disagreed with this statement. The weighted average was 4.14.

Figure 11. Resources are available at my job site to assist me in applying the content, strategies, and skills I have learned.



	STRONGLY AGREE (1)	AGREE; (2)	NEITHER AGREE NOR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
(no label)	19.05% 4	76.19% 16	4.76% 1	0.00% 0	0.00% 0	21	4.14

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	3.00	2.00	1.86	0.47

The next question examined the objectives of the professional development. These objectives are listed below starting with the objective with the highest-weighted average ending with the lowest-rated average item. The respondents' replies suggested that *Making aquaponics a value add for your school* (Weighted average – 4.43) and *Sustainable maintenance and use of an aquaponics system as an educational tool* (Weighted average – 4.33) rated the highest as objectives met. On the other hand, *Using real time data in the classroom* (Weighted average – 3.29) and *Designing authentic assessments that integrate aquaponics and computer science* (Weighted average – 3.19) received the lowest rating.

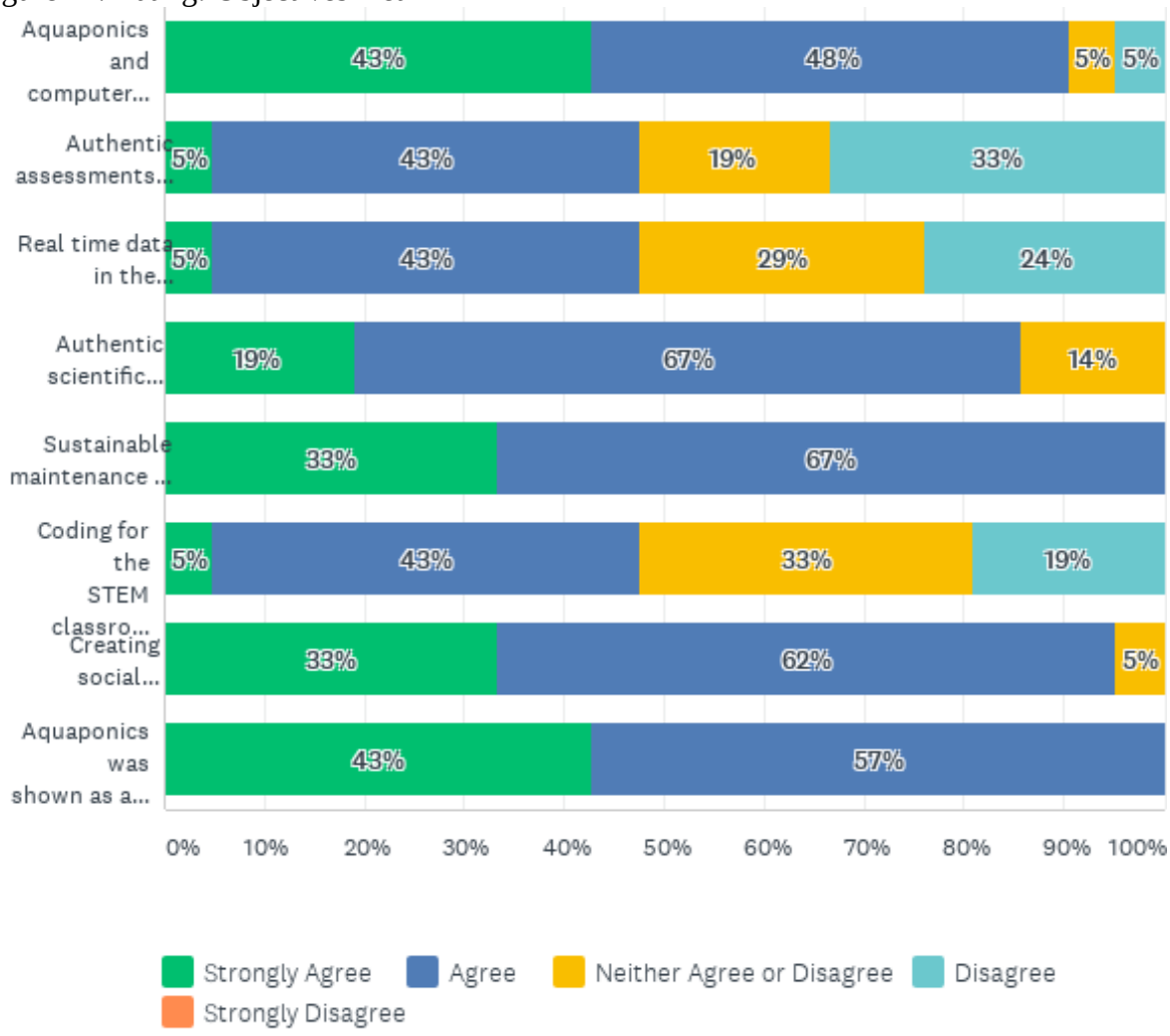
Topics covered during the course with weighted average per item are:

