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Leveraging Technology to Modernize the Agricultural Education Experience

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Moving the Agricultural Education Experience Online

by Gaea Hock

This is the first issue of the completely online Agricultural Education Magazine. Over a year ago I thought about what the focus of this issue should be and quickly determined it would be appropriate for the issue to include best practices for teaching and leading agricultural education programs in an online environment. Fast forward 12 months and it is surreal how quickly we were forced to adapt to providing instruction in a virtual format as COVID-19 raced across our country and the world.

I was on maternity leave when it was announced public schools in Kansas, and most other states, would be online for the remainder of the school year. Teachers quickly rallied together to identify and share resources, assist each other with new platforms, and participate in professional development to become more skilled to teach online. I communicated with the other agricultural education faculty members regarding the best way to support our 26 student teaching interns. We moved quickly to set up Zoom meetings to keep in touch and communicate updates regarding their degree program requirements and changes. Students shared the diverse ways their schools were educating their students. Several were continuing to engage and teach content to students albeit in a very different format than we anticipated them doing.

When considering how you can best teach online, also consider how best students can learn online. A couple summers ago I participated in a summer professional development program titled "Online Essentials" hosted by K-State's Global Campus. It helped me learn how I can better meet the needs of my online learners and have pulled out my notes to help me prepare for classes this fall.

This issue will showcase how teachers are leveraging online technologies and other innovations to meet the learning needs of their students. While distance learning is not a new concept, the forced adoption of online platforms to interact with our students was one many were not fully prepared to take on with little to no prep time.

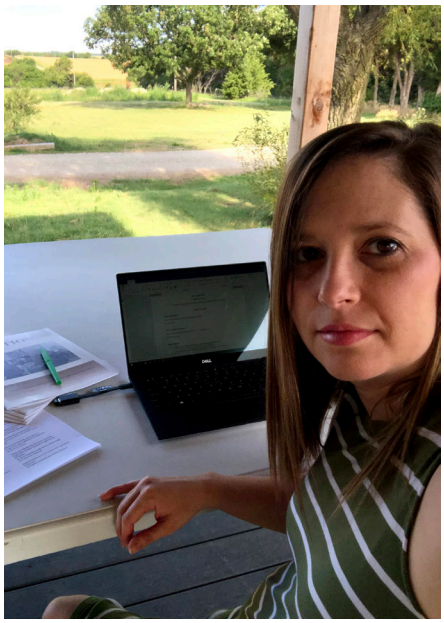
As I consider how my classes will look this fall and how I can prepare the next group of agricultural educators to be effective teachers, I appreciate the wisdom and advice shared in the articles included in this issue. I hope you too will find inspiration and support as we prepare to educate and lead our programs this upcoming school year.

A Few Online Teaching Resources

– NAAE Communities of Practice: http://communities.naae.org/welcome

– National FFA Remote Teaching Resources: https://www.ffa.org/my-toolbox/instructor/educator-resources/

– University of Florida Online Agricultural Education Resources: https://aec.ifas.ufl.edu/resources/ag-teachers/



One of the perks of having to work from home: my porch office.

Dr. Gaea Hock is an Associate Professor of Agricultural Education at Kansas State University and Editor of ***The Agricultural Education Magazine.***

Make Technology Work for You and Your Ag Ed Program

by OP McCubbins

If there was any doubt, the last few months have shown the world just how important teachers are and how much they do to ensure students are successful. Teachers all over the world completely transformed how they delivered instruction and leveraged technology in innovative ways to keep students learning in the middle of a global pandemic. If you haven't heard this from someone else, please know you are appreciated.

As you are well aware, technology pervades every aspect of our personal and professional lives. From the time we wake up until we settle in from a long day of work, we are constantly interacting with technology. You may have 'Zoom-fatigue' from constant videoconference sessions that replaced our traditional face-to-face delivery methods. As you reflect on the previous semester and begin preparing for the new academic year, I encourage you to keep exploring how to more effectively integrate technology into your program.

Technology can be transformative! It can connect us to experts on the other side of the world. It can empower students to share their voice with an authentic audience. It can shift students from mere consumers of content to creators of content. Technology can break down barriers for our students. As a former high school Agriculture Teacher, I know the time you have to learn about new technology tools is limited. This is why I developed "Ed Tech Tips." Ed Tech Tips is a weekly exploration of one technology tool. I create a one-pager that succinctly summarizes the what and how of a technology tool you could use in your program. Scan the QR code to visit the Ed Tech Tips Facebook page.

That's also the intent behind this edition of The Agricultural Education Magazine. To help you learn about various tools or how other programs are leveraging the transformative power of technology. This issue will have tons of great resources as you consider new ways to integrate technology into your program. You'll learn about a powerful web-based grading platform used to streamline scoring of competitive events that can also be used to guide instruction. Dive into the benefits of a summer STEM program that leverages drones and gaming to teach about agriculture. Learn tips and tricks for implementing virtual field trips or podcasting in your program… AND SO MUCH MORE!

Lean on the strengths of others if you aren't comfortable with technology. We are in this together and together we can better prepare students for a technologically advanced workforce and world.

OP McCubbins is an assistant professor at Mississippi State University.

Simple Tips to Effectively Promote Your Program Using Technology

by Anna Bates, Theresa Pesl Murphrey, Caitlin Stanton

"If we cannot go to the middle schools to directly talk to the students, what are the best ways to promote our agricultural education programs? How can we inform others about FFA?"

These questions are posted on Facebook teacher accounts and social media platforms daily. And – with the current COVID-19 pandemic requiring most to "stay home"- this has become an even more urgent question.

Agricultural science programs are more diverse than ever, with many expanding to offer competitive college prep courses, dual enrollment options, and career tech certifications. The message to students, parents, and our administration, is vital to reach the students who need our programming. The use of technology has skyrocketed and transcends word of mouth, posted flyers, and visits in person. We now can post words, images, and videos to deliver messages to potential students in diverse ways via the Internet. What should these messages look like, and where should they be posted? Why are some messages received and others not?

A tremendous difference in the overall outcome of a virtual message will depend on how it is crafted, when it is delivered, and what platform is used. The accessibility of multi-functional smartphones and video editing software makes it relatively simple for even the novice user to create professional content by applying smart, calculated strategies. To maximize impact, educators must avoid simply embracing the latest and greatest technology – and instead focus on purpose, meaning, and, most importantly, the way a message makes people feel. An emotional draw is critical to the overall influence a message has on the intended population.

At San Luis Obispo High School, we've had several successful examples. Our Agriculture Department Overview video was released on Super Bowl Sunday via YouTube. A video focused on school-wide diversity, 100 Reasons to be Anything You Want to Be, and our video response to the "shelter at home" online instruction rollout, My House, was emailed to the school district. Each message was created and delivered with the following key tips and tricks.

Tips & Tricks

The following tips and tricks will make the time you spend creating a video message worthwhile.

First, form a team of knowledgeable individuals to help capture and collect specific content. This team can be students who play an essential role in your agricultural education program or students who possess the tech-savvy skills needed. These students often acquire their skills and the wherewithal for what is "trending" with the target audience.

Next, plan your message. The planning is critical and should include a complete picture of what you hope to accomplish. This can involve a class brainstorm session or a smaller group discussion. A storyboard serves as a way to collect message com-

ponents and plan the associated imagery. Preparing a messaging strategy allows for a seamless transition into the production and editing of the video. Picking a lead project manager is critical.

The selection of the best video editing program to meet your goal is critical, as well as picking a place to store the videos captured. The most common and widely used programs are iMovie, Final Cut Pro, and Adobe Premiere Pro.The simplicity of iMovie on iPhones makes it one of the most preferred programs for teenagers. Do not overlook the options provided in your handheld device. Cell phones are capable of capturing a high-quality picture, audio, and video.

There is a filter to fix almost anything, but initial preparation can make the overall process fluid.

Use your team to help select which program meets your needs. Before beginning - determine where all the video clips will be uploaded. Will it be a shared Google Drive, an FFA members' phone, or a chapter laptop? This will prevent blurry videos. Air dropping videos from an iPhone is a handy way to share content. Take into account Android versus iPhone video transfers beforefilming.

Build the message to meet your goal. The staging of a video, arranging photo backdrops, and selecting who is speaking makes a difference. A common mistake is just to throw kids in front of the camera and have them talk about things such as their SAE project, FFA experience, or agriculture classes. This mistake can result in lengthy video clips, distracting backgrounds, and lack of expression. The intentional selection of students to be in the video is

important. While your message goal will drive this selection, it is good practice to show a wide array of diverse students so peers can connect. A mistake is a constant focus on the same students or chapter officers. This dulls the audience's interest and decreases the chance that new families will share your video. Aspects to consider BEFORE filming:

- Location, location, location - consider this for each video segment. Remember, your goal is likely to spotlight aspects of your program, select targeted backgrounds such as your classroom, school farm, greenhouse, etc. Lighting and clarity matter – consider this when filming.
- Always film horizontally to avoid the black sides on the video. This reminder cannot be stressed enough. It takes one vertical video to throw off the fluidity of your images.
- Time length - A rule of thumb is to make your videos no longer than 3 minutes. Longer than this and you will lose interest. Be concise and make your point.
- Timing - If the video being used will have specific timing with words to a song, create a spreadsheet with the exact time frames you want individuals to perform. Ask them to film 10 seconds more than their exact part to give you room to adjust.
- Written scripts and practice - Each person in the video should have a written script and practice before filming. Use cue cards to help, if necessary.
- Appearance matters - Students should wear FFA apparel, formal uniform, or an outfit specific to the project's purpose. Watch out for inappropriate clothing before pressing record.
- Music = Emotion - The song or background music choice is one of the most important details as this can be the emotional connectivity to your video. The music also labels your video as professional or playful. The words of the song should connect to your intent, although instrumental music can be just as powerful. Visualize the video clips with the song and do a test run of the music with a short clip. Royalty-free music, of all types, is available for download from various online outlets and

can save you from the headaches of copyright claims after upload.

● Caption your video and incorporate high color contrast with text elements to ensure accessibility for all types of viewers. Message delivery: Be prepared to post and upload your final video to multiple outlets. Where and when you deliver the message is critical. Remember your audience. Do you want to reach parents at home drinking coffee in the morning or teenagers on a weeknight when they are likely to be doing homework? Think about when your audience will be in tune with their devices. "Boosting" (paying for your video to show up as an ad) can be a good strategy if implemented deliberately. A free option is "purposeful tagging" to an industry partner or school-wide outlet. Strategies can also include sending the link directly to middle school teachers to show in their classes, to news stations to post on their websites, and to booster clubs and school- wide emails. Instagram TV (IGTV) makes it easier than ever to post longer videos to outlets more common to teenagers. Consider platforms designed for short videos, like Instagram Stories or TikTok, to provide a concise but compelling message. Promoting your program has never been more possible than today with the effective use of technology. Successful messages are well-thought-out and catch the eyes of the viewers. Treat it like an essay that needs proofreading. If you are looking for successful examples of purposeful videos, go to the San Luis Obispo FFA YouTube account and search for the following recent videos: My House, Choose Positivity, and SLOHS Agriculture Department Overview. Each of these videos was created following the tips and tricks shared and delivered specific messages. As you look at these examples – recognize the title, the cover photo, and the individuals in it were identified in the planning phase noted above to effectively promote our program and unique times of our school year. Whether it is to recruit new students into your program or to spread agricultural literacy, videos have the potential to generate emotions and connections just as powerful as a great teacher in a classroom. It is through careful and calculated planning that anyone can create a masterpiece that tells a story. The answer to "How can we promote our programs?" is to use the tools at our fingertips. Agriculture teachers, with their students, can create compelling promotional videos that are one "post, click, or like" away from bringing about awareness of programming that can forever enhance the lives of our intended audience.

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Caitlin Stanton is the marketing coordinator for the California Mid State Fair.

Using Technology for Engagement, Gamification, and Choice in the Classroom

by Robin C. McLean

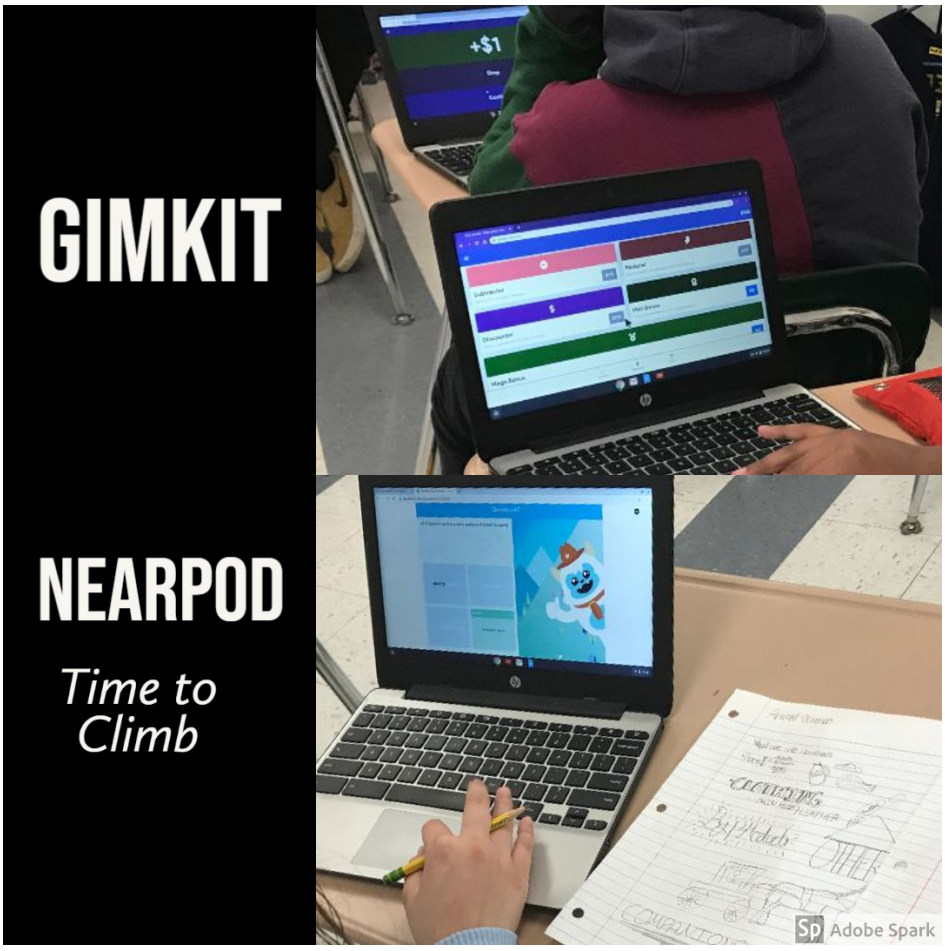
Technology in the classroom provides the chance to practice strategies for engagement, gamification and choice. My innate desire to learn and explore new teaching technologies combined with my middle school students' willingness to try new experiences and let me know their thoughts about it has provided me with the opportunity to try a variety of tools. One of the keys to success I have found is to use the support services the varied learning platforms provide and reach out to my network of educators.

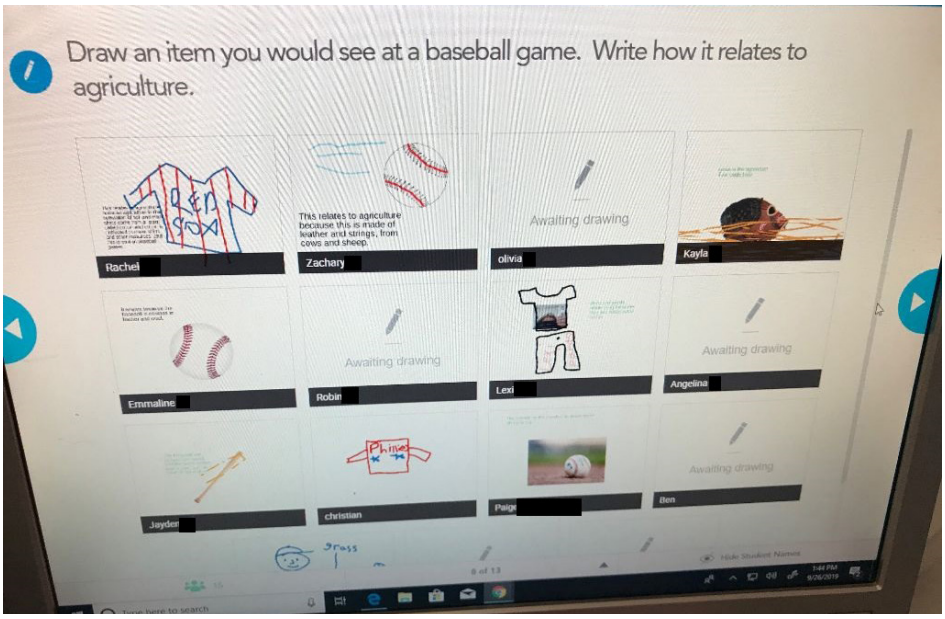
Student Engagement

For me, student engagement is when a student is connecting with the content. They are curious about how the topic might relate to their life and willing to share their ideas and experiences. My classroom is one that encourages dialogue and conversation so it is often easy to see how the more vocal students are processing and engaging with the information presented. Wait time that I try to provide to let students think about the question posed is often filled with the voices of students eager to share. Technology in the classroom can help level the playing field and encourage engagement for the sometimes-quiet learner.

