Think Like a Scientist and Engineer: Schools, University, and Community Partnerships Using an Aquaponics Project During COVID-19

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One way to expand the time spent teaching science in elementary grades and teacher access to science resources is through partnerships with local universities. This article examines one collaboration that aimed to help students "Think Like a Scientist and an Engineer" using aquaponics. This self-sustainable garden combines aquaculture (fish farming) and hydroponics (growing plants in water). The Biological Sciences Curriculum Study (BSCS) 5E Instructional Model was used to introduce the aquaponics project. This article first discusses the University-School partnership, highlighting the project logistics, successes, challenges, and lessons learned, and follows up with recommendations for future STEM teaching projects.

Keywords: aquaponics, STEM/STEAM, school/university interface, Covid-19, Inquiry-based teaching

INTRODUCTION

The National Science Teachers Association has recommended that elementary school teachers demonstrate competency in life, earth, and physical sciences. Nonetheless, science still needs to be a higher priority in teaching. A recent Horizon report indicates that elementary school teachers spend an average of "20 minutes per day on science, compared to 89 minutes on reading/language arts and 57 minutes on mathematics" (Plumley 2019, p. 15). This limited time spent teaching science in grades K-3 might be due to teachers' lack of content preparedness and inadequate scientific expertise. Indeed, only 31% of teachers in the Horizon study felt well-prepared to teach science in elementary classrooms. Plumley (2019) surmised that for "teachers to help students learn science, they must have a good understanding of the content and the discipline as a way of knowing" (p. 4). In addition to a lack of content expertise, factors such as lack of needed resources, time constraints from curriculum pacing, and schools' focus on standardized testing in 5th-grade language and reading limit the emphasis on science teaching to an average of one hour per day.

One way to expand the amount of time spent teaching science in elementary grades and teacher access to science resources is through partnerships with local universities (Sasson, 2018). This article examines one collaboration that aimed to help students "Think Like a Scientist and an Engineer" using aquaponics. This self-sustainable garden combines aquaculture (fish farming) and hydroponics (growing plants in water) (Gillan & Raja, 2016). The Biological Sciences Curriculum Study (BSCS) 5E Instructional Model was used to introduce the aquaponics project (Bybee et al., 2006; Spencer & Walker, 2011). This article first discusses the University-School partnership, highlighting the project logistics, successes, challenges, and lessons learned, and follows up with recommendations for future STEM teaching projects.

University-School Partnership

Before the COVID-19 pandemic, a team of researchers that included Baylor University professors and students from the Schools of Education, Engineering, and Social Work, the Department of Environmental Science, the Mayborn Museum, and the Truett Theological Seminary extended an existing Growing Leaders and Learners (GL2) aquaponics project for 4th and 5th graders. This project was funded by the Baylor Traditions Ornament Project and supported by a senior scholar working on an Environmental Protection Agency (EPA)-a funded project about science and environmental literacy. However, the COVID-19 pandemic upended initial plans, and the research team had to pivot. Rather than building a 20–40-gallon aquaponics system in person and requiring extra people on campus, the GL2 team developed a Do-It-Yourself (DIY) take-home system for each student at the two public elementary schools (School A and School B) involved.

School Profiles

Both schools are located in central Texas. Like most others, both shifted to a hybrid model using in-person and virtual learning options during the pandemic. Both have diverse and largely socioeconomically-marginalized student populations. At School A, 32.9% of students are African American, 37.7% are Latinx, and 22.8% are white, while School B has a predominantly Latinx student population (92.0%), and 5.7% are white. Students at School B are mostly bilingual and are more economically disadvantaged than those at School A. Nearly 75% of students at School B are classified as at-risk for dropout compared to 50% at

School A. Both have a garden on campus used for educational purposes; however, these were largely unused during the COVID-19 pandemic. See Table 1 for additional information.

Aquaponics Project Implementation Process

During the project development, principals and science teachers at the two schools partnered with the University GL2 team to determine the best delivery approach and implementation process for the DIY aquaponics project. Teachers contributed to the planning process by focusing on aligning the aquaponics project to meet their students' needs and required State teaching standards (Texas Essential Knowledge Skills; TEKS). School A prioritized working with Baylor University professors to ensure students interacted with scientists and engineers. They also incorporated a science day that included a virtual field trip with the University's Museum, science, and engineering professors' lectures, and assembling the aquaponics systems. School B focused on science concepts associated with water conservation, related to the University scholars' EPA project, and included the professors in assembling the aquaponics kits. Both schools received teacher lesson plans and supplies for the DIY project. Teachers planned to teach the lessons one week before the two-week aquaponic project; lesson plans focused on water conservation, nitrogen, and the water cycle. Each student received an aquaponics notebook to record their observations.

TABLE 1
SCHOOL A AND B PROJECT PROFILE

	School A	School B
Accountability Rating (2018–2019)[1]	F	B
Number of students (total)	375	733
Grades offered at the school	4-5th	K-5th
AVID certified[2]	Y	N
Grades and number of students involved in the project	Grades 4 & 5; 375	Grades 4 & 5; 216
Number of teachers involved in the project	6	1
Frequency of science instruction	4th grade: 70 minutes of daily instruction 5th grade: 70 minutes of daily instruction	4th grade: 50 minutes of instruction three days each week, plus one weekly lab 5th grade: 60 minutes of daily instruction, plus two weekly labs
The school had a greenhouse/garden before the project	Y	Y
The school had an aquaponics system before the project	N	N
Had online students during the project	Y	Y
4th-grade project	March 2021	December 2020
5th-grade project	January 2021	May 2021

[1] Accountability Rating: "The 85th Texas Legislature passed House Bill (HB) 22, establishing three domains for measuring the academic performance of districts and campuses: **Student Achievement**, **School Progress**,

and **Closing the Gaps**. Districts and campuses will receive a rating of A, B, C, D, or F for overall performance and performance in each domain. "(Texas Education Agency, 2020)

[2] AVID: Advancement Via Individual Determination (AVID) is an academic support program to prepare students for college eligibility and success.