- Making aquaponics a value add for your school (Weighted average – 4.43)
- Sustainable maintenance and use of an aquaponics system as an educational tool (Weighted average – 4.33)
- Creating social entrepreneurship projects with AgSTEM (Weighted average – 4.29)
- Tying aquaponics and computer science to the curriculum (Weighted average – 4.29)
- Incorporating authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis (Weighted average – 4.05)
- Coding for the STEM classroom (Weighted average – 3.33)
- Using real time data in the classroom (Weighted average – 3.29)
- Designing authentic assessments that integrate aquaponics and computer science (Weighted average – 3.19)

Figure 12 provides the breakdown of 100% of participants (21) reporting. The statements the participants responded to are shorten on the y-axis of the figure. Because Figure 12 does not show the complete statement associated with the bar chart, the items are listed for reference here.

1. Aquaponics and computer science was tied to the curriculum.
2. Authentic assessments that integrate aquaponics and computer science were designed.
3. Real time data in the classroom were used.
4. Authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis was incorporated.
5. Sustainable maintenance and use of an aquaponics system as an educational tool was discussed.
6. Coding for the STEM classroom was examined.
7. Creating social entrepreneurship projects with AgSTEM were created.
8. Aquaponics was shown as a value add for your school.

Figure 12. Rating: Objectives met



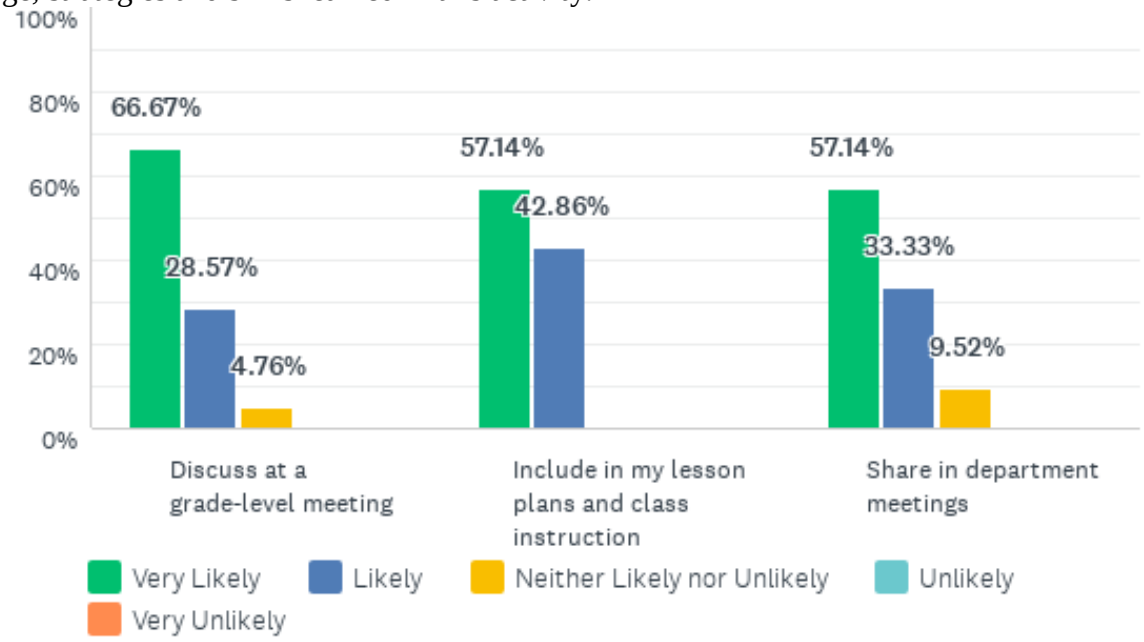
Part 2 of Figure 12

	STRONGLY AGREE (1)	AGREE (2)	NEITHER AGREE OR DISAGREE (3)	DISAGREE (4)	STRONGLY DISAGREE (5)	TOTAL	WEIGHTED AVERAGE
Aquaponics and computer science was tied to the curriculum.	43% 9	48% 10	5% 1	5% 1	0% 0	21	4.29
Authentic assessments that integrate aquaponics and computer science were designed.	5% 1	43% 9	19% 4	33% 7	0% 0	21	3.19
Real time data in the classroom were used.	5% 1	43% 9	29% 6	24% 5	0% 0	21	3.29
Authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis was incorporated.	19% 4	67% 14	14% 3	0% 0	0% 0	21	4.05
Sustainable maintenance and use of an aquaponics system as an educational tool was discussed.	33% 7	67% 14	0% 0	0% 0	0% 0	21	4.33
Coding for the STEM classroom was examined.	5% 1	43% 9	33% 7	19% 4	0% 0	21	3.33
Creating social entrepreneurship projects with AgSTEM were created.	33% 7	62% 13	5% 1	0% 0	0% 0	21	4.29
Aquaponics was shown as a value add for your school.	43% 9	57% 12	0% 0	0% 0	0% 0	21	4.43