One of the platforms I use to encourage engagement is Nearpod. This is a tool that can be live, meaning teacher-led, or student-paced. I tend to use the live option as it allows me to see student-learning in real time, share out examples, and spur further discussion on content. I can take students on a virtual field trip using videos or the 360-degree virtual field trip options. I have learned that including a "look for" before the "trip" is helpful but students will still find other items in the experience that spark their curiosity. The voice of the reluctant learner can be engaged through inserting a poll or having students respond to a prompt on a collaborate board. When results are displayed on student screens, student names are not revealed so it helps the shy learner have confidence in sharing their response. Other Nearpod tools including the draw it feature and open-ended questions give students a chance to synthesize information and make meaning of the concepts. The variety of tools that can be used in one lesson provides an opportunity to reach different modalities of learners to help them connect. (Note: Other platforms offer similar engagement features such as PearDeck.)

Flipgrid is another tool that I have found to help the reluctant learner have a voice and become engaged. By creating topics within grids, students can share their ideas and provide feedback to class-





mates. There are resources to help the camera-shy user, which allows students who may be reluctant to voice their ideas aloud in class. One of the lessons I've learned in using Flipgrid is that although it is a quality tool, trying to have students use it in the classroom at the same time is not practical. When using it, I either assign the recording as an out of class experience or schedule time in the media center or cafeteria so students have space to spread out and record.

Gamification

Another way I have found to help students engage in learning is with games. From the beginning of my teaching career, I tried to find ways to bring games into the classroom. Technology has made gamification easier and also supports the idea that with teens averaging 2.5 hours a day playing video games, gamified learning can help bring relevance to their experiences. I have used a variety of gamified tools such as Gimkit, Kahoot, and Socrative to provide a way to help students play while reviewing lessons, whether for a class or in preparation for career development events. Nearpod includes an option called "Time to Climb" which is also a gamified experience that allows me to assess where students currently are in their understanding. Each tool comes with strengths and challenges.

Socrative was the first tool I used and I like that it allowed me to easily upload content that I could share as quizzes or races. I used it mainly as a training tool for career development events with the races to challenge student learning and then the quiz to see how they retained the knowledge. I next journeyed into the world of Kahoot. I enjoyed the flexibility of modes it offered. Students were excited about it, until they weren't. As more teachers began using Kahoot, students began to get a little bored with the format. They were excited not to be doing "classwork," as they didn't realize the learning motive behind the gamification, but I could tell they were looking for something else.

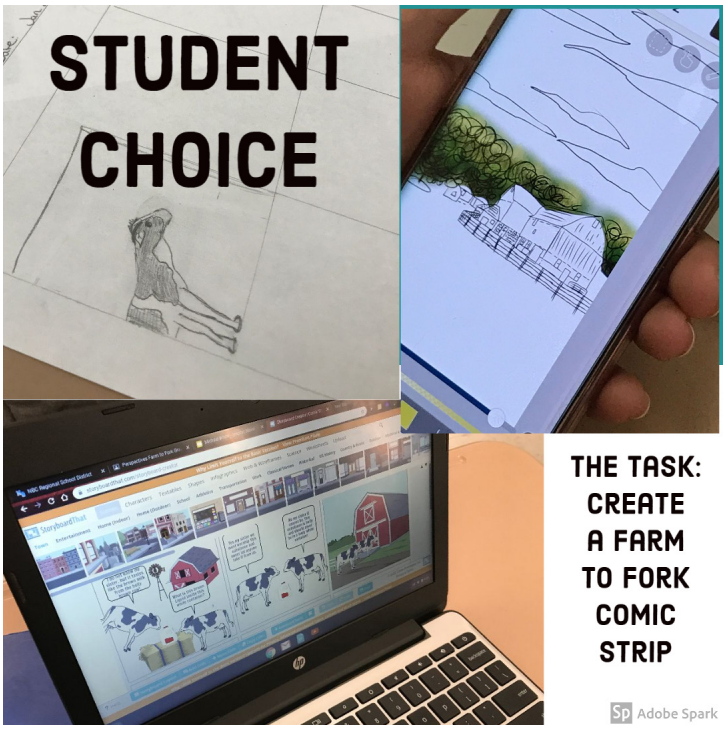
Luckily, as an EdCamp attendee, I had heard about GimKit and was ready to give it a try. This gamified tool was similar to Kahoot in that it provides four multiple-choice type answers, but it also involves strategy. As a teacher, I can set game parameters for how much virtual money my students need to earn or how long they can play. Then, students answer questions, earn money and can use power-ups to try to increase their earnings or thwart their classmates in a quest to reach the winner's podium.

(Note: There are other gamified options that I have seen shared in the various educational technology forums I participate in, as well as gamified learning that is not competitive. These are the tools that have worked for me.)

Student Choice

Just as games were a part of my teaching pedagogy from the beginning, so was attempting to find ways to give students a choice. Most often, this choice was in project presentation and design to help students feel more ownership of the final result. Phi Delta Kappan magazine has expressed that when students have choice, teachers are better able to help them meet their learning needs and also work with their strengths. I have learned that as a teacher, offering student choice exposes me to new technology tools.

When I initially began providing choice with technology tools for presentation, it was options of some basic tools I had used such as Google Slides, Prezi, and Piktochart. As I kept my eyes open to what others were using, I began to offer suggestions of tools including Buncee, Emaze, Adobe Spark, Canva, and Google Drawings. I learned that when offering a choice of tools, the evalu-



ation rubric had to be created in a way reflective of the fact there might be various tools used.

I began to have students ask me if they could use other tools. After asking them a few key questions about their choice, including: "How will you share it so others, besides you as the creator, can see?," "What makes you want to use this tool for the project we are doing?" and "How much experience do you have working with it?" I usually approved. Then I made a note of the tool they were using so I could find out a little more about it. Project overviews now often include "a design tool of your choosing once teacher approved." It is important to note that for some students, that design tool of choice includes hand-drawn illustrations or posters.

Project tool choice is not the only way I allow my students choice in the classroom. I have begun to use choice boards in a way that allows for the differentiation of learning. By using hyperlinks in a document, I am able to connect students with learning tools and resources. Without explicitly saying, "I differentiated for you," I can create a choice board that has both modified and more challenging content. While watching and providing students feedback as they progress, I can guide them to the choices on the board and technologies that can best meet their needs.

Technology take-aways

I have found that using technology for student engagement, gamification and choice does not always work as planned. I need to be prepared with a "Plan B" if there is a technology fail or the lesson isn't going as I had hoped. I need to give my students time to play a little with the tools and learn about some of the features before diving into using them. I have to be willing to accept the discomfort and struggle that comes with students exploring new tools and work with them to develop their problem-solving skills.

I realized it is better to focus on learning a few technology tools well as opposed to trying to delve into too many. Hence, I shared my notes of awareness of other tools but didn't elaborate. Once I have learned a tool and helped my students gain comfort in their use, then I add another to the toolkit.

I discovered that to bring technology into the classroom, I have to be willing to continue to learn. I need to be vulnerable in front of students and peers and admit when I don't know. I have to stay connected, not only to the technology tools other educators are using but to what my students are talking about. Willingness to learn, vulnerability, and connection will help me continue to find and effectively use tools to provide students with engagement, gamification, and choice.

Robin C. McLean, a middle school agricultural science teacher and FFA advisor from Columbus, NJ, is in her 22nd year in education.

References:

Parker, F., Novak, J, & Bartell, T. (2017). To engage students, give them meaningful choices in the classroom. Phi Delta Kappan 99 (2), 37-41.

"Video Games." Center on Media and Child Health, Boston Children's Hospital, 2019, cmch.tv/parents/video-games/.

Robin C. McLean is an agriscience teacher at Northern Burlington County Regional Middle School in Columbus, New Jersey.

Using Virtual Reality (VR) Technology in School-Based Agricultural Education Programs

by Trent Wells and Jay Solomonson

School-based agricultural education (SBAE) teachers have access to a wide range of technology options in the 21st century (Phipps, Osborne, Dyer, & Ball, 2008). These options are intended to help support teaching and learning within SBAE programs. Examples of technologies recently studied in the context of SBAE programming include precision agriculture sensors (King, McKim, Raven, & Pauley, 2019), smartphones (Smith, Blackburn, Stair, & Burnett, 2019), and virtual reality (VR) technology (Wells & Miller, 2020a).

VR technology is designed to provide immersive experiences for users and can be used for a wide range of applications (Bailenson, 2018). This may include developing psychomotor skills useful in agricultural mechanics tasks (e.g., welding, power equipment operation, etc.), practicing public speaking skills to help overcome anxieties and prepare for competitive events, virtually touring agricultural facilities, or even observing students' supervised agricultural experience (SAE) work sites. The immersive aspect of refined, high-quality VR technology allows a user to cognitively function as if they were present and engaged in the actual setting or task (Bailenson, 2018).

Using VR technology could be beneficial for SBAE teachers, students, and programs more broadly, especially considering current global events. VR technology can be used to: (1) more actively engage students who are digital natives adapted to using technology to accomplish everyday tasks, (2) provide immersive experiences through safe, controllable means, and (3) allow students who suffer from cognitive or physical afflictions to actively learn and engage in agricultural subject matter and experiences in ways congruent with their peers. While only serving as examples of VR technology's potential to positively impact teaching and learning within SBAE programming, consideration of these ideas is paramount to ensure we as teachers are creating impactful opportunities that engage them in meaningful ways. Let us take a look at how using VR technology could have practical implications for SBAE programs.

Skill Development

VR technology for skill development purposes can be reflected in many applications. The application SBAE teachers are likely most familiar with is VR welding. VR welding simulation systems have been adopted and used in numerous settings across the United States and abroad, including SBAE programs, welding programs in secondary-level career and technical education (CTE) centers, community colleges, universities, and industry. In particular, using VR welding simulation systems can be practical for SBAE teachers who provide instruction in welding and metal fabrication processes as part of their agricultural mechanics coursework.

Byrd, Stone, Anderson, and Woltjer (2015) and Wells and Miller (2020b) found using VR welding simulation systems can be a practical, useful component of the welding skill development process. Moreover, using VR welding simulation systems can help reduce consumable materials costs associated with welding, such as metal, electrodes, electricity, and so forth, while reducing environmental impacts and health hazards such as shielding gas fumes. Using VR technology for this welding skill development and assessment purposes could be considered as a method to market SBAE programs as using environmentally-conscious, sustainable teaching and learning practices that use evidence-based research to guide the skill development process.

As an example of using VR technology in agricultural education settings, I regularly integrated the Lincoln Electric® VRTEX® 360 VR weld training system into the agricultural mechanics course I taught as a graduate teaching assistant at Iowa State University. Students were required to earn two consecutive scores of 80% on the assigned welding activities to document their skill development. This requirement was designated based on input from agricultural equipment manufacturers who used the same type of VR experiences for their prospective manufacturing facility employees. As such, I wanted to align my course activities and requirements with the local agricultural industry, much like how SBAE programs operate. I also

found we saved a considerable amount of welding consumables by having students hone their skills in a virtual environment.

While using VR technology for welding skill development has been identified as practical and useful for the skill development process, the potential for applications of VR technology for skill development purposes does not end there. Considering the full range of skills taught within many SBAE programs, using VR technology could have potential in other agricultural subject matter, such as veterinary science. Veterinary science coursework frequently includes topics such as animal handling, disease control and prevention, administering vaccinations, and surgical procedures. As procuring physical animals or specimens can be difficult at times and can raise questions of ethics in some instances, perhaps identifying opportunities for using VR technology to teach skills needed for veterinary science could be useful.

A colleague of ours is studying this issue now. Jessie Juarez, a graduate student at Iowa State University, is researching how VR technology could be used in veterinary medicine. Her work will help steer how VR technology can be applied to teaching and learning veterinary medicine-related skills, such as suturing and performing euthanasia procedures, which could have significant ramifications for how veterinary science skills can be effectively taught within SBAE programs as well. Over time, technological advancements will trickle down from universities and industry to secondary schools. SBAE teachers should be prepared to embrace VR technology as a solution for teaching students practical skills that could impact their college and career opportunities.

Knowledge Development

In addition to employing VR technologies for skill development, it is also frequently used to provide content knowledge and interactive experiences for various segments of SBAE. Several companies, such as zSpace, VictoryXR, Google (Expeditions), Nearpod, MergeVR, and DiscoveryVR, are currently developing VR experiences (some are even working on full-blown curricula) for K-12 schools to provide instruction for content areas. While none are exclusive to SBAE, some developers offer an engineering and/or science-based curriculum

that could be easily adapted for use in SBAE classrooms. However, probably the most used application of this technology in SBAE is providing students with virtual field trip experiences to locations not normally accessible to SBAE students. Whether it is a virtual tour of a combine harvester manufacturing facility or a bio-secure hog farm, these experiences can provide a glimpse into facets of the agricultural industry not typically available to these populations. Several examples of these VR field trips can be found for free on the National Ag in the Classroom website at www.agclassroom.org/student/tours.cfm.

In our community, we use VR technology to create interactive agricultural literacy experiences for local elementary schools. For 12 years, the local Farm Bureau and FFA chapters hosted an agricultural field day for 25 elementary schools in the county. Students are bused to the county fairgrounds, where they would travel through six stations representing different areas of production agriculture. This experience typically reaches 600 urban elementary students over three days. The event planning committee has encountered several challenges securing presenters, volunteers, and livestock for the three-day event over the last several years. Securing additional funds to offset the costs of the event was problematic as well. The Farm Bureau Foundation board decided to examine an alternative format where they could still bring the farm experience to the school. They decided to invest funds to develop virtual learning experiences to accomplish this task.

In partnership with a local video production company, we developed three 15-minute VR experiences at a seed corn production facility. The VR experiences covered various aspects of the production process and had accompanying lesson plans. We piloted the videos and curriculum at one local elementary school and have gotten positive feedback from both the teachers and students regarding the experience. We plan to develop additional VR videos and instructional resources to use in the county. These forthcoming materials will focus on the dairy industry.

Ideas for the Future

With the growth and expansion of VR technology and its capabilities (Bailenson, 2018), there are numerous ideas for how such technology could impact SBAE beyond the examples previously mentioned. VR technology could be used to help SBAE teachers and students with activities such as SAE visits, competitive FFA activities, and other events in which face-to-face interaction may be inconvenient, logistically challenging, or even unfeasible. Recent events throughout the world

dictate we as SBAE stakeholders should contemplate using alternative methods for conducting our work, especially considering the positive impacts we could have on our students and ourselves when we proactively use our resources.

Closing Remarks

We wish to emphasize VR technology should be used as a tool to help supplement and aid the teaching and learning processes occurring within SBAE programs and should never completely replace doing the real thing. In essence, VR technology should be used whenever practical to help support activities conducted in SBAE programs. There are definitely some considerations and concerns that must be taken into account when deciding to adopt and use VR technology in SBAE programs.

A primary concern with adopting and using VR technology in SBAE programs is cost. Ready-to-use VR technology applications can be expensive. However, consider that funds from multiple sources are available to help teachers acquire VR technology for their SBAE programs. These funds include Perkins monies available annually to SBAE programs, grants from technology initiatives, educational consortiums, and so forth. Teachers interested in using VR technology should consider various avenues for acquiring such technology. The potential for students' acquisition of knowledge and skills is high. As teachers, one of our roles is to facilitate the transfer and application of knowledge and skills through engaging experiences. VR technology has a chance to positively and fundamentally alter many aspects of our lives (Bailenson, 2018). Perhaps these types of positive things could happen in our SBAE programs, too.

References

Bailenson, J. (2018). Experience on demand: What virtual reality is, how it works, and what it can do. New York, NY: W. W. Norton & Company, Inc.