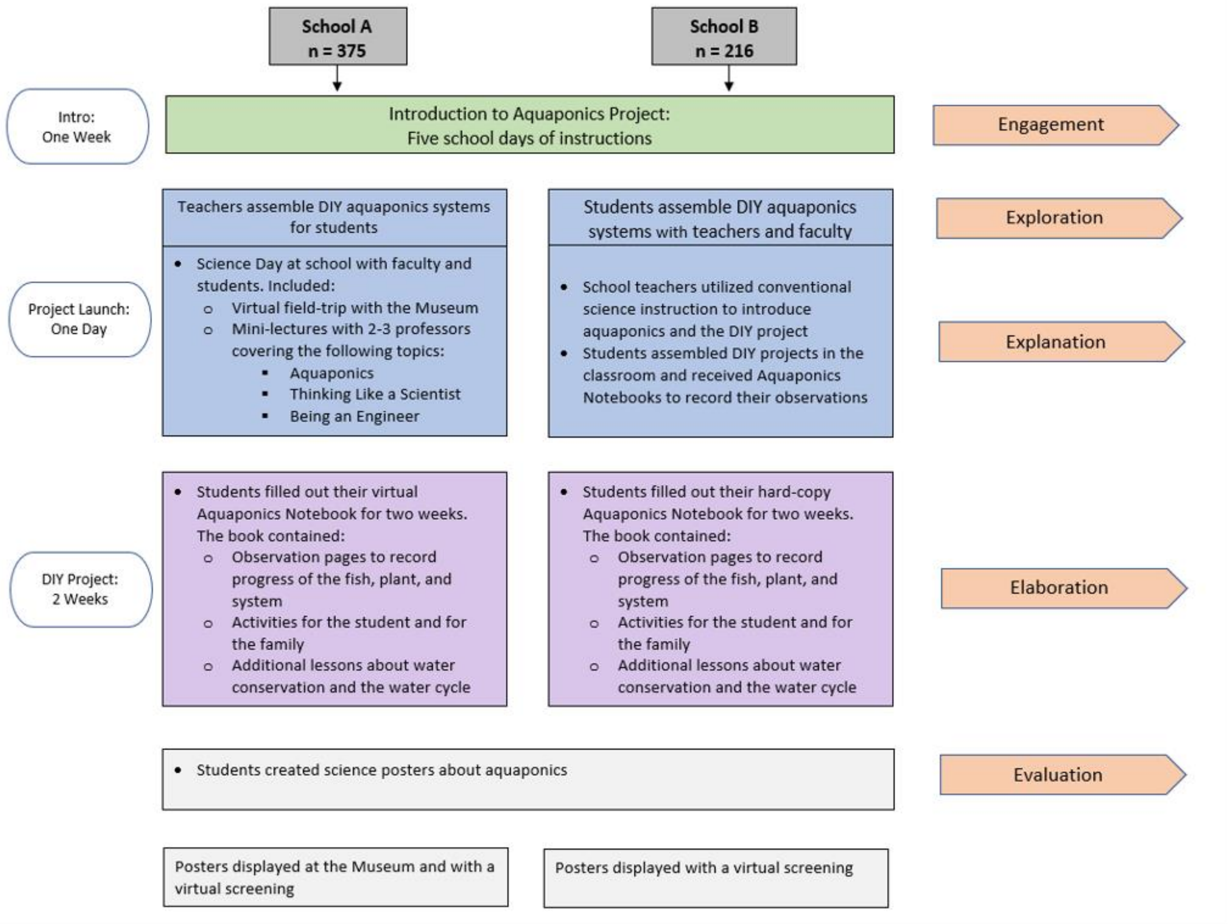
To guide the process, the research team developed the following core project elements:

- Project logistics include lesson plan format and duration, DIY aquaponic instructions, and maintenance plans.
- Student learning artifacts included an observation recording method and a final poster presentation instructions.

The schools followed the flowchart shown in Figure 1 to implement the DIY aquaponics project. The following 5E inquiry stages were used to implement the project (Bybee et al., 2006):

- **Engage** (introduction to the project, learning task, and question guiding the inquiry)
- **Explore** (consider new ideas/ assemble the aquaponics system)
- **Explain** (participate in the Science Day and/or other lessons on aquaponics)
- **Elaborate** (engage in an at-home project and chart observations in the lab notebook)
- **Evaluate** (complete a science poster highlighting lessons learned)

FIGURE 1
THE BIOLOGICAL SCIENCES CURRICULUM STUDY (BSCS) 5E INSTRUCTIONAL MODEL



Teachers assemble DIY aquaponics systems for students

- Science Day at school with faculty and students. Included:
  - Virtual field-trip with the Museum
  - Mini-lectures with 2-3 professors covering the following topics:
    - Aquaponics
    - Thinking Like a Scientist
    - Being an Engineer

Students assemble DIY aquaponics systems with teachers and faculty

- School teachers utilized conventional science instruction to introduce aquaponics and the DIY project
- Students assembled DIY projects in the classroom and received Aquaponics Notebooks to record their observations

- Students filled out their virtual Aquaponics Notebook for two weeks. The book contained:
  - Observation pages to record progress of the fish, plant, and system
  - Activities for the student and for the family
  - Additional lessons about water conservation and the water cycle

- Students filled out their hard-copy Aquaponics Notebook for two weeks. The book contained:
  - Observation pages to record progress of the fish, plant, and system
  - Activities for the student and for the family
  - Additional lessons about water conservation and the water cycle

- Students created science posters about aquaponics

Posters displayed at the Museum and with a virtual screening

Posters displayed with a virtual screening

Students were encouraged to ask questions like scientists and solve problems like engineers. Specifically, their driving inquiry question was: *"What is aquaponics? How do aquaponics systems work? What aspects of the aquaponics equipment design make it functional or not? How is the equipment maintained?" And what are the benefits of aquaponics?* Student responses to these questions reinforced their understanding of science and engineering principles.