BASIC STATISTICS	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION
Aquaponics and computer science was tied to the curriculum.	1.00	4.00	2.00	1.71	0.76
Authentic assessments that integrate aquaponics and computer science were designed.	1.00	4.00	3.00	2.81	0.96
Real time data in the classroom were used.	1.00	4.00	3.00	2.71	0.88
Authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis was incorporated.	1.00	3.00	2.00	1.95	0.58
Sustainable maintenance and use of an aquaponics system as an educational tool was discussed.	1.00	2.00	2.00	1.67	0.47
Coding for the STEM classroom was examined.	1.00	4.00	3.00	2.67	0.84
Creating social entrepreneurship projects with AgSTEM were created.	1.00	3.00	2.00	1.71	0.55
Aquaponics was shown as a value add for your school.	1.00	2.00	2.00	1.57	0.49

When queried about the way you will share the AgSTEM learning at your job site, the participants indicated that 95% of them will very likely or likely discuss at a grade-level meeting, 100% would include the learning in their lesson plans and class instruction, and 90% would likely or very likely share in department meetings as indicated in Figure 13. These responses provided a weighted average above 4.5 out of 5 in all areas.

Figure 13. Which of the following best identifies how you will share at your job site the knowledge, strategies and skills learned in this activity:



Page 2 of Figure 13

	VERY LIKELY (1)	LIKELY (2)	NEITHER LIKELY NOR UNLIKELY (3)	UNLIKELY (4)	VERY UNLIKELY (5)	TOTAL	WEIGHTED AVERAGE
Discuss at a grade-level meeting	66.67% 14	28.57% 6	4.76% 1	0.00% 0	0.00% 0	21	4.62
Include in my lesson plans and class instruction	57.14% 12	42.86% 9	0.00% 0	0.00% 0	0.00% 0	21	4.57
Share in department meetings	57.14% 12	33.33% 7	9.52% 2	0.00% 0	0.00% 0	21	4.48

BASIC STATISTICS

	MINIMUM	MAXIMUM	MEDIAN	MEAN	STANDARD DEVIATION
Discuss at a grade-level meeting	1.00	3.00	1.00	1.38	0.58
Include in my lesson plans and class instruction	1.00	2.00	1.00	1.43	0.49
Share in department meetings	1.00	3.00	1.00	1.52	0.66

The participants provided the following comments related to how the content of this activity will impact student achievement in their job setting:

- Connects students to real world learning. Makes learning fun.
- Students will learn how to use an aquaponics system. They will also see how it relates to many of the units they study in school.
- Student achievement increase as they will be more actively engaged with the lessons that are connected more to the real world.
- Hands-on learning of the content.
- I am hoping the real-world connection will increase student achievement.
- Hands on activities to learn about nutrients.
- Students will have the opportunity to make connections and engage in authentic learning experiences.
- Students will learn about sustainability and social entrepreneurship.
- To be seen.

- PBL supports deep learning because students make connections based on real experiences.
- Hands on activity will reinforce the lessons.
- It will give my kids a better understanding of the aquaponics system.
- Help them be better problem solvers and critical thinkers.
- The aquaponics system will serve as a hands on/visual model for learning.
- It will bring real world experiences to students. These may be in short supply this year (no field trips) due to COVID.
- This will give students a real-world example of the topics that we discuss in class, allowing them to see more value in what they learn in the classroom and to be able to think beyond just a test.
- Students will be more engaged because it's a real-world situation and problem.
- It will deepen their understanding and create new learning opportunities for them.

Participants' comments suggested that the teaching strategies would enhance students' learning by providing real experiences, creating problem solvers and critical thinkers, and providing hands-on and visual models.

Participants provided at least two specific ways they would demonstrate at your job settings that you are using the knowledge, strategies and skills acquired in AgSTEM PD as shown in Figure 14.

Figure 14. Describe at least two specific ways you will demonstrate at your job setting that you are using the knowledge, strategies and skills acquired in this activity.