Byrd, A. P., Stone, R. T., Anderson, R. G., & Woltjer, K. (2015). The use of virtual welding simulators to evaluate experienced welders. Welding Journal, 94(12), 389-395. Retrieved from http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1114&context=imse_pubs

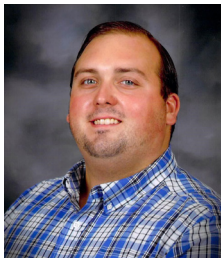
King, L. G., McKim, A. J., Raven, M. R., Pauley, C. M. (2019). New and emerging technologies: Teacher needs, adoption, methods, and student engagement. Journal of Agricultural Education, 60(3), 277-290. doi:10.5032/jae.2019.03277

Phipps, L. J., Osborne, E. W., Dyer, J. E., & Ball, A. (2008). Handbook on agricultural education in public schools (6th ed.). Clifton Park, NY: Thomson Delmar Learning.

Smith, H. E., Blackburn, J. J., Stair, K. S., & Burnett, M. F. (2019). Determining the effects of the smartphone as a learning tool on the motivation of school-based agricultural education students in Louisiana. Journal of Agricultural Education, 60(3), 141-154. doi:10.5032/jae.2019.03141

Wells, T., & Miller, G. (2020a). Teachers' opinions about virtual reality technology in school-based agricultural education. Journal of Agricultural Education, 61(1), 92-109. doi:10.5032/jae.2020.01092

Wells, T., & Miller, G. (2020b). The effect of virtual reality technology on welding skill performance. Journal of Agricultural Education, 61(1), 152-171. doi:10.5032/jae.2020.01152



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Zoom, Google Hangout, and Skype: Oh My! The Many Ways to Connect Your Program Through the Power of The Internet

by Katrina Swinehart Held

Many educators, especially those in Agricultural Education, appreciate the value of experiential learning. Experiential learning is an integral part of Agricultural Education's three-circle model. Agricultural Educators know that one of the most powerful ways to educate students about the industry they are studying is to immerse them in industry-related experiences. Students are hungry to see how the lessons they are learning translate into the "real world." However, with school budgets under constant watch, and constraints on travel, many schools have had to reduce the number of field trips. I know that when I left the classroom in 2018, I had lost almost 25% of my field trip funding due to budget issues, and I knew my district wasn't alone in this situation. So how do we continue to offer robust experiential learning within these challenging constraints? Through the use of technology, of course.

Over the past five years, a growing concern among agricultural enterprises and producers has been how to share their production practices with consumers. Also, enterprises and producers want to inspire a new generation of potential agriculture industry employees and demonstrate how great their future could be in the industry. Given the concerns about biosecurity, potential accidents, and the safety of the participants, many of these experiences have been moved online through virtual field trips. Whether they are live experiences or ones that are recorded and made available through different avenues, their popularity has soared. Why is this happening? Why do enterprises have an interest in reaching out to students this way? What do students gain from these experiences? These are all evaluative considerations as individuals move forward in engaging in these experiences.

Students are hungry to see how the lessons they are learning translate into the "real world."

What value do virtual tours provide to agricultural enterprises?

When I was in the classroom, my students were the first to experience a virtual tour from Fine Swine, which is a large hog operation in Ohio and Pennsylvania. Ms. Katie Morrison, their Recruitment Operations Director, was the individual we worked with to conduct this opportunity. Fine Swine began offering virtual tours of their facilities because they wanted everyone to know what happened in their facility and what careers existed within their operation. Most importantly, they wanted to do this without worrying about biosecurity issues. Morrison stated, "At our facilities, we have everyone shower in and out of the barns, so trying to get an entire classroom of students through this process would be difficult" (K. Morrison, personal communication, March 10, 2020). She added, "also, agriculture students may own hogs, which prohibits them from entering our facility" (K. Morrison, personal communication, March 10, 2020). Virtual tours were the answer to help them meet all their needs. Morrison shared that these virtual opportunities allow them to continue sharing their story about the swine industry without all the concerns.

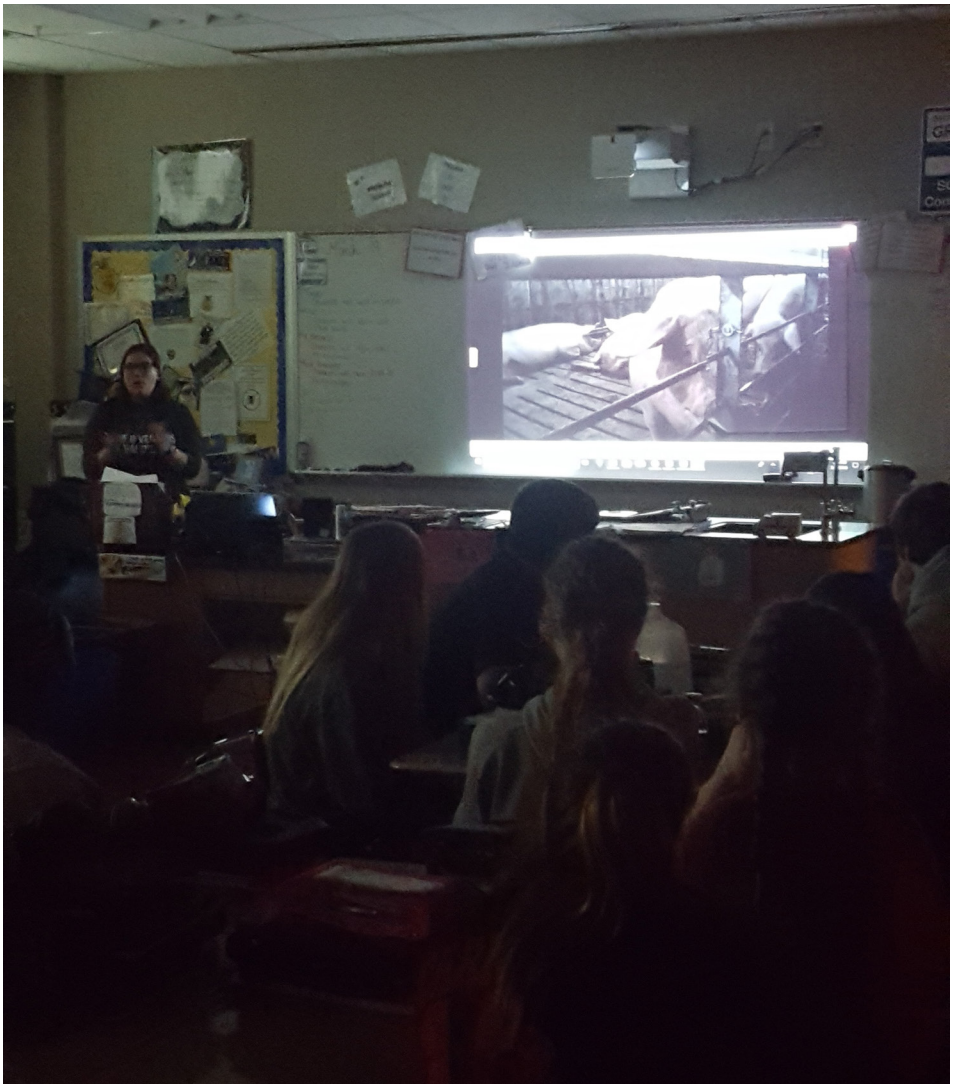
Many other groups within Ohio Agriculture have also been part of this trend. Ohio Pork Council, Ohio Cattleman, Ohio Soybean Association, and Ohio Corn and Wheat Growers have all offered similar opportunities for students in Ohio. Some even work with elementary students. Many of the tours are videoed and posted to YouTube. The videos help to further the impact of these opportunities and reach as many individuals as possible.

Morrison shared that offering virtual tours was a process of trial and error. Internet connectivity throughout the barns is challenging due to the construction of the buildings. She records "backup" video in case of technical difficulty. Advice for other agricultural businesses hoping to use virtual tours to connect with youth include using a tablet as they are easy to handle (she suggested a Verizon Samsung tablet), noise-canceling headphones in order to hear participant questions over background noises (Morrison suggests

the Blue Parrott headphones) and turning the video off while moving or moving slowly to prevent a blurry screen. Fine Swine has had great success with these tours as a mode of raising awareness of their operation, industry, and careers. Personally, when I was in the classroom, several of my students applied for positions and worked at their facility. This connection created a win-win situation for both Fine Swine and my program.

What value do virtual tours add to educators?

While in the classroom, I had classes participate in three virtual tours: Fine Swine, a local cattle farm, and a local grain farm. Each allowed them to "see" what they were learning in class in a real-life setting. Engaging with farmers, seeing processes and topics from class, and asking their questions provided the experiential learning that would happen on a field trip; now, with technology, all this powerful learning can happen within the walls of your classroom. Several agricultural educators in my area have also conducted virtual tours. A few admitted they had a learning curve; this included making sure the video conference program was available on the school network, making sure they had the internet bandwidth to have good quality video, and preparing students for the experience. Students should be placed in such a manner they can easily see and engage with the material in the video conference. Arranging your classroom (or another space) in a way that can accommodate your group, with a large screen, is very helpful. Other tips include having students think of questions to ask in advance and completing a reflection over the experience.



How can virtual tours impact the student experience?

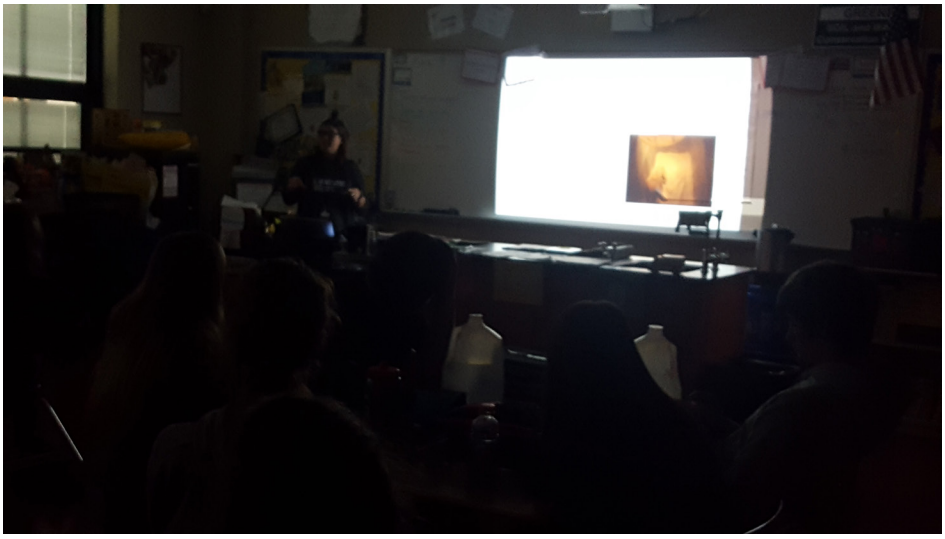
Given that 36% of students enrolled in Agricultural Education live in a non-rural area, the need for consumer education within our programs is more critical than ever (National FFA, 2017). Additionally, this percentage of students coming from non-rural areas poses the importance of career awareness in all facets of the agriculture industry. Virtual tours allow students to experience, maybe for the first time, what processes look like on a farm. These virtual tours also enable them to see what a career in the agriculture industry may look like. For students who are from a family farm, virtual tours allow them to experience another type of agricultural enterprise and learn about additional careers. Additionally, virtual tours can emphasize experiential learning, consumer education, and career awareness. Facilities that offer virtual tours, including food processing facilities, manufacturing facilities, and other unique facilities can open their doors and students' eyes to different processes they may not see otherwise. All of this learning and these experiences can be accomplished without leaving the classroom and within your usual class time.

Locating a Virtual Tour

As mentioned earlier, several organizations have begun using virtual tours to connect with students and schools. National FFA has scheduled virtual tours you can register your students to participate in. Additionally, many state FFA Associations are serving as a bridge to connect programs with tours. Some are listing the tours in their weekly newsletters or on their websites. You may even see virtual tours listed in the NAAE Monday Morning Monitor. Commodity associations, enterprises, and facilities are reaching out directly to teachers and programs. You might consider reaching out to a facility you have interest in visiting; chances are they are willing to accommodate you as well. Finally, never underestimate the value of a virtual tour previously posted to YouTube. They can also offer valuable experiences for your students.

Other Applications of Virtual Tours

Outside of virtual tours, another student application of video conferencing is mentorship. Many students can benefit from connections with individuals to assist with their Supervised Agricultural Experience, Agriscience Fair, Career Development Event, or Leadership Development Event. Using video conferences to connect professionals and experts with students in areas of study within the Agricultural Education program is yet another valuable tool. Faculty at my university have connected with and assisted FFA members in all of these areas. It allows for robust, meaningful mentors to connect with students to help make an impact on their learning.



This article is being written while on a "stay-at-home" order due to COVID-19. Everything is being conducted virtually from the courses I'm teaching, and taking, to my advising meetings and office hours. Suddenly, overnight as it seems, everyone had to adapt to using technology for every aspect of their job or education. It is likely individuals will feel more comfortable and confident after this experience. Your school has probably made some IT upgrades or updates, and your students are getting better at engaging with video conferences, so capitalize on this to assist in building meaningful, high-quality virtual learning opportunities for your students. From virtually touring agricultural enterprises to interviewing agricultural professionals or conducting a panel discussion over a class topic, all of these are a possibility for your classroom and your students.

Conclusions

Using the power of the internet, great mentors or agricultural enterprises can make lasting impressions on students in Agricultural Education programs across the country. Whether you choose to connect locally or find connections far away, using video conferences to enhance the educational experiences of your students is a great way to bring the power of experiential learning and mentorship into your Agricultural Education program.

References

National FFA. (2017). Organizational annual report: National FFA Annual Report for2017. https://ffa.app.box.com/s/c87new5wj8pap1nuej8bajhgt8fxmeia/file/312874421284

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The Power of Google

by Kathryn Teixeira

The hat I wear is a little different these days. My role at Oklahoma State University has allowed me to work with pre-service teachers in preparing them for student teaching and the agricultural education profession. I find joy in working with these future educators, and as often as I can, I try to give them little nuggets of information to help them along the way.

Google offers many tools useful in SBAE programs. For starters, it is free, and who doesn't love free? The content saved on a Google Drive can be accessed anywhere the internet is available and can be shared with multiple users (e.g., teaching partners, FFA officer teams). In this article, I am excited to share three ways the Power of Google helped me as an agricultural educator.

Chapter Newsletter

There are many programs available to make a chapter newsletter. As an agricultural educator, I tried a few but always ran into the same three problems. The newsletter would be put on my desk for editing ten minutes before it needed to be printed, the computer program would crash in the midst of a student working, or the reporter could only work on it at school because they didn't have the particular program at home. Then one day, at the beginning of the school year, I was playing around in Google Slides and realized I could change the size of a slide. Immediately I thought about the endless possibilities for my students to create posters and flyers for classroom assignments and FFA events. When my reporter came to me to ask how to start the chapter newsletter for the year, it hit me, Google Slides.

Before employing Google Slides, our chapter used Microsoft Publisher. I quickly found students did not have access to the software outside of school, and Publisher did not support simultaneous collaboration on multiple computers. Harnessing the Power of Google Slides, advisors can work with chapter officers to create newsletter templates accessible on any computer connected to the Internet. In addition to the benefits above, Google Slides offers more flexibility than other Google applications for picture and content layout and mimics what you would be able to do in more technical design programs.

The real-time collaboration functions enable an advisor to edit content while the chapter reporter continues working simultaneously. Google Slides also saves the content directly to the cloud, so no worries about a crashed computer. Additionally, students can continue working on the newsletter at home by logging into their Google account.

Creating your own Google Slides newsletter is easy. Simply log into a Google account and create a new Google Slide document. From the file menu, select the page setup option and enter 8.5" x 11" as your custom page dimensions. Share with your students and have them begin designing. When it's time to make another newsletter, simply duplicate the pages from the previous month and start editing your next newsletter.

FFA Activity Points

To tell you the story of the evolution of our points tally system would be another article in itself. But to shorten the story, I used Microsoft Excel to tally points and display student rankings. Still, only one computer could open the file at a time, and there was always some kind of mix-up in sorting data for student rankings. After about a year of using group and total functions, I turned to Google Search for a more straightforward way to total up points for our FFA chapter and found Pivot Tables.