In addition, School A hosted a science day to launch the project for their 4th- and 5th-grade classes. The event was a full-day experience for both grade levels and included a virtual field trip focused on teaching students to think like scientists and the museum staff presenting lessons via Zoom (see Figure 3). The University students assisted in assembling the aquaponics kits at School A, while the professors guest-lectured on aquaponics and what it means to be a scientist and an engineer (see Figures 4-5). These interactions allowed teachers and students to compare the approaches, problems, questions, inquiry process, habits of mind and thought process, and the research design process used by scientists and engineers (see Table 2).

At School B, the science specialist teacher devoted three days to launching the project. During the first two days, students learned about acid-base balance (pH) and discussed how to conduct quality observations and care for their fish (see Figures 6-7). On day three, students assembled the aquaponics systems with the help of professors (see Figures 8-10). Finally, the assembled kits were taken home by the students. Notably, students at School B did not have the deeply engaged interactions with University professors presented at School A.

TABLE 2
SCIENTIST AND ENGINEER COMPARISONS

Scientist	**Engineer**
Habits of Mind (Gauld, 2005), • Curiosity • Objectivity • Open-mindedness • Skepticism • Rationality • Suspension of belief • Mistrust of arguments from authority	Habits of Mind (Jacobs et al., 2009) • Systems Thinking • Creativity • Optimism • Collaboration • Communication • Ethical Consideration
Science Inquiry Process (National Research Council, 2000) • Ask – What is the question? • Imagine – Propose preliminary explanations. • Plan – Plan and conduct an investigation. • Analyze – Gather and analyze evidence. • Explain – Develop an evidence-based explanation and consider other explanations. • Share – Communicate findings and explanations.	Engineering Design Process (Engineering is Elementary, n.d.) • Ask – What is the problem? • Imagine – What are some solutions, and what is the best idea? • Plan – Draw a diagram and consider the needed materials. • Create – Build my design and test it out. • Improve – How can my design be improved?

Data Collection

Primary data were collected and analyzed to explore students' and teachers' understanding of the aquaponics project's key concepts. During the two-week-long project, students documented their observations of fish, plants, and the maintenance of the aquaponics system by filling out their notebooks (see Figure 7). At the end of the project, students created a poster outlining lessons on aquaponics systems and the related science concepts learned. The primary data included 51 science posters from students, transcripts from the teachers' focus group interviews at School A, the principal at School A, and the science specialist teacher at School B. All data collection methods, assent, and consent forms were reviewed by the Baylor University institutional review board (IRB reference # 1697457). The parents of all participants signed the consent and assent forms.

Data Analysis

This analysis process quantified students' understanding of the driving questions stated above. Posters were analyzed for keywords from the lesson plans and coded using the content analysis method. The keywords included water and nitrogen cycle—nitrifying bacteria, ammonia/ammonium, producers, consumers, decomposers, root systems, mechanisms of the aquaponics components, and sustainability (see Table 3 for the tallied number of references to each keyword). Transcripts were coded to document students' and teachers' understanding of the project and the success stories, lessons learned, and challenges.

TABLE 3
STEM CONCEPTS IN STUDENT SCIENCE POSTERS

	School A (25 posters)	School B (21 posters)	Total Sum
Aquaponics			
System diagram and/or explanation	33	29	**62**
Building and maintaining the system	6	1	**7**
Aquaponics components and functioning	37	14	**51**
Aquaponics Benefits			
Produce more food	10	1	**11**
Saves energy, labor, and space	12	0	**12**
Comparison with other farming methods	28	2	**30**
Key Science Concepts			
Decomposers, producers, consumers	8	0	**8**
Data analysis	7	0	**7**
Hydroponics	4	0	**4**
Nitrogen Cycle Mechanism	44	19	**63**
Oxygen/carbon dioxide	7	6	**13**
pH	4	0	**4**
Root system	7	15	**22**
Water Cycle and Water Conservation	27	7	**34**
	234	94	**259**

Findings

The result of the analyses showed that students demonstrated an understanding of the concepts through their drawings, descriptions, and labeling of components of the aquaponics system. The posters highlighted the following themes: farming methods; benefits of aquaponics and hydroponics; pH, oxygen, carbon dioxide; root systems; and food production (see Table 3 for the tallied number of references to each keyword). Students from School A presented the lessons learned in much greater detail than School B. Of the 51 posters, 25 were selected from School A and displayed at the Mayborn Museum for six weeks at the end of the school year (see Figures 11-13). The more intensive instructional process at School A yielded increased learning outcomes compared to School B. Teachers at both schools shared success stories, lessons learned, challenges, and recommendations for future projects.

Project Success Stories and Lessons Learned

Inclusive Education for All Learners, In-Person and Virtual Students

According to the teachers' feedback, the aquaponics project was highly engaging for the in-person and virtual students, emphasizing that the inclusive format engaged all the students simultaneously, especially those participating remotely. One teacher at School A noted that she had about "25-30% virtual [students] and out of those probably 60-70% came up [to the schools] to pick up the aquaponics system and did the project with us… So, I probably had an 80 to 90% participation rate at the start." The data also showed that of the 375 students participating in the project, about 80% remained engaged. At least 50% of the students returned the following year interested in continuing this project. One student at School A in the Gifted-Talented program decided to continue researching aquaponics as a culminating project based on experience from the previous year. When discussing the aquaponics launch day at School A, another teacher described the experience as follows:

> Oh, the kids and the professors, we were able to record that [activity] for our virtual kids. If we had anything for them to observe, we were able to show those videos again and keep them, you know, sort of, so it was good.