WAY 1	*WAY 2*
Use the lessons created in my science specials.	Collect real time data from aquaponics system
I will use an aquaponics system in my classroom once students come back to school.	I will use the lesson plans, unit plans created.
My grade level is going to have a yearlong PBL related to AgSTEM and Aquaponics for.	STEM committee will be training teachers on the Aquaponics system and impact it will have.
Using the lessons.	Allowing students access to the aquaponics system
I will provide PD for grade levels	I will model lessons for teachers
Setting up an aquaponics system	Using some of the curriculum created

WAY 1	*WAY 2*
We will be implementing the unit we planned	We will be engaging in a community market day, providing students with relevant real world experiences
Scientific research projects	Farmers market
lab development and implementation relevant to AgStem	New teaching tools/strategies
Taking pictures, sharing lessons, encouraging others to join in	Share info on school platforms for community
Lessons	PBL
We will use the unit during our plant and animal unit.	We will use the hands on activities in our Stem lab and classroom.
integrate the lesson plans created in to my plans	Share lesson plans and related ideas with grade level and offer support as needed
Incorporate lessons developed	Utilize the aquaponics lab for instruction
Integrating the aquaponics setup into my Science instruction	Sharing the information and lesson ideas with other Science teachers on my grade level
Help to maintain the system	Use data from the system in math
I will specifically be integrating the system into the study of plant and animal cells, ideally to take samples from the plants and view under the microscope and to compare the processes of photosynthesis and cellular respiration	When studying ecosystems and human impacts on those systems we will discuss hypothetical situations based on what has/could happen in our system (pH imbalance, over saturation of ammonia, etc.)
Using the lab and creating more lessons	Sharing and teaching others so the learning spreads
I will use the lessons that were created	We will refer to our aquaponics system often
I will embed the lessons and units created in our lesson plans.	I will also create background knowledge with my students by introducing them to aquaponics.

Comments provided by participants align with one another and can be summarized in three areas: using the curriculum and lesson plans to teach, model and work with other teachers, and use data interdisciplinary.

Finally, the 21 participants provided other comments and suggestions, which are listed below:

- None
- Some of the speakers/content in the zoom sessions seemed to be more appropriate for high school students or even college students. Much of the material didn't seem to address the needs of our elementary aged students.
- I know that this was supposed to be face-to-face, but it was difficult to understand what was expected of us. I do not think we had clear expectations from week to week.

- I am really looking forward to the aquaponics this year and I am excited to see what it leads to!
- More information on how to set up and actually run an aquaponics system
- 1) I would have a syllabus with due dates, topics covered and expectations for participants

  2) I would send an email out to groups that appear to be missing a major component(s) of a module

  3) I would eliminate the competition aspect if you are interested in creating a sense of cooperation within the cluster.

  4) I would have more explicit instructions in for the aquaponics computer simulation.

  5) Make sure the bugs are out of the simulation programming.
- Next time we need to meet face to face.
- Great program
- I feel this course would have been much better if it was face to face, especially setting up and using the sensors and using the coding. Unfortunately, that was not an option due to our current circumstances. That being said, this course was well done in the virtual format.
- I would love to see some of the work pared down so that we could focus on the essentials and then focus on integration into the classroom. I would have liked more weekly interaction with the computer systems to be able to better explain them at a student level. I also appreciated that the email address was monitored by several people, but this sometimes made getting an answer back frustrating for my team because we would get the same response multiple times.
- Thank you!!
- Need more help with the coding part of the tools.

The comments provided compliments for the professional learning experience and gave specific information for enhancing the experience of others participating in STEM professional development in the future.

Analysis of data across evaluation methods

An analysis across the various evaluation instrument demonstrated consistency in responses. The analysis is summarized in three areas: review of the professional development structure, a look at objectives and moving forward.

Review of professional development structure

The plan for the AgSTEM professional development was first envisioned as a two-week face-to-face session with hands-on experiences; however, COVID-19 caused the planners to reconsider and provide the program virtually. With that change, the sessions were moved to a four-week experience with participants working asynchronous two times a week and coming together for instruction synchronously once a week. With this change, the majority of participants adjusted well; however, others hoped for the face-to- face experiences. Considering the virtual approach to learning, participants suggested a more structured approach to starting the professional development, which included:

- Designing a syllabus with due dates, topics covered and expectations for participants.
- Sending out emails to groups for missing major components of a module.
- Eliminating the competition aspect if you are interested in creating a sense of cooperation within the cluster.
- Being more explicit with instructions in for the aquaponics computer simulation.