Pivot tables can seem a little

scary at first, but with some pre-planning in the way you manage the input of points, the Pivot Table is truly magical. I started with pivot tables in Microsoft Excel, but again, only one person could work on the file at a time. Too many times, students forgot to log out of the file, and I would be locked out. Additionally, our school had just moved to be a Google school, and I thought it would be neat to have our students' awards points in real-time on the website.

The switch from pivot tables in Excel to Google Sheets was simple. Google Sheets is more intuitive when it comes to using pivot tables. The first step is to create a sheet within your workbook for a student roster. This ensures student names are correct in the points pivot table. The next step is to build the ledger for student points. The components of the ledger I used are shown in Table 1. Using Data Validation, I connected the Student Name column in the Ledger to the Student Roster to ensure the student names were spelled correctly, and they didn't use nicknames (e.g., Joseph, Joe, Joey). Add a third sheet to the workbook and insert a pivot table. You can include as many additional sheets to run different pivot tables for various purposes.

The three pivot tables I used most were:

— *Points Summary - Student Name + Activity Points + FFA Points by Quarter (showed the number of activities students attended each quarter).*

— *Activity List - Student Name + Activity + Activity Points (showed which activities the student attended and points earned)*

— *Student Name + Activity Points (sorted reverse descending, shows the students in order, highest to lowest by points).*

The QR Code below links to an example of the spreadsheet I used for managing student points. Snippets of each of these are shown on the right.

Using Google Sheets, this information could also be added to a chapter website for real-time point calculations. Additionally, points could be added immediately after an event, or even during an event, because the chapter sentinel (in charge of points for our chapter) had access to the spreadsheet at all times.

Daily Objectives and Bell Work

I struggled writing bell work and class announcements on the board, mostly because I taught multiple subjects and never had enough room on my whiteboard. Even if I was able to fit all the information on the whiteboard, students in the back of the room had a hard time seeing the board, and it was information overload with three or more classes.

Using Blogger gave a home to all the bell work for this class. I was also able to use the delay post function and write questions for the entire week (and sometimes further in advance), and just schedule the posts for 6:00 am the morning I was going to use them. My favorite use of this technology came when I wasn't in the classroom. I was able to use my bell work blog to relay instructions to students when there was a substitute. Absent students could also visit the blog to stay updated on important information. An example is shown in Figure 6.

I see this technology being used in so many other creative ways. For teachers who need to identify their objectives for the day, using a blog allows for you to keep track of objectives by class, and the teacher can layout the objectives for the week ahead of time, saving valuable planning and prep time.

Google Drive allows multiple users to collaborate by editing documents simultaneously and empowers students through creative implementations of technology. I believe the Power of Google provides opportunities to help put the 'advise' back in advisor and gives agricultural instructors great tools to help save valuable planning time and better manage the classroom.

Kathryn "Katy" Teixeira recently earned a Ph.D. from Oklahoma State University. She taught high school agriculture for seven years in Northern California and is native of the Central Coast of California.

Examples of the spreadsheets I used for managing student points.

Activity List

Points Earned

Total			0
Student A	9/1/2017	Football Concession Fourth Shift	10
		Football Concession Third Shift	10
	9/8/2017	Football Concessions Fourth Shift	10
		Football Concessions Second Shift	10
	9/28/2017	Pacheco Drive-Thru Dinner	15
	10/4/2017	Greenhand Leadership Conference	25
	10/10/2017	October Meeting	20
	10/12/2017	Shasta College Field Day	50
	10/13/2017	Drive Thru Dinner	20
		Drive Thru Dinner Ticket Sales	105
	10/21/17	Harvest Festival	20
	11/1/2017	Football Concessions Fourth Shift	10
		Football Concessions Second Shift	10
		Football Concessions Third Shift	10
	11/15/2017	November Meeting	20
	11/18/2017	Tree Cut	30
Student B	6/21/2017	Shasta District Fair	50
	9/27/2017	Farm City Day	15
	10/10/2017	October Meeting	20
	11/4/2017	Anderson Explodes Dinner (Steak & Shri	40
	11/18/2017	Tree Cut	30
	11/27/2017	Tree Lot Sales- Monday	25
	12/2/2017	Tree Lot Sales- Saturday	25
Student C	6/21/2017	Shasta District Fair	50
	6/25/2017	Shasta District Fair Clean Up	10

Activities and POA Points Total

		Quarter		
		1	2	Grand Total
Student A	SUM of Activity	19	6	25
	SUM of Points	275	100	375
Student B	SUM of Activity	3	4	7
	SUM of Points	85	120	205
Student C	SUM of Activity	15	19	34
	SUM of Points	310	520	830
Student D	SUM of Activity	6	9	15
	SUM of Points	135	250	385
Student E	SUM of Activity	4	12	16
	SUM of Points	75	285	360
Student F	SUM of Activity	9	2	11
	SUM of Points	165	50	215
Student G	SUM of Activity	12	22	34
	SUM of Points	230	195	425
Student H	SUM of Activity	6	4	10
	SUM of Points	165	75	240
Student J	SUM of Activity	12	12	24
	SUM of Points	280	210	490
Student K	SUM of Activity	7	11	18
	SUM of Points	120	210	330
Student L	SUM of Activity	11	4	15
	SUM of Points	215	70	285
Student M	SUM of Activity	11	16	27
	SUM of Points	265	450	715
Student N	SUM of Activity	8	15	23

TOP 25 POA

1	Student R	855
2	Student C	830
3	Student M	715
4	Student W	635
5	Student N	600
6	Student J	490
7	Student T	450
8	Student G	425
9	Student D	385
10	Student A	375
11	Student E	360
12	Student Z	330
13	Student K	330
14	Student L	285
15	Student S	280
16	Student P	265
17	Student O	265
18	Student X	260
19	Student H	240
20	Student V	225
21	Student U	225
22	Student Y	220
23	Student Q	220
24	Student F	215
25	Student B	205

Entry #	Qtr	Date	Event #	Event	Student	Points	Activity	Notes
184	1	10/12/2017	16	Shasta College Field Day	Student H	50	1	
185	1	10/12/2017	16	Shasta College Field Day	Student U	50	1	
186	1	10/12/2017	16	Shasta College Field Day	Student Z	50	1	
187	1	10/12/2017	16	Shasta College Field Day	Student Y	50	1	
188	1	10/12/2017	16	Shasta College Field Day	Student A	50	1	
189	1	10/12/2017	16	Shasta College Field Day	Student C	50	1	
190	1	10/12/2017	16	Shasta College Field Day	Student R	75	1	3rd place high team and 4th place high individual
191	1	10/12/2017	16	Shasta College Field Day	Student M	65	1	3rd place high team
192	1	10/12/2017	16	Shasta College Field Day	Student J	50	1	
193	1	10/12/2017	16	Shasta College Field Day	Student T	50	1	

Utilizing Online Peer Evaluations for Student Accountability in Group Projects

by Chaney Mosley

Call them what you will - team activities, collaborative assignments, #squadgoals - regardless of nomenclature, group projects are a staple for teaching and learning in classrooms across the country, and for good reason. As they say, adulting is hard. Part of what makes the transition from adolescent to adult difficult is learning you can't make it in life by yourself. Eventually, we all have to work with others to accomplish goals. This requires respecting diverse opinions and people from diverse backgrounds, relying on others to do something we cannot, effectively communicating with people, and trusting someone other than ourselves. Similarly, others will depend on us, and group projects present an opportunity to develop the mindset and work ethic needed to be a dependable partner. Still, we often have a love/hate relationship with group projects.

Why Teachers Love Group Projects

Accomplished teachers are intentional when assigning students to collaborative groups for a project, knowing that strategic grouping yields more positive learning outcomes for academic, technical, and employability knowledge and skills. Consider the students who struggle to demonstrate their strengths with written assignments or traditional testing measures – group projects provide them an opportunity to excel. For students that may not have grasped content during the first round of instruction, group projects allow them to get support from their peers. In addition to reinforcing what has already been taught by requiring students to apply what they learned, group projects also facilitate the enhancement of skills desired by employers.

Collaborative problem solving, communication, conflict resolution, and self-awareness can be enhanced when students work in groups to complete projects. Teachers know that an outcome of education is employability – developing these skills in students supports greater preparation for the workforce. In spite of this, though, many students loathe working in groups.

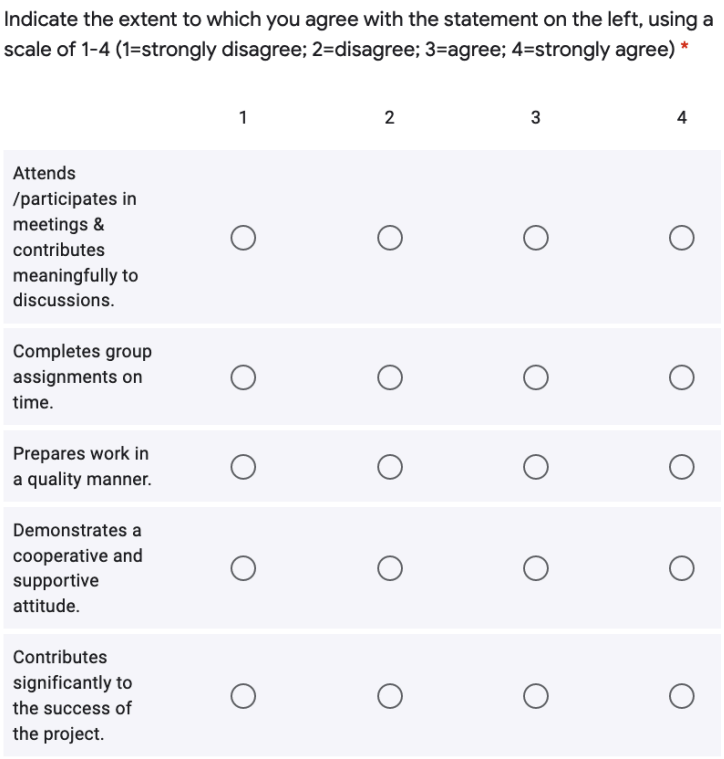
Why Students Hate Group Projects

When students choose who they work with, life is grand; however, when they don't get to choose, life can be miserable. Think about the different roles a student may play in a collaborative group: (a) the student who doesn't show up … to class, in text messages, on email threads; they are just not engaged; (b) the student who is there, but isn't there - they show up, but don't contribute at all; (c) the student who is always late, volunteering to do something but waiting until the last minute to do it; (d) the student who doesn't follow through, committing to a task but never doing it; (e) the student who controls the project - they volunteer to coordinate work, lead meetings, and sometimes do others' work for them; (f) the student who will do as told, waiting for someone to tell them what to do and offer nothing more; and (g) the unicorn … they show up, engage in conversation, share the workload, complete tasks on time, and get along with everyone in the group. We can all think of students who meet these descriptions, and we all probably work with colleagues who meet these descriptions, so we get why group projects may not be fun, but often what drives students (and us) crazy, is a lack of accountability.

I've seen too many examples of group projects where all students receive the same grade for the finished product. What motivates other students to contribute if one or two group members are willing to complete the project for everyone else? What students hate about group projects is they rarely have the opportunity to evaluate their teammates. Offering a chance to evaluate peers and using those evaluations in the final score of individuals, introduces an element of liability for each student to share in the work. So, here are five steps to administering peer evaluations online:

Step 1 – Determine What Should Be Assessed

Think about what it is you want students to do in a group project – that will help in determining what you will assess in a peer evaluation. When I deliver my peer evaluations, I focus on


Indicate the extent to which you agree with the statement on the left, using a scale of 1-4 (1=strongly disagree; 2=disagree; 3=agree; 4=strongly agree) *

	1	2	3	4
Attends /participates in meetings & contributes meaningfully to discussions.	○	○	○	○
Completes group assignments on time.	○	○	○	○
Prepares work in a quality manner.	○	○	○	○
Demonstrates a cooperative and supportive attitude.	○	○	○	○
Contributes significantly to the success of the project.	○	○	○	○

This Likert scale gives students a range on which to evaluate their peers against predetermined criteria.

five things: (1) attendance AND participation in meetings and meaningful contributions to discussion; (2) completion of assignments on time; (3) quality of individual work; (4) demonstration of a cooperative and supportive attitude; and (5) contribution to the overall success of the project.

Step 2 – Identify the Online Platform

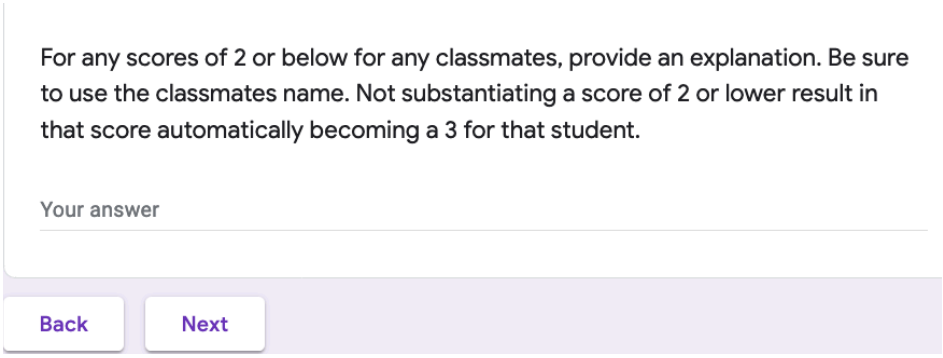
There are numerous online survey software options. Some of the more popular tools I've heard teachers use include SharePoint, Google Forms, and Survey Monkey. Often, a school system will have a subscription to a specific vendor. Regardless, you have to identify the survey platform you will use. While you can administer paper-based surveys, scoring them by hand is extremely time-consuming, especially in larger classes. When choosing a platform, consider the number of questions you are allowed to ask, the number of responses you can secure, and whether or not the results are downloadable in a spreadsheet. If the platform doesn't allow downloading the results in a spreadsheet, don't bother – you'll find out why later on. Personally, I prefer Google Forms. The platform is free and no limit to the number of responses. Also, because I use peer evaluations frequently, I did purchase an add-on that allows me to recycle previously used surveys and just change the student names.

Step 3 – Design the Peer Evaluation

When designing your peer evaluation, determine the information you'd like to gather. I use a Likert scale that reads: "Indicate the extent to which you agree with the statement, using a scale of 1- 4 (1=strongly disagree; 2=disagree; 3=agree; 4=strongly agree)" and then I list the statements (see picture for example). I list five statements, each with a maximum 4-point value, for a total of 20 possible points. If students assign a rating of 2 or below for a peer on any statement, they are required to justify that rating in written form through an open-ended question. Additionally, I offer an open-ended question where they can brag on their peers as well! When creating the evaluation in the online platform of your choice, be sure to require each student to evaluate EVERY peer in the group. This can get tricky and time-consuming. Because I only use peer evaluations for whole-class projects, I just load every student's name into the form with the same question. If you have multiple groups in a class, it might be more time consuming because each group would need their own evaluation survey, or you would have to create multiple sections and ensure students only complete the section for the group to which they were assigned.

Step 4 – Deliver to Students

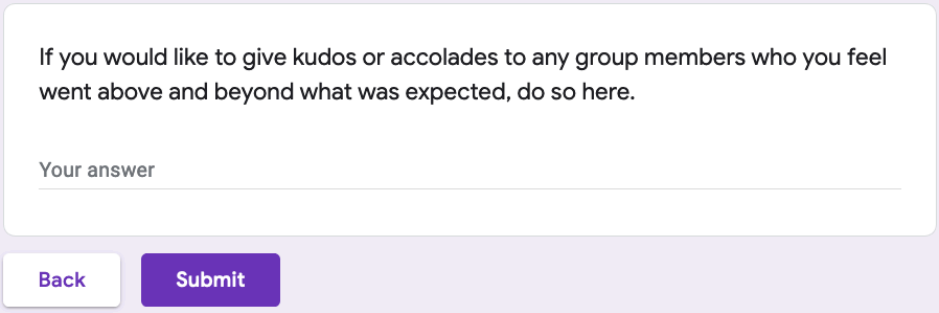
When having students complete the survey, I provide a link via email directly to them. They


For any scores of 2 or below for any classmates, provide an explanation. Be sure to use the classmates name. Not substantiating a score of 2 or lower result in that score automatically becoming a 3 for that student.

Your answer

Back Next

When students rate a peer low, they have to justify the rating.



The last part of the evaluation asks students to offer praise for their peers!

seem to like this, so they can quickly click it and complete it. If time allows, I give time in class; however, if time doesn't allow, I give them one week to complete it. When a student fails to complete the peer evaluation, I handle that on a case-by-case basis. Depending on the size of the group, the peer evaluation might take a while for them to complete. Be sure to let students know that only you, the teacher, will see how each individual rated classmates. This added layer of protection encourages students to be truthful.