In addition to solidifying the TEKS requirements (e.g., ***4.2B*** collect and record data by observing and measuring, ***5.9A*** follow the way organisms live and survive in their ecosystem (Texas Education Agency, 2014), the project motivated students' interest, as noted by one teacher:

> I thought it was a good real-world application of our TEKS and how the kids, how they can use it. And a lot of the kids felt the desire to want to take it further or continue and make it bigger.

At School B, the science specialist teacher dedicated class time for the in-person students to assemble aquaponics kits for the virtual students to pick up later that day. She noted that the "students seemed enthusiastic about creating posters after the project…. The students showed what they had learned! They had some depth of knowledge represented within the posters." The teacher added that after the 5th-graders completed the project, the fourth-grade students "asked me all the time when they can take a fish home!" indicating that the project's first cohort raised excitement in younger grades who wanted to create an aquaponics system.

Positive Connection with Collaborative Team

The aquaponics project enhanced the existing University-School partnership. For example, School A had previously worked with Baylor University's Schools of Engineering, Social Work, Education, and the Seminary to build a greenhouse and develop garden education resources. Similarly, the science specialist teacher at School B collaborated with University professors on an EPA project simultaneously during the aquaponics project. This dual process deepened University-School relationships and helped to expand the aquaponics project. Additionally, the interactions between the elementary students and the university team made college seem more accessible to them, as articulated by the School A principal:

> The partnership has surpassed my greatest hope for accomplishing this goal. The Baylor professors were amazing in interacting and teaching our students, being compassionate, and showing them a little bit of college life. I think their ability to interact with the professors and the college students will help [my students] understand that there is a place

> for them and that college can be for them. Our students could see Baylor professors in action and interact by asking questions and stating their own opinions. The aquaponics project that students took home, observing, monitoring, and tracking their data, gave them the responsibility of taking care of the fish, planning, organizing, time management, and delayed gratification; all those things… are real-life experiences.

Thinking Like a Scientist and an Engineer

Beyond understanding State TEKS standards (TEKS), the students demonstrated personal growth in their expressions of the science and engineering habits of mind (see Table 2). The principal at School A observed that the inquiry focuses of the project allowed students to think like a scientist, be "inquisitive with an unstoppable desire to understand more," and utilize science and engineering processes by "observing a problem, researching the problem, [and] planning out ways to try to solve the problem." One teacher described a professor as saying, "the fifth graders were asking more questions than his college kids. And he was surprised at the quality of the questions, and they weren't just fluff questions." From this teacher's perspective, the students expressed an enhanced level of interest in the content, which, in turn, provided an opportunity to envision the potential for attending college and pursuing STEM careers.

Additionally, this project helped students adapt to problems as they encountered them. For example, when the students' fish died, the teachers encouraged them to leave the decaying fish in the aquaponics system rather than dispose of them. The decaying fish provided nitrogen for the plants. This creative solution helped students adapt to unexpected circumstances and made the nitrogen cycle come alive. According to one teacher, the students "could watch the nitrogen cycle, even with the fish dying. Because I did keep some decomposers in my room, and the plants were great. I think that whole process helped TEKS become solid."

Similarly, a teacher from School A noted, "the students were able to deal with the death process in the year to come" as the COVID-19 virus claimed lives around them. Furthermore, when a snowstorm interrupted the 4th-grade project at School A, the principal said, "I think the lesson that was learned was perseverance, continuing to keep trying. But I think that the lesson learned was that life still goes on, even in those trying times."

Opportunity for Enriched Science Education for Teachers and Parents

At the beginning of the teacher focus group, one teacher expressed gratitude to the University professors for making this science experiment available for her students:

> I just wanted to start with a thank you as well, because it's nice to have something that wasn't, you know, in such straight COVID it was like, oh, we could break for a minute and have a little bit of what just felt like good science and without the funding and support of you guys, it just wouldn't have happened.

Especially with social distancing protocols, the teachers appreciated a chance to lead the students in an engaging and educational hands-on project. One parent from School A shared her excitement that her daughter could participate and engage in the project remotely. Further, the principal at School A reported that "three or four parents come up during the project, thanking [him] for the opportunity for their students' ability to interact with university professors and have a rigorous, engaging, yet attainable project for the students to participate in." Teachers at School A unanimously agreed they would want to repeat the project next year.

Challenges

Students' Data Collection Process

The University team created hardcopy and electronic versions of the aquaponics notebooks for students to document their observations during the two-week-long project. While both schools liked the idea of students recording their observations in notebooks, about 5 percent completed their aquaponics lab notebooks. School A preferred digital versions of the resources; the hardcovers were digitalized, which was a simple and cost-effective process. The digital resources were shared on Google Drive as PDF and word documents. School B preferred to use hardcopy versions.

One teacher at School A noted, “I know I had some kids who were actually doing the project, so they would tell me what was going on, but I think they forgot to put it down on their notebooks.” The digital notebooks at School A may have been more engaging and accessible to some students but may have challenged others, especially online learners. Virtual students working from home did not always stay on schedule and seemed to encounter more problems maintaining their aquaponics system.

During the Spring term, a snowstorm hit the School A area, leaving many houses without power for days. This interruption impacted students’ ability to maintain their aquaponics system and record their observations. This interruption led to suggestions that the project is conducted during the Fall term instead. The teachers reasoned that students would have more time to focus on this project-based work in the Fall instead of competing with preparation for State standardized tests in the Spring. In addition, the teachers recommended that students leave the aquaponics project at school for the first two weeks to learn how to maintain the system and document their observations in a more controlled setting. One limitation is that School B has only one science lab teacher, so there is limited time and space to incorporate the project into the daily schedule for two weeks.