The participants appreciated the 'spread out' approach over the four weeks and the strong implementation of asynchronous lessons and that supported the synchronous lesson. Further, the participants valued having the website as a 'one stop shopping.' They suggested having asynchronous lessons prepped at least a week in advance and defining expectations in advance would be helpful.

The participants believed that the open communication between the attendees and experts was a strong aspect of the AgSTEM professional development. Three items from the Mercer University AgSTEM Summer STEM Educator Workshop support the review of the professional development structure:

- The virtual structure for learning was suitable for the workshop (Weighted average 3.81 out of 5).
- Personnel conducting professional learning exhibited qualities essential to a successful professional learning experience, i.e. knowledgeable, creativity, appropriate written and oral communication, effective interpersonal skills (Weighted average 4.33 out of 5)
- Personnel conducting the professional learning effectively modeled the strategies and skills that were taught (weighted average 4.0 out of 5).

Finally, participants indicated that the professional development was challenging and required viewing videos and reading that they believed could have been reduced. One respondent indicated "I would love to see some of the work pared down so that we could focus on the essentials." Another participant suggested the work seemed to be for middle and high school teachers. However, overall the students appreciated the support that was rendered and the responsiveness of the facilitators of the program.

A Look at Objectives

As seen in Figure 15, the objectives of the AgSTEM professional development were incorporated in the modules with many spanning over the majority of the modules. It seems that if the objectives were included in multiple modules then clarification of purpose is supported more.

Figure 15. A Look at Objectives Across the Modules

OBJECTIVES INCLUDES WEIGHTED AVERAGES OUT OF 5.	**MODULE 1 INTRO TO AGSTEM**	**MODULE 2 CONNECTING AGSTEM TO TEACHING & LEARNING STANDARDS**	**MODULE 3 SOCIAL ENTREPRENEURSHIP/ SERVICE-LEARNING IN AGSTEM**	**MODULE 4 AGSTEM CURRICULAR DESIGN**
Tying aquaponics and computer science to the curriculum (4.29)	X	X	X	X
Designing authentic assessments that				X

OBJECTIVES INCLUDES WEIGHTED AVERAGES OUT OF 5.	MODULE 1 INTRO TO AGSTEM	MODULE 2 CONNECTING AGSTEM TO TEACHING & LEARNING STANDARDS	MODULE 3 SOCIAL ENTREPRENEURSHIP/ SERVICE-LEARNING IN AGSTEM	MODULE 4 AGSTEM CURRICULAR DESIGN
integrate aquaponics and computer science (3.19)				
Using real time data in the classroom (3.29)		X	X	X
Incorporating authentic scientific investigation and engineering design challenges into the classroom that use aquaponics and computer science as a basis (4.05)		X	X	X
Sustainable maintenance and use of an aquaponics system as an educational tool (4.33)	X	X		X
Coding for the STEM classroom (3.3)		X	X	X
Creating social entrepreneurship projects with AgSTEM (4.29)			X	
Making aquaponics a value add for your school (4.43)	X	X	X	X

Several comments from participants supported the Likert Scale values seen in the survey. For example, the respondents discussed how including AgSTEM in the assessment process was unclear, especially with assessments being preset at their schools. Also, one suggestion was to redesign the Social Entrepreneurship / Service – Learning to align with the asynchronous curriculum. Some of the participants struggled with coding and the various apps and suggested 'the bugs are out of the simulation programming' before they start.

In summary, the participants indicated they believed the course was a 'great program' and was well done in the virtual format.

Moving Forward

One of the major components of the AgSTEM program was the support for capacity-building and social entrepreneurship projects implemented during the 2020-21 school year. How to accomplish this purpose was met with the question of whether schools would meet virtually or face-to-face. The uncertainty caused the school leadership and program participants to discuss the strategies used for teaching and learning. The participants reached the conclusion that they would be able to implement projects that support AgSTEM in either setting. Further, they looked forward to vertically aligning across grade levels.

There was discussion about project-based learning and a need to provide professional development in this area to support teachers. Students had demonstrated higher level of engagement when they were involved in the AgSTEM activities previously and the principals' conversation demonstrated commitment to implementing AgSTEM in their schools. Ninety five percent of the teachers (21) indicted that resources were available at their site to assist in applying the content, strategies and skills learned in the AgSTEM professional development.

The participants (21) indicated they would share AgSTEM via a grade-level meeting (95%), include in lesson plans and class instruction (98%) and share in department meeting (90%).

Finally, participants believed that AgSTEM would influence student achievement by providing real world connections, making learning fun, increasing engagement, focusing on authentic learning experiences, and learning sustainability and social entrepreneurship.