Step 5 – Calculate Scores

Calculating scores might be the most challenging part of the online peer evaluation – it takes a bit of finagling the spreadsheet and creating formulas. Here's the gist, for each student you need to determine the average peer evaluation score. In other words, out of 20 possible points, on average, how was each student rated by peers. While it's simple addition and division, there will be a lot of numbers, and it will take a few times sorting the data before you get comfortable with it. However, once you get it down, you'll appreciate the information provided. For each group project, 20% of a student's final score derives from the average peer evaluation. In theory, if a student has an average rating of 5 and the rest of the project was 100%, that student would score an 85; rarely does a project earn maximum points, and there are components on which I assess individual students as well.

Pro Tips

I have been using the online peer evaluation protocol for a couple years. I learned a few strategies for peer evaluations that might make for a smoother transition in your classroom. First, when assigning a group project, be sure to let students know they will be completing a peer evaluation at the end and how much of their score is dependent on that evaluation. Also, this is an excellent time to share with them what the peer evaluation will cover. If a student knows that participating in meetings is part of the evaluation, for example, they will be more likely to engage with peers. Second, when assigning groups, consider different skills students might bring that will help the group be successful. Third, create projects where the answer or end result is unknown to require students to create something new – this will decrease the likelihood of students slacking off out of boredom. Finally, allocate time for whole-class reflection after the project has ended. Conducting a debrief will help you learn what aspects the students enjoyed and opportunities for you to improve the next time you assign a group project. Also, lead students through a reflective process that requires them to think about the challenges they experienced and how they persevered as well as what they learned.

I have seen group projects transform the dynamic of my classroom. With the first project, students are figuring out how to work together, but slowly, through the process, they build camaraderie. Currently, I have a class mostly with students who have been together for three courses. They no longer sigh or roll their eyes when I assign a group project. They have developed excellent practices for being successful. Also, no one in this group receives ratings of 1 or 2 anymore; that stopped after the first project! Recently, when I was out, my administrator covered class. Afterward, she told me it was impressive to see the students teaching themselves, and there was no need for her to even be in the room. They were on task the entire time. This does not happen immediately, but it can occur over time. Teachers must establish a classroom culture that supports collaboration, mutual trust and respect, and appreciation for the skills each student brings.

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Homegrown Podcasts: Implementation of Podcasts for Agricultural and Natural Resources Education and Engagement

by Peyton N. Beattie, Jacqueline V. Aenlle, and Dr. Jamie L. Loizzo

Communicators and educators have identified podcasting as an effective multimedia method for increasing awareness and knowledge, due to its ease of access from any location, low production cost, and low consumption cost (Fannin, 2006). "Podcasts are the perfect way to engage adult learners, distance learners, and other diverse target audiences," said Jacqueline Aenlle founder of From Urban to Agriculture, "not only are podcasts easily created, but they also allow learners to receive new information from their own safe environment, where they feel most comfortable and ready to learn, whether that be in the car on the drive to work or at home." This article features interviews with agricultural communication, education, and leadership researchers and professionals who have developed and produced podcasts around agricultural and natural resources (ANR) education content and experts as engagement experiences for their audiences.

Homegrown ANR Podcast Examples

There are numerous podcasts focused on ANR. The authors spoke with podcast producers close to home in agricultural education and related disciplines. Here is an overview of each podcast:

From Urban to Agriculture

- Target listeners: Consumers with little to no previous exposure to the agricultural industry
- Content: One-on-one interviews with experts
- Goal: Connect urban consumers with little to no exposure to agriculture, to scientists and industry experts to answer their questions

"Consumers have so many questions and concerns when it comes to their food and other products they use. It can be hard for them to know where to get answers. I want to make it as easy as possible for them to get science-based information to build their opinions and buying decisions off of," said producer Aenlle.

Owl Pellets: Tips for Ag Teachers

- Target listeners: Middle and high school agricultural education professionals
- Content: Current research findings and best practices
- Goal: To take research conducted in the field of agricultural education and produce easy and understandable content in the form of 'pellets' for practitioners

Dr. Brian Myers produces the Owl Pellets: Tips for Ag Teachers podcast alongside his colleagues, Drs. Marshall Baker, Kate Shoulders, and Mike Retallick. "Podcasts can absolutely be used as an education tool, especially now that we are all online learners," said Myers. He added, "Consistency with content creation and publishing is critical to the success of a podcast."

Wedgeworth Leadership Institute

- Target listeners: Wedgworth alumni and stakeholders
- Content: Alumni spotlights, guest speakers, and leadership development research highlights
- Goal: To engage Wedgworth alumni and stakeholders with relevant and timely leadership content and discussion

The Wedgworth Leadership Institute podcast aims to increase listeners' science awareness, literacy, and behavior intentions. "Our podcast has the potential to do each of these because of the level of trust that is a product of the organization itself. The content is curated for a specific group, and because of that, the listeners value the content and conversation. There's a lot of intentionality involved with developing the topics and finding the right guests – a similar level of intentionality that each of our listeners have witnessed while participating in the Wedgworth Leadership Institute," said producer Kevin Kent.

Two Bees in a Podcast

- Target listeners: Anyone (beekeepers, scientists, students, teachers) interested in learning about honey bees
- Content: Guest speakers who talk about their specialty as it relates to honey bees

- Goal: To provide educational content about honey bees

Shelby Howell, producer of Two Bees in a Podcast, has a conversational way of producing podcast episodes and mentioned, "We try to record in a very conversational style and let the topics flow naturally, while still managing to hit a few predetermined key points... It is very relaxing and natural for everyone involved."

Streaming Science

- Target listeners: Middle and high school students, teachers, and fellow scientists
- Content: Feature interviews with ANR scientists, produced and hosted by agricultural communication students
- Goal: To increase public science engagement, interest, and literacy

"Streaming Science podcasts feature ANR scientists discussing their research in conversational, digestible ways. Science communication students learn how to interview scientists, produce the podcasts, and share their work with real-world audiences," said founder Jamie Loizzo.

Software and Hardware

For ANR educators and communicators who wish to incorporate podcast production into their instructional materials, it is easy to get started with a laptop and a topic. When asked about the equipment she uses, Howell said that "It was all very cost efficient and still produced, what I consider, professional quality sound." The recording equipment used by the producers interviewed were Zoom via a laptop, Audacity computer application with Blue Yeti Mic via a laptop and, Rhode lavalier mics. The editing software most commonly used was Garage Band and Adobe Creative Suite. Anchor (which distributes to other podcast platforms) and Podbean were the most frequently used distribution software.

Content and Format

Purchasing the equipment may be considered easy compared to developing and producing content. Identifying an audience is the first step in developing content and will guide the direction for the podcast along the way. "When choosing a target audience, it is important to be as specific as possible about identifying what groups of individuals are most likely to have access to your chosen channel. For podcasting, many of your listeners will be adult learners," said Loizzo.

The content to be discussed during the podcast episodes should be planned next. The level in which you choose to have your audience play a role in the content is dependent upon the producers. Howell said, "We are very open to any topic that the listeners ask us to talk about."

Commonly, podcasts include more than one voice, and the episodes most often resemble light-hearted discussions. Many of the podcast producers in the field of agricultural education invite guest "experts" to join for rich discussions. When recording an interview, "act like you're having coffee with a friend," Myers suggested, "the more comfortable you are with each other, the more people enjoy listening to your conversation."

Homegrown Success

There are several ways to gauge the impact and success of a podcast, including: views, comments, likes, etc. "We currently have listeners in 49 countries," explained Howell, "and we receive a ton of feedback via reviews, social media comments, emails, and phone calls!" Other agricultural education podcast producers have received informal feedback from their listeners who have requested for the podcast to continue. "Though I consider my podcast to still be in a 'piloting' phase, I have already received so much great feedback from listeners and the experts I interview," said Aenlle, "everyone seems to agree that there is a need for this kind of communication/extension work and it is crucial to utilize these new media platforms to better connect with audiences!"

When producing a podcast, all producers agree on one inevitable challenge - time. Recording, editing, and promoting a podcast can be very time-consuming. Some ways to circumvent this issue is by having the podcast be a team effort. Geographical dispersion of podcast producers and the guest experts may present audio quality challenges. Kent experienced this when recording with Wedgworth alumni and stakeholders and mentioned, "Anchor makes the process a little easier."

There are endless examples of homegrown podcast producers experiencing different forms of success. Whether podcast tracks reach 20 students, or if they reach 2,000 people nationwide, podcasts are a versatile educational tool with the opportunity for significant lasting impacts. Podcasting can be as technologically simple or ad-

vanced as the producer wishes it to be. Podcast impacts are endless. They can support learning objectives, raise awareness, and increase engagement and ANR literacy. As Howell said, "we can treat our podcast as an extension event. It's a great tool for relaying information to as many people as possible, and we can get educators in the mindset that it can be used just like any other form of teaching."

References

Fannin, B. L. (2006). Podcasting agriculture News: Producing portable audio news for farmers and ranchers. Journal of Applied Communications, 90(2). doi: 10.4148/1051-0834.1280

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THEME ARTICLE

Program-Wide Swivl Adoption

by Christopher Eck, Nathan Smith and Jon Ramsey

It does not matter if you are completing the first year or the 25th year; we have all experienced the overwhelming notion that we are not doing a "good job." Or, think we are not doing justice to our students, schools, or communities because we cannot be in five different places at one time. We plan for instruction, execute innovative and exciting lessons for our students, and expose them to multiple opportunities within the agriculture industry. Additionally, we feel guilt or stress because we spend afternoons and evenings visiting and checking supervised agricultural experience (SAE) projects, training career development event (CDE) or leadership development event (LDE) teams, or on rare occasions, go home and spend time with our families. Either way, we constantly feel we are neglecting one or more areas of our life and career. We try to find balance in our work and personal life but seldom do we seek out tools that may help make this balance attainable. This article highlights a tool that can do just that, allow you the opportunity to create a safe and accessible platform to conduct SAE visits, train CDE/LDE teams, and develop a library of meaningful class lessons/presentations to use for years to come. This tool is called Swivl, and it uses video collaboration in an online format.

Video collaboration has been integrated into university-level agricultural education teacher preparation programs (Eck et al., 2019) through Swivl, but how can this technology benefit the local school-based agricultural edu-

cation (SBAE) teachers? Swivl integration has the potential to enhance all three components of a complete SBAE program (i.e., Classroom/Laboratory Instruction, FFA, and SAE) through purposeful video collaboration. Swivl technology integrates a robot for tracking and recording via a secure online platform for viewing and collaboration. "The Swivl robot rotates to the teacher automatically. It connects to multiple markers for recording audio throughout the room and uses the tethered (or mobile device) for recording video" (Swivl, 2020, para. 4). After the video has been recorded, it can be viewed on a secure Swivl account for self-reflection, peer feedback, or coaching (Swivl, 2020).

Swivl technology can be implemented for classroom/laboratory instruction to record class sessions for SBAE teachers to later watch and reflect upon their teaching. These recordings could also serve as a tool for peer coaching from other teachers or for real-time evaluations for administrators. Building a cohort of peers for peer coaching using Swivl allows teachers the opportunity to provide suggestions, assistance, and support as needed for professional growth in a non-evaluative environment (Chism, 1999; Skinner & Welch, 1996). Additionally, creating a video library of ag content for your agricultural courses would be beneficial when a substitute is charged with delivering relevant instruction. Furthermore, in situations where you are required to provide instructional content via distance, the library of content-based lessons would serve as a valuable instructional tool. Daily, Swivl could provide an opportunity for teachers working to implement a flipped classroom, allowing additional in-class time for the application of critical concepts. The classroom/laboratory application opportunities are abundant, allowing agricultural education teachers the ability to tailor the technology to their programmatic needs.

Furthering the program-wide application, Swivl can be used for CDE and LDE training. For example, a class of steers could be recorded using Swivl to be later played during livestock evaluation CDE practice. Although the initial recording may be with a team evaluating the animals in a live setting, future teams could use the videos as a training tool. Similar scenarios could be developed for a variety of CDEs. Pre-recorded videos could serve as a self-guided training tool for future CDEs or allow a teacher to facilitate multiple team practices at the same time. SBAE teachers could also use the technology for LDEs. One example is recording parliamentary procedure practice to later watch as a group and reflect upon the performance. Individual public speakers (i.e., creed, extemporaneous, or prepared) could utilize the Swivl app on their device to record and reflect upon their presentations. These recordings could also be shared with you as the FFA advisor to evaluate and provide feedback. Outside of training teams, Swivl technology could serve other roles within the FFA chapter, from recording meetings and banquets to developing promotional or recruitment videos.

Supervised agricultural experiences are the final component. As programs continue to grow and responsibilities of SBAE teachers continue to increase, the time and availability for SAE visits reduce. Therefore, SBAE teachers would have the ability to integrate Swivl technology into SAE visits. Students can utilize the Swivl app on their device to record their SAE projects or to provide project reflections, of which the teacher could then watch, providing time-stamped feedback to the video. The implementation of this would allow teachers an opportunity to conduct remote SAE visits, freeing up valuable time.

Overall, Swivl provides a practical technology that can be integrated throughout an SBAE program. Practical applications exist through classroom instruction, FFA coaching and advisement, and SAE supervision. To accomplish this integration, we recommend that the teacher purchase a Swivl robot for classroom and laboratory recordings, while also needing to maintain an annual subscription for the teacher and members using the technology. The additional subscriptions for members on FFA teams and those with active SAEs requiring visitation would allow those students access to the Swivl app on their device to record, reflect, and share with the advisor. This platform then allows for time-stamped feedback from the student, peers, and the teacher. The implementation of this technology will be well worth the investment in the time savings for the SBAE teacher and the additional opportunities for teaching, feedback, coaching, and SAE visitation.

Balance can be an elusive goal that SBAE teachers can hope to accomplish sometime "down the road," but balance can begin with the implementation of a few targeted goals. The integration of Swivl technology holds the potential for

SBAE teachers to take control of specific tasks aligned with the facilitation of the three-component model of agricultural education.

References

Chism, N. V. (1999). Peer Review of Teaching. Anker Publishing Company, Inc.

Eck, C. J., Toombs, J. M., & Ramsey, J. W. (2019). Purposeful video reflection – A program-wide adoption. 2019 Western Region AAAE Conference, Anchorage, AK.

Skinner, M. E., & Welch, F. C. (1996). Peer coaching for better teaching. College Teaching, 44 (4), 153–156.

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THEME ARTICLE

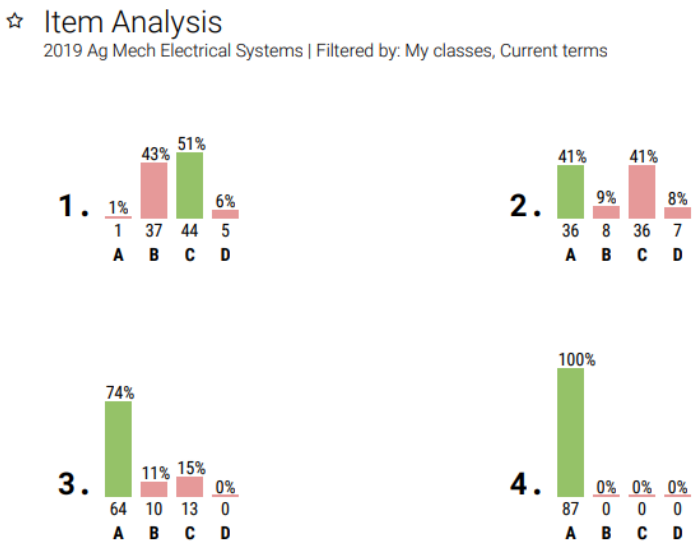
Using GradeCam to Instantaneously Assess Student Performance

by Scott Johnson

Technology is a factor in everything we do, both personally and professionally. It could be argued that it might be more difficult to be disconnected today than it was to be connected 20 years ago. The "How do we utilize technology to…?" conversation has been a constant in my professional experiences as a high school instructor and as state staff. As technology advances and innovations become accessible, the opportunities and options to pursue grow as well. Will the use of technology or a different technology result in an improvement of "x"? How do we value the implementation of a new technology related strategy? Is it worth the investment? Will it truly save time? Are the long-term benefits worth the short-term challenges related to implementation? And finally, how long can the technology be used before it becomes obsolete?