High Fish Death Rate

Schools A and B reported a 40-50% fish death rate by day three, even when teachers regulated the water by adding a water de-chlorinator and allowing the water to sit for 24 hours before adding the fish. School A used goldfish for both cohorts, while School B used goldfish only for the Fall cohort. The teachers reported that about 30-40% of the fish were still alive after two weeks. Due to the high fish death rate, the researchers contacted the local fish store that provided the goldfish for the project. They suggested using smaller fish, such as guppies, that might survive in a mason jar. Based on this recommendation, School B used guppies for their second cohort of 4th graders for the Spring project; however, a similar death rate between goldfish and guppies was reported. While this dilemma provided an opportunity for students and teachers to adapt and think of creative solutions, it was disappointing to students and frustrating for parents. Teachers suspected that plant seeds may have killed some fish and recommended providing seedlings with exposed roots next time. Notably, a professor tested the same procedure, and the fish survived in the mason jar for two months.

Parental and Community Involvement

This project aimed to engage parents through family-based activities provided in the aquaponics notebooks; however, there was no evidence that parents were involved. Parents from both schools reached out to the teachers, principal, and researchers about their excitement for the project, and some bought replacement goldfish for their children if they died. School A teachers reported a high rate of parent involvement compared to other school projects. While it was not the widespread engagement hoped for, there was evidence of parent engagement.

Museum Exhibition

The exhibition of student work in a public forum had many benefits. First, it encouraged students through recognition of hard work and quality. Second, exhibits of student projects highlighted the staff’s belief that the Museum is a forum for local work and not reserved for the elite. Third, students whose posters were selected received a voucher to attend the Museum at any time, and all participating students and their families could attend a community day for free. The exhibition and encouragement to school districts through social media increased accessibility to students’ families and the broader community. It also allowed students to envision their work in a museum worthy of contributions to society, including STEM fields.

Recommendations for Future Projects

Teachers and other GL2 team members presented several new ideas to enhance similar projects in the future. The teachers' ideas included changing the time of year the project is offered, using electronic tools to document observations, and using a larger mason jar to increase the fish survival rate. Teachers at School A suggested using Google Forms to make the project easier to observe students' work or the Padlet© software that allowed students to see others' work. A teacher at School B suggested providing a mini notepad with a page of directions for reporting observations and caring for the fish and plants. Teachers preferred to develop their lesson plans instead of using existing lesson plans and activities.

To support the development of their lesson plans, the GL2 team suggested providing professional development series or workshops with teachers and University students to tailor lesson plans to the needs of teachers and students. Engaging teachers from both schools in a week-long workshop to develop the lesson plans and other project activities would allow for a deeper understanding of aquaponics and related concepts for teachers, students, and parents. Lastly, teachers supervised student observations and data recording before taking the aquaponics systems home to ensure higher fish survival. To assess student learning, teachers should implement pre-and post-tests. Consideration will be given to measurement instruments such as the science identity scale and the 2-MeV scale for pre-and post-test (Vincent-Ruz & Schunn, 2018; Johnson & Manoli, 2010). Another strategy recommended is to increase parental involvement through regular communication during the project. Involving parents can help develop project goals, concise instructions, and data charts to guide and engage parents to support their children in tracking the data. Similar collaborations can be used to teach other STEM concepts across grade levels.

CONCLUSIONS

The partnership was successful and productive as student learning exceeded expectations. The project created excitement in younger students who look forward to learning about aquaponics systems in upper elementary school. Having a transdisciplinary team with multiple partners across the University and elementary schools also had many advantages and few disadvantages (Nesmith et al., 2021).

Digitalized Data Collection

While using digital notebooks presented challenges, providing easy access for teachers and researchers was beneficial. Digital versions were less expensive and more environmentally friendly than hardcopy notebooks. In addition to being easily editable, digital notebooks allowed students to record their observations and data at home, provided they had access to the technology.

Experiential Learning

Despite finding this new learning method challenging and struggling with the high fish death rate, students increased their knowledge about decomposition. They also learned about the equipment design and functionality of the aquaponic systems as part of the engineering inquiry process.

Parent and Community Engagement

The project invited parents and the community to engage in the featured posters at the University museum and postings on the University research team's blog. Finally, younger students were excited about and looked forward to learning more about aquaponics systems in upper elementary school the following year.

Overall, this DIY aquaponics project helped students to begin thinking like scientists and engineers and forming scientist and engineer identities (Vincent-Ruz & Schunn, 2018). Despite the hurdles, the teachers appeared to be ready for the project's next phase, using a 20-gallon aquaponics system built by Baylor University engineering students for year-round instruction and to repeat the DIY aquaponics project for future students (see Figure 8) with an overarching goal of increasing the time elementary school students spend learning STEM topics.