The consideration of options and factors associated with using technology assets in education generally focus on expense of purchasing, ease of implementing, accuracy of results, and speed of feedback. If any of these four factors is lacking confidence from the prospective user, it is difficult to compel them to change from the existing process that is already in place. The philosophy can be applied until the existing process simply cannot be sustained. It is a simple example of the difference between a proactive approach and a reactive approach. The longer an existing process is maintained, the more likely a change becomes reactive.

A few years ago, we were exploring options relative to management of forms, scoring, and results of our Career Development



Events (CDEs). We were specifically looking at how to move from a mechanical scoring process (Scantron / bubble sheet) to a digital process. All of the factors previously identified were considered and the ease of implementing may have been the most challenging factor to analyze. It was a priority that the system selected would interface with our existing roster, registration, and recognition system. It was also important that the system had flexibility in user accessibility across multiple accounts to provide for scoring multiple events in the same day. Finally, there was significant value in being able to provide flexibility in events forms to go beyond a standard five-choice, selective answer bubble sheet. Once these priorities surfaced, the cost associated with available options became a significant factor as well. Ultimately, we were able to identify an option that we believed could be utilized to meet our needs. That option was GradeCam.

GradeCam is an online scoring program that offers features and flexibility beyond a standard mechanical bubble sheet form. When the implementation factors listed above for us were considered, GradeCam checked all the boxes: interfaced with our existing system, flexibility in user accessibility across multiple accounts, and flexibility to create a variety of event forms. Interfacing occurs with comma separated (.csv) files, we were part of beta testing by GradeCam to provide for collaboration across multiple user accounts, and a number of our event forms were re-designed within the GradeCam format to utilize more of its digital scoring features. As we transitioned into fully utilizing GradeCam in our events, the GradeCam Go! mobile app added flexibility to scoring capacity.

The nature of FFA CDEs are obviously competitive in nature. In any competition, fairness, equality, accuracy, and results determine its quality. Thus, in terms of an FFA competitive event, utilizing GradeCam in tandem with the already existing event rules, resources, and competitive environment really did not impact the fairness or equality of the event. However, in the areas of accuracy and results, benefits were identified as we advanced through the transition.

The accuracy of event scoring improved. Many event forms that were previously scored by hand became part of the electronic scoring process. Doing this reduced the amount of human error involved, thus improving accuracy of scoring the event forms submitted by the participants. When a mechanical Scantron was used, it was generally accepted that the score provided by the Scantron would be considered accurate, regardless of how the machine scanned any entry made by any participant on any form. An electronic scan of GradeCam forms includes a process that brings to attention forms with completion errors for review for scoring room staff. These errors could then be manually reviewed for interpretation of what a participant's answer is. A participant that made an error with a mechanical form would not receive credit for a correct answer whereas with the GradeCam form credit for a correct selection is possible.

The final results of the competitive event could be generated in less time with fewer staff in the score room. As mentioned above, electronic scanning of event forms reduced the volume of manual labor needed to score the event. While this efficiency varies by event, it was possible to reduce scoring staff by up to half in some cases. Our events are coordinated and executed with a high percentage of volunteer staff--many of whom may have participants in the event. Reducing the time needed to generate results decreases downtime participants have between the completion of the event and announcement of results. The reduction of staff needed in the score room can pro-

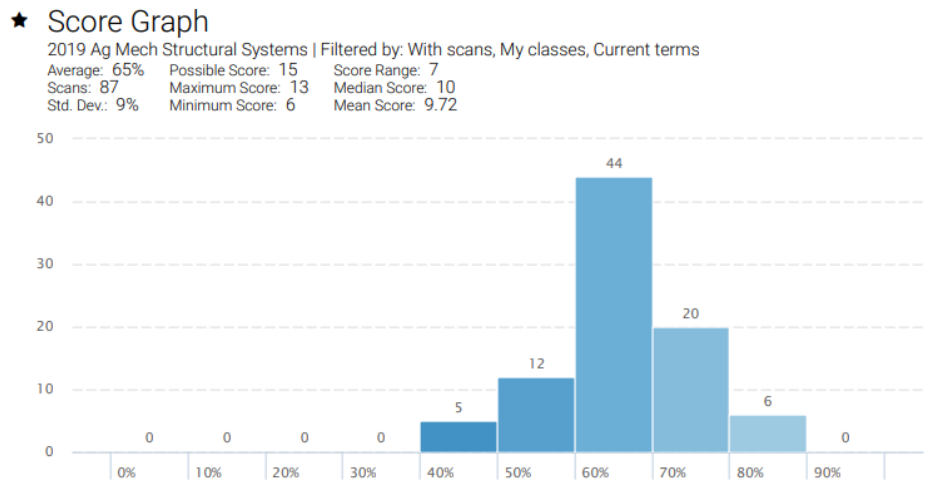
vide for more support in the event areas. This can improve safety, general oversight, and support of the participants in the event.

If CDEs are truly intended to be an extension of classroom instruction, then it is important the events are structured to be authentic assessments in order to genuinely evaluate students' advancement in learning. While a number of factors can influence the effectiveness of a CDE to be an authentic assessment, GradeCam offers features that support this effort as well. For any portion of a CDE, aligning the content, activity, and type of assessment is critical. GradeCam has options of different formats and assessment types to provide flexibility in generating event forms. There are the typical selective answer options, but there are also number grids, rubrics, and handwritten numeric capture. The system can scan and score or scan and record entries if the entries need an alternative review for scoring. Each answer and each option can be weighted differently as well. GradeCam may not be 100% inclusive of all components in all of our events, but there are enough options to provide value to how we deliver these opportunities to participants.

I would be remiss if I did not address the data that is available within this electronic scoring system. Reports can be made available by student, by question, by assignment (event component), by class (CDE) and by other options as well. During an event, an item summary can be reviewed to determine if a question has an extremely low percentage of being answered correctly. In the event of that or no one answering correctly, more analysis and review can be performed to determine the issue or potential error and then adjust accordingly. Following an event, the data can be used to compare information across event components or across event years to determine strengths, concerns, and trends.

For example, the Iowa FFA Agricultural Mechanics CDE has a skills portion and a knowledge portion for each of the five systems areas identified in our rules: Electrical, Energy, Environmental/Natural Resources, Machinery and Equipment, and Structural. The knowledge portion of all five areas are scored in GradeCam. Following the event, we are able to provide reports to our coordinators and schools showing where the strengths and weaknesses are across the five systems areas. At the 2019 event, the Environmental/Natural Resources systems area could be identified as the most challenging area for students because their average score (61%) was the lowest of the five areas. However, it could also be argued that this area is the least likely content taught in the local programs because the standard deviation of the assignment summary was the highest (21%). Having this data available provides stakeholders the opportunity to dig deeper into the event results and provide for more specific efforts to support education of students about respective subject matter in programs across the state.

Using technology for the sake of using technology really can cause a misplacement of priorities and resources in education. However, when the process of consideration is intentional and the objectives and priorities are clear, it is easier to determine the value of all available options. More often than not, there is an option that can meet the needs of the organization. Integration of electronic scoring technology like GradeCam may or may not have positioned us to do more with less, but it has allowed us to do more with similar resources. I will take that as a win for our programming.



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The Modern Pen Pal

by Jack Elliot and Kerri Vance

Decades ago, when communication outside of a local community was limited to writing and receiving letters, some creative people initiated the "Pen Pal" process. Usually, the Pen Pal was the same age and gender and within the same country. Waiting for a letter from your Pal could take days or weeks depending upon many factors, but tearing open the letter and reading about the personal daily activities in another part of our country enabled young people to compare differences and similarities. Learning about life in another part of our country intrigued us. Fast forward to the present. The dawn of the Internet and the exponential growth of social media platforms allow us to traverse our planet from the safety of our devices, but without a purposeful and meaningful dialogue with individuals, increasing the challenge of comparing differences and similarities among cultures.

The Modern Pen Pal is a Virtual Student Exchange between Texas A&M University and the Moroccan University of Mohamed VI Polytechnic (UM6P) students. The focus is for students to study each other's cultures, comparing differences and similarities while engaging in lessons about Global Issues in Agriculture. Six African countries are represented in the UM6P course, which will be taught in English.

The Stevens Initiative partially funds the virtual exchange and is sponsored by the U.S. Department of State, with funding provided by the U.S. Government. The Aspen Institute administers the course. The Bezos Family Foundation and the governments of Morocco and the United Arab Emirates also provide support. The Stevens Initiative virtual exchange definition is, "… an educational tool that uses online technology to connect young people around the world in a learning experience that builds cross-cultural communication and collaboration skills and helps participants gain a greater understanding of, and empathy for, people from backgrounds different from their own."

During an on the ground visit to Morocco, Texas A&M University personnel established a personal relationship with the UM6P faculty and students. A shared vision of enhancing the education of students on both campuses guided our work. We addressed concerns and questions surrounding the creation of the project. The co-developed curriculum integrated ten Reusable Learning Objects (RLO) into existing courses at both institutions. The RLOs will enable Texas A&M students to meet some of the objectives required for a Cultural Competency Certificate. Because of the semester calendars, the courses overlap for seven weeks in the fall and spring. During those seven weeks, time is designated within the courses where the virtual exchange is the central activity of the class. Also, students are paired with a counterpart, and standalone assignments (such as extracurricular activities and jointly prepared presentations) are expected and assisted by a facilitator. The RLOs include:

1. Personal & Social Responsibility
2. Steven's Story Introduction
3. Working in Modern Teams (Teamwork + Diversity/technology/etc.)
4. Active Listening
5. Conflict Management
6. Leadership/ Followership
7. Critical thinking
8. Problem Solving
9. Effective Communication
10. Cultural Competence

This type of program provides an equitable alternative to traditional study abroad experiences. Many students cannot afford to go abroad but need to gain cultural competencies for personal and professional benefit. Collaborating with international students provides participants real-world experiences and skills that enhance their abilities to solve problems in their communities.

Recognizing that companies make substantial monetary investments training their employees in cultural competencies, the College of Agriculture and Life Sciences believes that investment should be made during a student's college career. The Cultural Competency Certificate was designed to engage students in practical, cultural experiences that promote diversity awareness. Experiences include specialized courses, internships, service-learning projects, study abroad, research, and our new virtual exchange courses.

Students are required to complete a combination of experiences that are facilitated by qualified faculty members to obtain the certificate. Having students recognize the importance of cultural and diversity awareness prior to employment will make them more valuable to global companies.

The recent outbreak of the coronavirus pandemic has ceased international study abroad travel. Virtual student exchange allows Texas A&M faculty and students to continue working with international partners in a meaningful and intentional way that benefits students. We are targeting students with low socioeconomic status and have financial need. Study abroad is an additional cost for students, one that many students cannot afford. Also, some students show concern in traveling abroad because they are unfamiliar with the country, culture, and language. The Modern Pen Pal program provides them with a cost-effective international experience as they develop cultural competencies in the classroom.

The Intercultural Development Continuum (The Roadmap, 2020) illustrates five phases people go through to move from a monocultural to an international mindset. Phase one is "Denial" and is illustrated with the comment, "You don't know what you don't know." Reading and traveling broaden one's horizon and vision. However, traveling as a tourist can further reinforce stereotypes. It is when you are immersed in a society that you learn of its culture and traditions.

Phase two is "polarization," which can be thought of as a "right and wrong world" where judgmental comments about other cultures are heard. Listening to a baby cry or hearing children laugh in a far-off land reminds us of our similarities, making us more accepting of others. As one transcends through the polarization phase, de-emphasizing differences becomes the norm, which is the primary attribute in Phase three, "minimization."

"A Cultural Competency Certificate" is an attempt to categorize human behaviors and qualities that an international mindset person possesses. Phase four, "acceptance" is when people not only see differences but comprehend why those differences exist. Acceptance of differences is essential in the evolution to phase five, "adaptation." Cultural perspective is broadened, and valuing diversity in everyday lives is natural and a key characteristic in phase five.

Moving through the Intercultural Development Continuum will differ for students within both campuses and between the two campuses. There will be students who have spent their entire lives within a small regional locale, and students who have traveled extensively. Instructors will utilize that diversity to enhance the virtual student exchange and move students, regardless of their starting point, as far as possible toward an international mindset. The Modern Pen Pal has the potential to bridge cultural gaps at all levels of education.

The Modern Pen Pal program provides an opportunity to develop cultural competency skills that are needed in today's job market. Students will develop skills in intercultural teamwork, effective communication, and problem-solving. It also introduces students to technical and digital skills when working with people in different locations and time zones.

The instructors will facilitate global learning without the expense of students physically traveling. The Modern Pen Pal holds the key to building strong cross-cultural understanding and empathy. Students will anticipate interacting with each other as much as young people, decades ago, anticipated receiving Pen Pal letters.

Reference:

The Roadmap to Intercultural Competence Using the IDI (retrieved March 31, 2020) https://idiinventory.com/generalinformation/the-intercultural-development-continuum-idc/

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Technology and Agricultural Education Programs: Promoting Tech-Savvy Ag Students and Teachers

by Gale Wells-Brickhouse, Robert Cobb, Jr., and Paula Faulkner

Today, more than ever, agricultural education teachers are adapting to an ever-changing educational environment to enhance their students' success inside and outside of the classroom.

Traditional methods for teaching are becoming obsolete. The brick and mortar environments and lecturing as the lone instructional strategy to disseminate information and knowledge are becoming a thing of the past.

Technology is now! Williams, Warner, Flowers, and Croom (2014) reported, "To adapt to an ever-changing education environment, they [agricultural education teachers] must possess the skills necessary to integrate technology into their classrooms" (p. 1).

With today's technology infused society, teachers must educate students to learn communications skills especially in multimedia as these skills have become more and more critical in agricultural department's work to gain and maintain school and community support (Edgar & Edgar, 2017).

We will now hear how I [Brickhouse] began my journey as an agricultural educator over 30 years ago when computers in the classroom were rare. At this same time, Mark Zidon, current faculty at The University of Wisconsin at Platteville, was completing his dissertation on computers in high school agricultural programs. His study's objectives were to determine the need for computers in high school agricultural classes, determine how they were being used, and determine the teacher's perceived value of the effectiveness of using computers. It was concluded that all teachers should include computer use for students as a part of their instructional program in agriculture. Fast forward to the present-day, and the same is taking place.

Dr. Zidon was contacted to learn more about his thoughts on his dissertation research and how it applies to agricultural education today. He stated, "We have far surpassed my expectations from 1990; the Internet didn't exist for agriculture teachers back then. Google wasn't a thing. Email, Twitter, Facebook... all non-existent. While I was very interested in technology, I didn't imagine it [technology] was on the horizon." Zidon currently thinks we need to assess the culture of technology. "How has it affected our way of communicating? Has it increased or limited learning? How are we using technology to teach? Kahoot, Quizlet... such programs didn't exist when I conducted my research. I would like to see someone compile the current picture of teaching with modern technology. I'm interested in both the positive and negative impact it has had" (M. Zidon, personal communication, March 10, 2020).

Today, students are being educated and raised in the digital world. Learners have changed because of the "influx of technology," with most becoming tech-savvy. Murphrey, Rutherford, Doefert, Edgar, Edgar, and Leggette (2013) offered, "Beyond students' educational experiences, it is critical to recognize learners have changed due to the influx of technology in their personal lives including, but not limited to, television, the internet, gaming devices and mobile communications technologies" (p. 2). Agricultural educators must continue to stay current with identifying new educational trends to become tech-savvy along with their students.

The use of learning management systems (LMS), such as Moodle or Canvas, allows online instruction. For instance, Moodle is an open-source learning management platform designed to help schools educate their students. While Canvas is a learning management solution created to allow educational institutions to build a digital learning environment to meet the unique challenges they face. In the wake of COVID-19, the use of LMS's has increased among most teachers.

While not all agricultural education teachers may be prepared for this transformation they are committed to best prepare 21st Century learners. Searching for digital tools for the classroom can be time-consuming; however, there are plenty of tools and applications (apps) for making infographics, presentations, videos, animations, and assessments (see Table 1). In a study conducted by Warner (2016), she examined the need for technology ideas for the classroom where one participant (agricultural teacher) said, "I could not have imagined how dependent

I would be on technology in my daily life and especially in my teaching!" (p. 3). Ferguson (2016) noted that technology could enhance the caliber of any lesson and make learning fun and educational for both students and teachers.

Utilizing technology has the potential to put one's mind at ease by assisting in organizing, record keeping, and promoting creativity in the classroom. It may even make learning more fun (McMichael, Slates, & McQuillen, 2018)! Technology is a powerful tool, and if leveraged properly, it can open up endless possibilities for assisting in delivering the philosophy of Agricultural Education (Foster & McCubbins, 2018). When teachers are confident in their ability to use technology, they are more likely to utilize it in the classroom. Attending professional development workshops and webinars are two ways teachers become tech-savvy. I participate in professional developments to create a more engaging learning environment and accommodate the learning styles for a diverse student population. PearDeck, Quizlet and Nearpod, Prezi, Google Slides, PowerPoints, Screencastify, Flipgrid, Edupuzzle, Canvas, Google Forms, Quia, and Moodle are all innovative digital tools that are easy to use. Tools best for connecting with parents include Remind and Canvas.

Using technology in the classroom can be intimidating at first; however, with the many tools and apps I have mentioned above, teachers are sure to find one or more that are easy to use. Williams et al. (2014) found that teachers acquired technology skills to a moderate extent from personal trial and error and interaction with other faculty/staff. I suggest starting small by integrating one tool a week during lessons. Asking fellow teachers to share their best classroom tools can help. Then, soon, both teachers and students will be "Tech Savvy," just as I am along with my students!

References

Edgar, D. & Edgar, L. (2017, November/December). Telling our story through students: In & out of the classroom. The Agricultural Education Magazine, 90(3), 5-6.

Ferguson, A. (2016, May/June). Eight simple rules to Rockin' the Tech-Ed. The Agricultural Education Magazine, 88(6), 5-9.

Foster, D. & McCubbins, OP. (2018, July/August). Geeking. The Agricultural Education Magazine, 91(1), 4.

McMichael, J., Slates, M, & McQuillen, J. (2018, July/August). From the desk of fellow Owls - Technology you can use. The Agricultural Education Magazine, 91(1), 18-22.

Murphrey, T., Rutherford, T., Doefert, D., Edgar, L., Edgar, D., & Leggette, H. (2013). Chalkboard to Virtual Environments: Technology's role in expanding the classroom to provide professional development and education for agricultural communicators. Journal of Applied Communications, 97(2). Available at: https://doi.org/10.4148/1051-0834.1116

Warner, W. (2016, May/June). Reflecting on 20 Years of technological change. The Agricultural Education Magazine, 88(6), 3-4.

Williams, M.R., Warner, W., Flowers, L., & Croom, B. (2014). Teaching with technology: North Carolina agriculture teachers' knowledge acquisition, attitudes and identified barriers. Journal of Agricultural Education, 55(5), 1-15. DOI: 10.5032/jae.2014.05001

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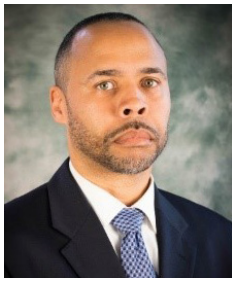

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How Integration of Technology in the Agriculture Classroom Promotes Teacher and Student Learning

by Hailey Batchelor, Robert Cobb, Jr., and Paula E. Faulkner

The use of technology is soaring in U.S. classrooms, especially during the pandemic and the transition to remote teaching. To remain up-to-date, I use a variety of technology in the classroom, which allows students of all abilities to collaborate. Fortunately, my school has a 1 to1 Laptop Initiative (1:1), which is an initiative that provides every student in the school a laptop; the goal is to enhance student learning and boost their 21st Century skills (Doran & Herald, 2016). While the 1:1 Initiative is beneficial, some believe having "Open Access" for all does not always mean it' easier to integrate technology in the classroom. For all to be successful, teachers should be learners with their students.

By staying current with the use of new technology in my classroom, my students are engaged. It's a win-win because I often find myself learning with my students when using digital learning tools. For those interested, there are a plethora of digital learning tools offered through Google Suite. On the World Wide Web, hundreds of free technology resources can be found.

Today's reality is that technology is a "hot" topic for use in classrooms, especially for preparing students for the workforce. Some examples of the best tools used to integrate technology in the classroom include computers and handheld devices, (U.S. Department of Education, n.d.). This article shares my teaching needs today, including how different technology tools can be used to enhance student's technology skills and content mastery.

Agriculture teachers across the U.S. such as myself are becoming more eager to find the best ways to integrate technology into their classrooms.

Technology use is not just a skill needed in IT jobs; it is a required skill in a variety of environments. Johnson, Jacovina, Russell, and Sota (2016), offered, "While many schools across the country are making the transition to (1:1) computing, many students do not have regular and reliable access to a computer. Inconsistent computer access makes it extremely difficult for instructors to integrate technology into existing lesson plans" (p. 4).

At my high school, we have students whose parents are unable financially to pay the required fee for the 1:1 Initiative. For rural students, many do not have access to the Internet at home, which limits their use of technology in the classroom. The 1:1 Initiative may provide easy access for students; however, technology is not always easy to implement in the agriculture classroom. I have faced challenges when implementing technology in the classroom. Professional development opportunities related to technology integration in the agriculture classroom are scarce. I often find myself identifying technology resources that fit my classroom, and I teach myself how to use them.

As the integration of technologies continues in agriculture classrooms, teachers are encouraged to ensure they are appropriate. For example, The Josephson Institute Center for Youth Ethics surveyed 43,000 high school students in public and private schools and found that one out of three high school students admitted that they used the Internet to plagiarize an assignment (Turnitin, 2017). Students are assigned research projects which require them to cite the sources. Also, they are taught how to cite sources using MLA and APA formats. Because it can be challenging to monitor what students work on with their Chromebook, I use computer monitoring tools such as Impero and GoGuardian.

MiroBoard is a technology that allows students access to work in teams in real-time on an interactive whiteboard. Flipgrid allows students to collaborate by creating video clips. In level one courses, students complete a public speaking unit using Google Docs to compose speeches and then use Flipgrid to record their speeches. Students are working on presentation skills utilizing digital tools to prepare them for their careers.

The Agriculture Experience Tracker (AET) allows students to perform record keeping electronically. Agriculture teachers can integrate technology during the Supervised Agricultural Experience (SAE) component of agriculture education programs. AET has significantly changed how

SAEs are implemented. Students explain how their SAE projects develop skills related to finance and career readiness, such as creating resumes, applying for FFA awards, and degrees (Agriculture Experience Tracker, 2020).

In closing, I am excited to learn with my students on the best ways to integrate technology into the classroom. To continue learning, I attend digital learning professional development opportunities offered by the North Carolina Agriculture Teachers Association (NCATA). Educators never stop learning. During this time, technology is everywhere in school, home, business, and leisure. Technology is ever-changing and helpful for promoting learning for teachers and students. For instance, I attend professional development trainings to improve my knowledge in the use of technology in the classroom. I also decided to return to school to earn a graduate degree in Agricultural Education, and then in 2019, became a certified Google Educator. Now, I feel fully prepared to integrate the best technologies in my classroom. (See Table 1).

Table 1

Technologies Best integrated into the Classroom

Technology	Description	Website
Go Guardian	A platform for teachers and school administrators that allows the monitoring of students 1:1 devices. Allows teachers to set scenes that keep students on task. The program develops a daily report for each student based on their device activity	https://www.goguardian.com/
Impero	A platform for students and school administrators to monitor student's 1:1 devices. Allows users to display sites on student devices in a course, freeze screens, and use other interactive tools to keep students on tasks when using devices	www.imperosoftware.com
Miro Board	An interactive electronic whiteboard that allows teachers to set up groups for students. The program sends invitations to student emails and students can then work collaboratively in groups in real-time	www.miro.com
Padlet	A tool that allows students to post to a wall and comment. This tool is great for bell ringers, exit tickets, and class discussions	https://padlet.com/
Flipgrid	A video tool that allows teachers set up a grid and invite students to participate using a code. Students can record short videos to be played in class.	https://info.flipgrid.com/

References

Doran, L, & Herald, B. (2016). 1-to-1 Laptop Initiatives boost student scores, study finds: First-of-its-kind analysis examines 15 years of data. Available at https://www.edweek.org/ew/articles/2016/05/18/1-to-1-laptop-initiatives-boost-student-scores-study.html

Johnson, A. M., Jacovina, M. E., Russell, D. G., & Soto, C. M. (2016). Challenges and solutions when using technologies in the classroom. Retrieved from https://files.eric.ed.gov/fulltext/ED577147.pdf

Purcell, K., & Rainie, L. (2019. Technology's impact on workers. Retrieved from https://www.pewresearch.org/internet/2014/12/30/technologys-impact-on-workers/

The Agricultural Experience Tracker. (2020). Our Story. Retrieved from https://www.theaet.com/story

Turnitin. (2017). Plagiarism: Facts & Stats: Academic integrity in high school. Retrieved from https://www.plagiarism.org/article/plagiarism-facts-and-stats

U.S. Department of Education. (n.d). Use of technology in teaching and learning. Available at https://www.ed.gov/oii-news/use-technology-teaching-and-learning

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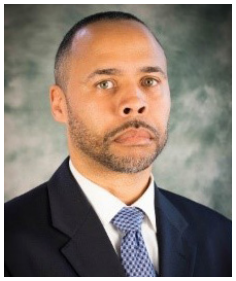

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Technology in Agriculture: Keeping the Classroom Current and Innovative!

by Samantha Wilson, Robert Cobb, Jr., and Paula E. Faulkner

From the start of my day, technology is impactful. My cell phone serves as my alarm clock, notifies me when it's time to start a new school day for this Agricultural Education Teacher. On the commute to school, my favorite podcast plays through my vehicle's speakers. For many, this morning routine is normal. What's more interesting is how technology follows us from home to work.

When I arrive in the classroom, I use technology to promote student learning. Smartboards, videos, cellular devices, and laptops are all used in class. I consider my classroom a "technology classroom" and strive to stay current and innovative! In my classroom, global citizens are developed using a variety of technologies to teach agricultural topics. I reach a diverse population of students, including homebound and community college students.

Online instruction allows me to remain engaged with all students. I believe students who have a grasp on how to use multiple technologies better prepares them for the future, whether that be attending college, vocational programs, the military, or the workforce.

Technology is a commonality in many careers, and being able to use technology is a useful skill required for future student success. Technology allows students to be creative, and enables them to access course materials easily (Williams, Warner, Flowers, & Croom, 2014). In this article, we will detail how agriculture teachers can integrate technology in the classroom while also supporting the agricultural education classroom mission.

As technology use in the classroom continues to evolve, educators must stay current and innovative in how it is integrated into the classroom. Teaching methods must remain current to

keep students' interest. Through the years, it has become common for students to be engaged in technology throughout their day, in and out of the classroom. Students are continually utilizing phones, laptops, tablets, or even smartwatches to stay connected to the outside world while on the move. For my students, it's safe to say that it is unusual for students to be without an electronic device of some sort. Research suggests people who use their devices often develop emotional attachment in the same way human bonds and relationships are formed (Hertlein & Twist, 2018). Teachers can integrate these tools into daily instruction by taking advantage of students' attachment to technology.

We understand students enjoy being active learners. From planting flowers and vegetables in school gardens, working in the shop to build rocking chairs, and caring for animals in the barn; technology can be utilized to deliver each of these topics. There are many free educational websites teachers can use for lesson planning. Based on my use, I have found my students enjoy Kahoot, Quizizz, Quizlet, or EdPuzzle to gamify instruction.

Smartboard allows teachers to deliver course material. The boards are essentially touch-sensitive whiteboards that allow interactive media content, including making notes with pointers and markers, magnifying pictures and charts, and even taking screenshots. Students with various needs and accommodations benefit from smartboards because lessons can be tailored just for them, such as larger font size for students who are visually impaired.

Planning and timing are essential during decision-making when addressing curriculum-based requirements for agriculture education in the state of North Carolina. While some states have transitioned from using standardized assessment for agriculture education, others continue. Standardized assessments allow teachers to measure student mastery. Online programs allow teachers to measure student mastery with the click of a button.

Recently, it has become easier than ever to collect data teachers can use to improve classroom instruction. For example, technology is used for assessment with Schoolnet, which combines assessments, reporting, and instructional management tools in an online platform — eliminating the need for costly paper test booklets and answer documents (Pearson, 2020).

In summary, it is paramount for agriculture teachers who are motivated to keep their classrooms current and innovative!

References

Hertlein, K. & Twist, M.L.C. (2018). Attachment to Technology: This missing link. Journal of Couple & Relationship Therapy, 17(1), 2-6. DOI: 10.1080/15332691.2017.1414530

Pearson. (2020). Schoolnet. Available at: https://www.pearsonassessments.com/large-scale-assessments/district-assessment/schoolnet.html

Williams, M., Warner, W., Flowers, L., & Croom, B. (2014). Teaching with Technology. North Carolina Agriculture Teachers' Knowledge Acquisition, Attitudes, and Identified Barriers. Journal of Agricultural Education, 55(5), 1-15. DOI: 10.5032/jae.2014.05001

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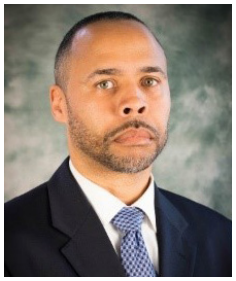

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Use of Drone Technology in Agriculture: Implications for Agricultural Education

by K.S.U. Jayaratne and David Smilnak

Technology is changing the industry our farmers and ranchers work and live in. Global Positioning System (GPS) guided tractors and irrigation systems operated by a phone app are just a couple examples of how agriculture has modernized. Another piece of technology that is gaining momentum in agriculture is Unmanned Aerial Vehicles (UAVs), commonly known as drones. Drones are offering agricultural producers a new perspective on their operations and providing new information previously unavailable to them. With adequate training, agricultural producers can use drones to make their farms and ranches more efficient and profitable (Adrian, Norwood, & Mask, 2005). As the educational demands of the agricultural industry change, those in the industry (e.g., farmers, ranchers, FFA members, researchers) need a different knowledge base to be successful in it.

Use of Drones in Agriculture

Agricultural producers are finding creative and unique ways of implementing drones in their operations. This is true in many sectors of the agricultural industries, including; livestock, row crops, horticultural crops, and forestry. The most common use is to observe. Multirotor and fixed-wing drones are regularly outfitted with cameras to make observations of a field or herd. A typical camera, visible spectrum, can be used to identify topographical features, monitor livestock, detect faults in equipment or infrastructure, or measure tree canopy density.

Cameras outside the visible spectrum, thermal, ultraviolet, or multispectral, find more use in precision agriculture. Precision agriculture is using localized spatial and temporal data combined with environmental measurements such as soil and crop characteristics to more intensely manage agricultural operations (Watson, Segarra, Lascano, Bronson, & Schubert, 2005). The use of these cameras in precision agriculture is helpful to identify pest and disease infestations (Mogili & Deepak, 2018), early signs of crop stress, and allows for more localized treatments (Natu & Kulkarni, 2016). Precision agriculture also features active management via drones. This can include tasks such as spraying pesticides, planting seeds, tracking farm animals, and inspecting farm infrastructure.

Figure. Agriculture Drone (Wayne, 2019)

Need for preparing the Future Agricultural Workforce to Use Drones

Drones are at the forefront of the precision agriculture industry. Global markets for drone technology are predicted to increase between 25% (BIS Research, 2019)-37% (MarketWatch, Inc., 2019) by the mid to late 2020s. But, this

trend might change due to COVID-19 global pandemic. The projected drone market growth also leads to job creation. For instance, between 2017 and 2018, hiring intent for those with drone pilot training rose by 183% (CompTIA, Inc., 2019). Agriculture is a large part of those jobs. Excluding military use and personal use, agriculture is the second-largest sector utilizing drones, just behind the construction industry (Goldman Sachs, 2020).

Drones play a significant role in precision agriculture, and there is a need for preparing the future agricultural workforce to use this technology for the betterment of the industry. Agricultural educators should see this educational need as a challenge as well as an opportunity. Introducing drone technology into agricultural education curricula is a challenge because it is a relatively new concept in agricultural education. It is an opportunity because the incorporation of drone technology into agricultural education will create many prospects to expand STEM education and attract nontraditional students into agricultural education.

Educators have started to use drones in the classroom to foster growth in science, technology, engineering, and mathematics (STEM) related fields (Farr & Light, 2019). Drones can be incredibly valuable in the classroom. They can help develop a deep understanding of complex topics, encourage and motivate with hands-on learning, improve technical understanding, and promote critical thinking (Sattar, Tamatea, & Nawaz, 2017). Drones can open up opportunities that may not otherwise be accessible to some students. Additionally, they could be used to augment or replace field trips. Students who have participated in a drone-based field trip suggest that they were more enthusiastic about the experience while using drones, found the learning experience engaging and enjoyable, and felt they retained more about the learning topic than they otherwise would have (Palaigeorgiou, Malandrakis, & Tsolopani, 2017).