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APPENDIX: LIST OF FIGURES

FIGURE 3
SCHOOL A VIRTUAL FIELDTRIP "THINK LIKE A SCIENTIST" WITH BAYLOR MAYBORN MUSEUM STAFF

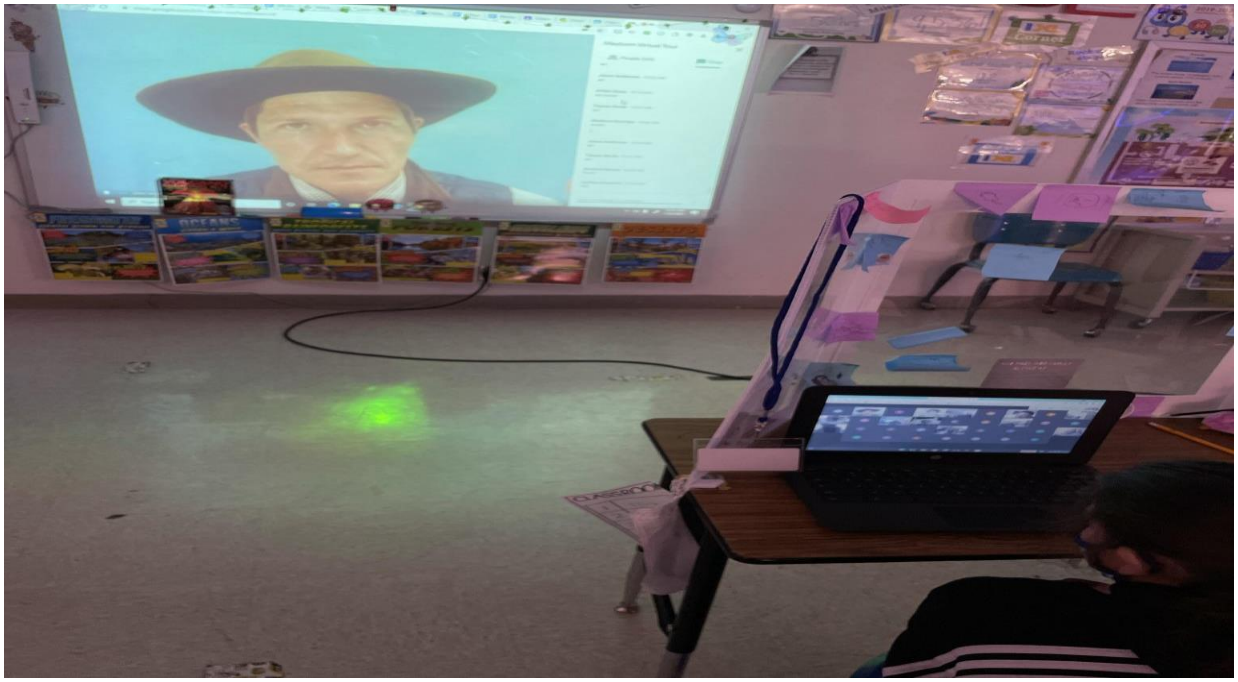


FIGURE 4
DEPARTMENT OF ENVIRONMENTAL SCIENCE PROFESSOR TEACHING SCHOOL A STUDENTS ABOUT AQUAPONICS

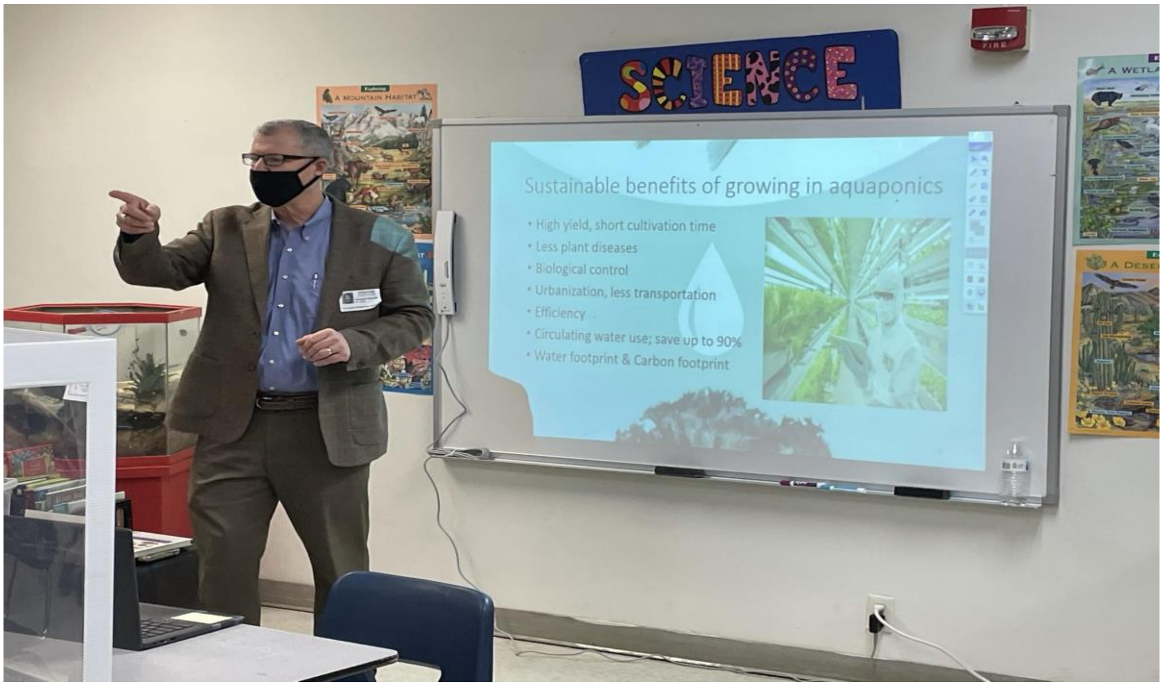
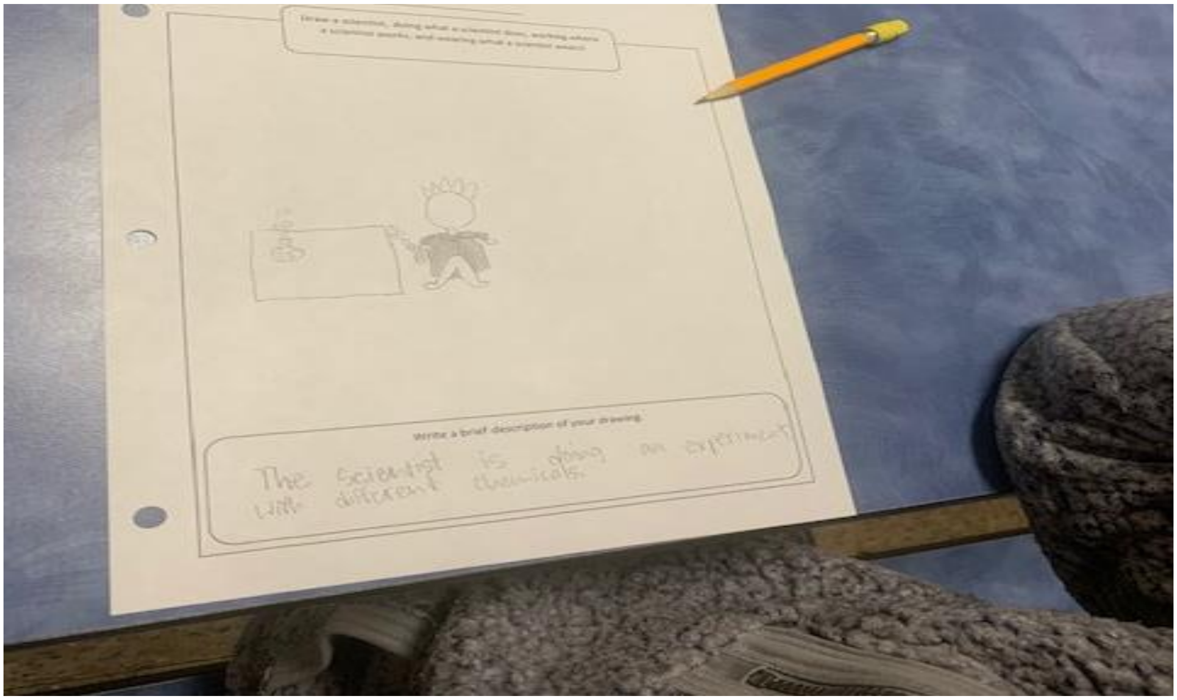


FIGURE 5
A STUDENT IMPRESSION OF WHAT SCIENTISTS DO, WEAR, AND WORK WITH "THE SCIENTIST IS DOING AN EXPERIMENT WITH DIFFERENT CHEMICALS"



Write a brief description of your drawing.

The scientist is doing an experiment with different chemicals.

FIGURE 6
SCIENCE LAB TEACHER FROM SCHOOL B INTRODUCING HER STUDENTS TO AQUAPONICS

FIGURE 7
SCIENCE LAB TEACHER FROM SCHOOL B HOLDING AQUAPONICS LAB NOTEBOOK

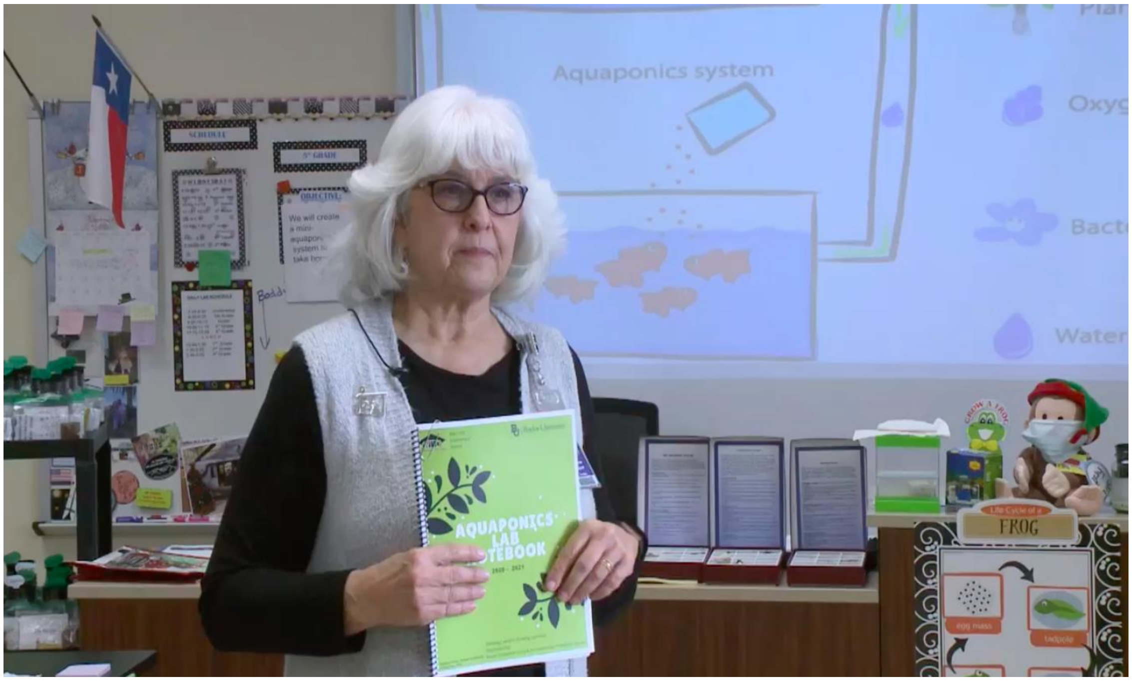


FIGURE 8
ENGINEERING PROFESSOR HELPING A SCIENCE LAB TEACHER ASSEMBLE DIY AQUAPONICS SYSTEMS FOR SCHOOL B STUDENTS

FIGURE 9
ELEMENTARY TEACHER AT SCHOOL B WORKING WITH THE PROFESSORS

FIGURE 10
ASSEMBLED DIY AQUAPONICS JARS WITH INSTRUCTIONS AND FISH FOOD FOR STUDENTS TO TAKE HOME

FIGURE 11
STUDENT POSTER CREATED BY A SCHOOL A STUDENT AFTER THE 2-WEEK LONG AQUAPONICS PROJECT

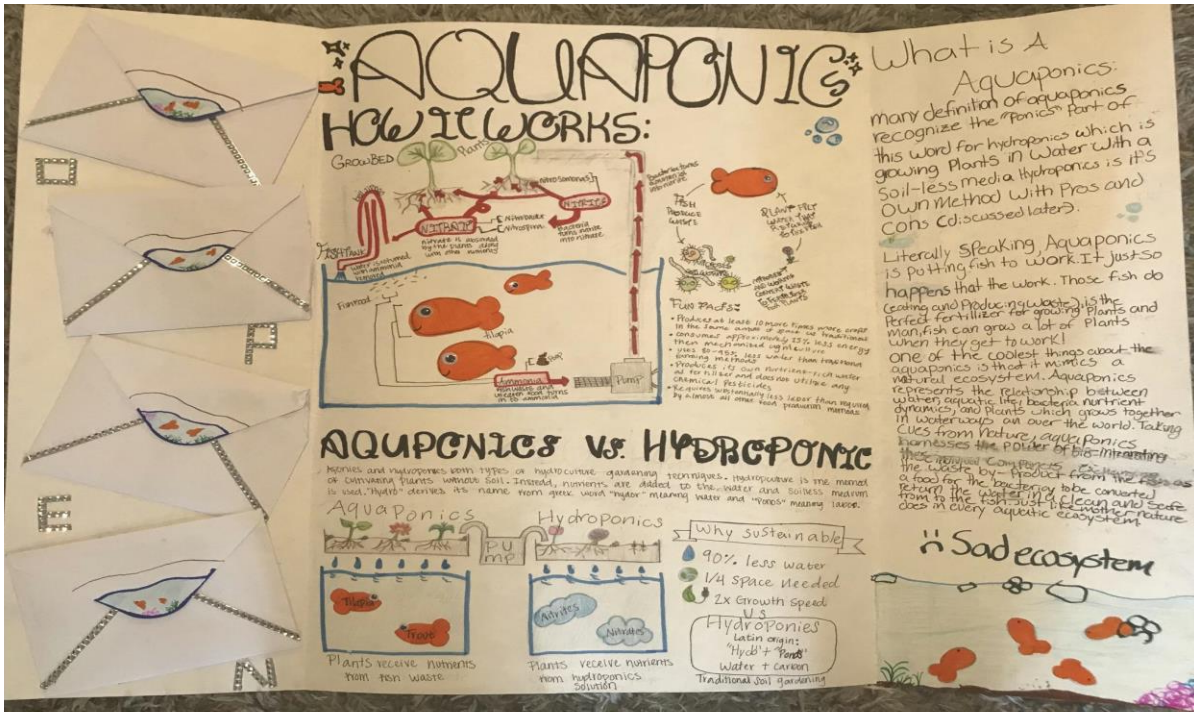


FIGURE 12
STUDENT POSTER CREATED BY A SCHOOL B STUDENT AFTER THE 2 WEEK AQUAPONICS PROJECT

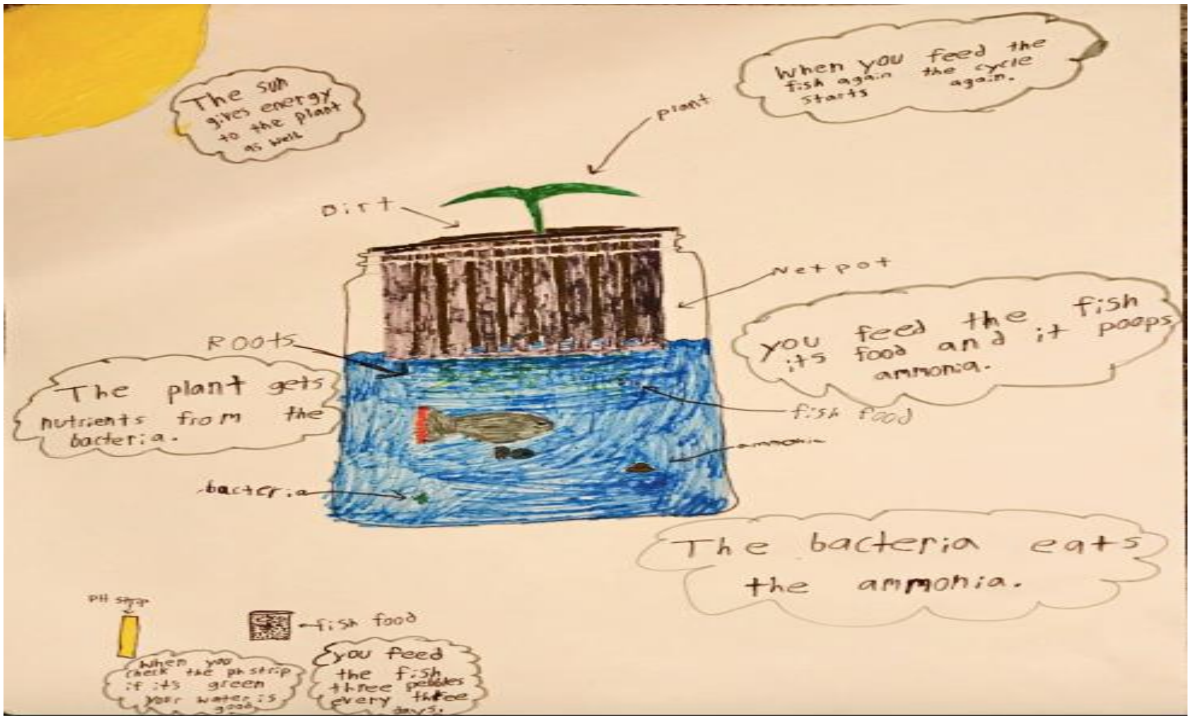


FIGURE 13
MUSEUM EXHIBIT POSTER FOR SCHOOL A

Think Like a Scientist

An interdisciplinary team of faculty and students has been working with an elementary school since 2018. This year, we launched a 2-week aquaponics project with 4th and 5th-graders to encourage students to think like a scientist and engineer. Students assembled a DIY aquaponics system, named their fish, documented their observations in their lab notebook, grew herbs, asked new questions, and made several discoveries. Students learned about the history of aquaponics, the benefits of aquaponics, how to build a DIY aquaponics system, water conservation, the nitrogen cycle, and much more. We hope you enjoy the students' science posters.

In Partnership With:

School of Social Work
School of Engineering and Computer Science
School of Education
Theological Seminary
Department of Environmental Science

APRIL 15TH - MAY 21ST, 2021

SPECIAL EXHIBIT
FUNDED BY TRADITIONS ORNAMENT PROJECT

Graphic Created by Asianna Brown