Many public and private organizations offer funding support to promote STEM education as a necessary step in preparing the future workforce in the United States. For instance, the U.S. Department of Education (2018) has plans to invest $200 million annually on STEM education. The application of drone technology in agriculture opens opportunities for agricultural educators to use it as a tehing tool for integrating STEM education concepts into agricultural education curricula.

In addition to tapping the available funding resources for STEM education, integration of drone technology into agricultural education curricula has a great potential to attract nontraditional students into school-based agricultural education programs because of its appeal to a new generation of technology-savvy students. This has a practical significance for us to attract nontraditional students into agricultural education programs, especially in an urban setting, because many students in urban settings do not have a good understanding, appreciation, and interest in agriculture (Jean-Philippe, Richards, Gwinn, & Beyl, 2017). Agricultural educators should be aware of the current and potential applications of drones in agriculture and should be prepared to use it as a teaching tool. Integrating STEM concepts into agricultural education curricula can attract prospective students who otherwise may not be interested in agricultural-related careers. Agricultural teachers need training, education, and learning materials for preparing them to integrate drone technology into agricultural education curricula.

Implications for Agricultural Education

Drone-based curricula offer intriguing experiential learning opportunities to prepare students for the demanding high-tech workforce. However, the integration of new technology, such as drone technology into the agricultural education curriculum, can be a challenging task for many school-based teachers. State agriculture coordinators and others who plan and develop teacher in-service training programs need to understand the potential challenges of integrating drone technology as a STEM concept into agricultural education and provide the necessary technical and instructional support with the help of experts in drone technology. Initiating partnerships with the industries promoting the application of drone technology in agriculture is an option to be considered when putting together learning resources and planning training programs. Drone technology can be used to teach hands-on learning for farm operations such as areal surveying and mapping, pests and disease surveillance of crops, and observation of farm operations.

Drones in High-Tech Farming (Grades 6-8) is an available curriculum resource for teachers (National Agricultural Lit-

eracy Curriculum Matrix, 2013).

Chang and Nepal (2019) provide a drone-based precision agriculture teaching module as a teaching resource.

Agricultural educators should be aware of current and future uses for drones in agriculture. Developing STEM curricula to include drone technology will attract potential students to agricultural programs as well as prepare the U.S. agricultural workforce to meet the current and future challenges facing precision agriculture.

References

Adrian, A. M., Norwood, S. H., & Mask, P. L. (2005). Producers' perceptions and attitudes toward precision agriculture technologies. Computers and Electronics in Agriculture, 48(3), 256-271. doi: 10.1016/j.compag.2005.04.004

BIS Research. (2019). Global agriculture drones and robots market: Focus on drones, robot type (milking robot, harvesting & picking robot, autonomous robot tractor), farm produce, farming environment, business model, regulations, and patents – analysis & forecast, 2018-2028. Retrieved from https://bisresearch.com/industry-report/agriculture-drones-robots-market.html

Chang, J., & Nepal, M. P. (2019). Using drones for precision agriculture. ILEARN Teaching Resources. 2, 38-42. Retrieved from https://openprairie.sdstate.edu/cgi/viewcontent.cgi?article=1006&context=usda-ilearn_resources

CompTIA, Inc. (2019). Growing use of drones prompts commercial customers to examine future needs and options, CompTIA study finds. CompTIA. Retrieved from https://www.comptia.org/advocacy/news/comptia-advocacy-news/2019/09/10/growing-use-of-drones-prompts-commercial-customers-to-examine-future-needs-and-options-comptia-study-finds

Farr, V., & Light, G. (2019). Integrated STEM helps drone education fly. 2019 IEEE Integrated STEM Education Conference (ISEC) (pp. 398-401). doi:10.1109/ISECon.2019.8881958

Goldman Sachs. (2020). Drones: Reporting for work. Retrieved from Technology Driving Innovation: https://www.goldmansachs.com/insights/technology-driving-innovation/drones/

Jean-Philippe, S., Richards, J., Gwinn, K., & Beyl, C. (2017). Urban Youth Perceptions of agriculture. Journal of Youth Development, 12(3). doi: 10.5195/jyd.2017.497

MarketWatch. (2019). Agricultural drones market- future scope, demands and projected market growth till 2025. Retrieved from https://www.marketwatch.com/press-release/agricultural-drones-market--future-scope-demands-and-projected-market-growth-till-2025-2019-10-15

Mogili, U. R., & Deepak, B. B. V. L. (2018). Review on Application of Drone Systems in Precision Agriculture. International Conference on Robotics and Smart Manufacturing (pp. 502-509).

National Agricultural Literacy Curriculum Matrix. (2013). Drones in high-tech farming (Grades 6-8). Retrieved from https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=692

Natu, A. S., & Kulkarni, S. C. (2016). Adoption and utilization of drones for advanced precision agriculture: A review. International Journal on Recent and Innovation Trends in Computing and Communication, 4(5). 563-565. Retrieved from https://www.scribd.com/document/338726930/Adoption-and-Utilization-of-Drones-for-Advanced-Precision-Farming-A-Review

Palaigeorgiou, G., Malandrakis, G., & Tsolopani, C. (2017). Learning with drones: Flying windows for classroom virtual field trips. IEEE 17th International Conference on Advanced Learning Technologies, pp. 338-342. doi:

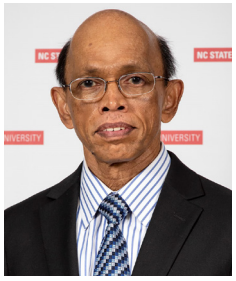
10.1109/ICALT.2017.116

Sattar, F., Tamatea, L., & Nawaz, M. (2017). Droning the Pedagogy: Future Prospect of Teaching and Learning. International Journal of Educational and Pedagogical Sciences, 11(6), 1622-1627. doi.org/10.5281/zenodo.1132212

U. S. Department of Education (2018). U.S. Department of Education fulfills administration promise to invest $200 million in STEM education. Retrieved from https://www.ed.gov/news/press-releases/us-department-education-fulfills-administration-promise-invest-200-million-stem-education

Watson, S., Segarra, E., Lascano, R., Bronson, K., & Schubert, A. M. (2005). Guidelines for Recommending Precision Agriculture in Southern Crops. Journal of Extension, 43(2). Retrieved from https://www.joe.org/joe/2005april/rb7.php

Wayne, F. (2019, March). Fort Wayne's aerial photography and videography information. Drone News. Retrieved from http://www.skysquirrelstudio.com/news/category/Agriculture



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THEME ARTICLE

Impact of Drones and Gaming in a STEM Academy Summer Experience

by Quintin Robinson, John Ricketts, Tom Broyles, and Rick Rudd

Success in creating a competitive workforce requires investing in high-quality agricultural education. Many 4-H programs operate on the premise that in addition to an effective learning environment, experiential learning activities, and positive youth development, high-quality agricultural education programs incorporate the four key domains of STEM, science, technology, engineering, and mathematics. Recognizing the value a curriculum developed with a STEM framework has for youth, Tennessee State University's (TSU) STEM Academy (Broyles, 2019) was launched as part of the TSU 4-H Youth Development program. In an attempt to build urban students' interest in 4-H youth development programs and building their interest in pursuing further education in agriculture, the TSU College of Agriculture hosted summer camps as an outreach endeavor to develop students' skills across the STEM domains.

Middle school youth are not the easiest group of youth to engage, but one particularly attractive way the program attempted to engage students in pursuing careers in STEM fields was through gaming technology. "As much as any other theme, the 21st century classroom is about diversity–infinite possible pathways between content and students, resulting in self-directed learning as much as data-driven 'teaching.' [Gaming]… can be a significant part of that" (Heick, 2018).

This article describes one program's use of gaming technology, specifically with the use of drones and drone programming, to improve STEM self-efficacy and motivations for career interest in STEM, especially agriculture among middle-school students. Few people recognize that technology (and all of the other STEM disciplines) is at the core of ef-

ficient, productive, and sustainable agricultural practices. This makes it possible to transform the stereotypical view of agriculture as being rudimentary and labor-intensive. On a more global level, the 4-H STEM Academy intended to stimulate the students' interest in science and technology at an early age, so that the seemingly endemic shortage of scientists and academics in agriculture in the United States can be resolved.

Many of the participants of the 4-H STEM Academy were from the inner city of Nashville, Tennessee. The drones, programming, and gaming activities were a means for engaging and creating opportunities for the inclusion of minorities and other underrepresented populations in STEM. We hoped that they would begin to seriously consider and pursue careers in the agricultural sciences. We surveyed students and analyzed ethnic and racial differences in self-efficacy related to STEM and gaming, and there were no differences between groups.

Even among those who ultimately choose against careers in STEM fields, agricultural education programs such as the 4-H STEM Academy are critical for increasing the degree of science literacy in society. Unfortunately, the general population (in the United States and all over the world) lack a basic understanding of scientific methods and concepts. Students in the STEM Academy, however, had a good understanding of scientific inquiry. The program was successful at making STEM less complex and more enjoyable for all students.

This innovative program established by TSU's Cooperative Extension for Nashville middle school youth also demonstrated that students had the highest levels of self-efficacy in video and computer gaming compared to scientific inquiry and problem solving. The workshop utilized drone technology theory, coding, and gaming. We were impressed with the competence in video and gaming and believe those competencies need to be integrated into STEM and agricultural education programs to leverage the strong existing student self-efficacy as a tool for learning.

The STEM Academy was a three-day camp that took place on the Tennessee State University farm and learning center. During the camp, students learned how to program and fly drones, build and launch rockets, and build and fly hot air balloons. This was achieved by using three different curriculums: flight theory and simulation, drone operation, and drone programming. Lesson plans included purpose, materials, vocabulary, and three objectives. The classroom procedures for flight theory and simulation included drone safety explanations, defined pitch, yaw, and roll, and a simulation activity. The procedures for drone operation included the review of safety rules, re-defined yaw, pitch, and roll, identified parts of the drone (e.g., motor, propellers, flight receiver, battery, battery charger), and flying the drone. While flying drones, students practiced taking off, landing, hovering, yaw, pitch, and roll, free flight, and concluded with an obstacle course.

The procedures for coding drones included drone safety, defined coding, programming, and debugging in addition to more yaw, pitch, and roll. Students completed two different activities in the Tynker programming application. The first activity was to play a programming game to familiarize students with coding in specific patterns to complete each level. The second activity was to follow a flight path to complete the obstacle course. These activities allowed students to put what they learned to work.

Integrating drones and gaming technology in agriculture and related fields may contribute to furthering environmental sustainability and even community development. In terms of environmental sustainability, some technologies have demonstrated a reduction in contamination and increased resource optimization. One such technology is unmanned aerial systems (UASs), which have been found to correlate with more precise chemical application, weed prevalence, enhanced drip irriga-

Scan this QR code to access mobile agriculture lesson plans and curriculum.

tion performance, and higher returns on investment for different crops (e.g., soybeans and wheat).

For continued program growth, a structured approach should be utilized. Apart from having to acquire the additional UASs, stakeholder advisory groups should be established to guide the development and revision of course curricula, evaluations, and the course schedule. If properly developed and executed, which is the expectation, the program will be beneficial through the various outputs it will generate, which include: evaluation instruments for faculty use; educational materials (e.g., fact sheets and videos); reports, and journal articles. This will help ignite and nurture the newfound interest in agriculture and STEM across Tennessee and beyond.

References

Broyles, Thomas. (2019). Tennessee State University 4-H STEM Academy, Nashville, TN.

Heick, Terry. (2018). Exactly How to Teach with Video Games in the Classroom. Teach thought: We grow teachers.

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THEME ARTICLE

Students Discover Career Ready Skills Through Biotechnology

by Randy Webb, Rachelle Rasco, Daniel Steger, and Hannah Scherer

Introduction

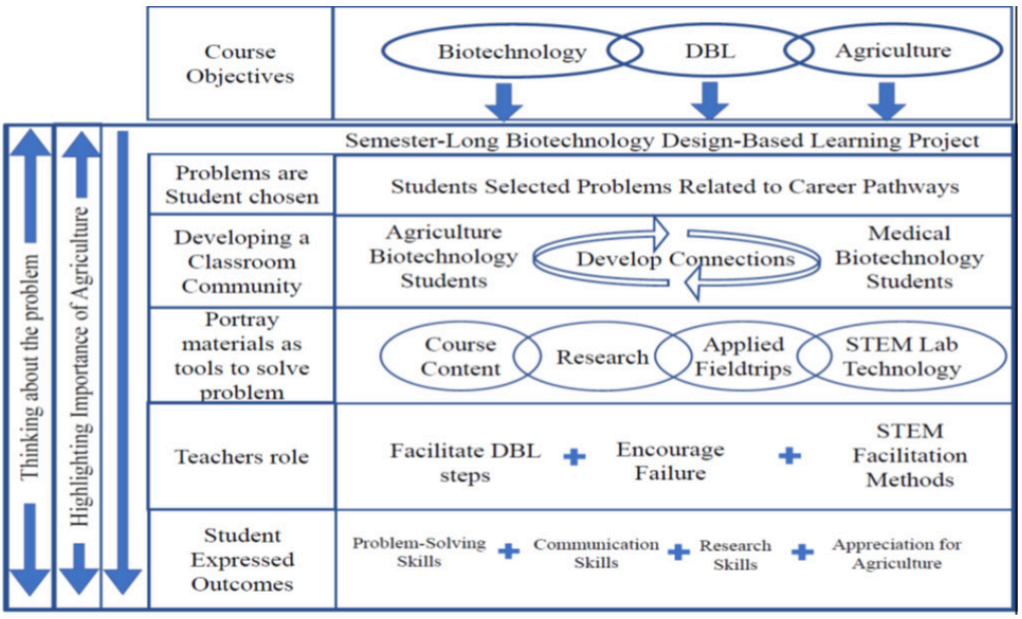
Having students understand the particulars of Integrative STEM (Science, Technology, Engineering, and Mathematics) is a focus of current trends in agricultural education. Teaching methods such as Design-Based Learning (DBL) are considered excellent vehicles to deliver STEM content. So, how does implementing these teaching methods apply to all students? How can a connection to the real world prepare students for careers no matter what pathway they choose? How do agricultural educators show the relevancy of the content to all students and not just the ones who are interested in agriculture? One rural Virginia high school has developed a model program designed to address changes in the agricultural industry as they occur. The program includes courses in agricultural biotechnology. These courses are agriculturally intensive, but often appeal to students who are less agriculturally focused, and more biotechnology driven.

Recurring themes of what students reported about the course were developed, and a visual representation of the model was constructed (see figure 1). The DBL project changed the narrative of how students view classroom materials, encouraged community learning, changed the role of educators, all the while supporting the importance of biotechnology in agriculture.

Student-Driven, Design-Based Learning Project Components

In its purest form, a DBL experience gives students a real-world problem with no clear solution,

Figure 1



and they work toward developing a solution through conducting scientific inquiry (Wells, 2015). Over the semester, student groups researched and brainstormed solutions, designed a model, tested the model, adjusted the model and re-tested, recorded data from tests, and prepared a formal report, poster, and working model (Wells, 2015).

Initiating the projects

The projects began with students identifying the problems, understanding the context and challenges of each problem. This was done through lecture and discussion where both groups gained an understanding of each other's problems.

Literature reviews

The students researched their topics to determine what research had been done related to their problems and determine how this information could be useful in solving their problems (Wells, 2015). This resulted in a literature review of related research that helped guide and support the students' projects.

Collaborative brainstorming to identify potential solutions

All students brainstormed, no matter their assigned groups, and recorded their ideas and thoughts about a solution to share during class. This led to further discussion that sparked new ideas and concepts not previously recorded.

Developing and testing solutions to solve problems

Using available resources, each group developed procedures to test their ideas. Initially, all their initial results failed, requiring them to discuss their findings further, critically rethink the process, redesign the solution, and re-test. After numerous tests, solutions were achieved by each group, and the procedures were documented.

Culminating project

Final models of students projects were built (ex. Lungs printed using a bio-printer to represent human lungs which contained simulated cancer cell that illuminated under a blacklight, and a racking system that demonstrated growing feed for cattle in space for a year), a poster was designed, and a research paper was produced. The paper included an introduction, literature review, documentation of brainstorming, pictures drawn by the students to reflect the test models, testing results, evaluations of the initial test, any redesign and problem solving, final design, final results, and conclusion.

Formal presentations

The student projects concluded with a formal poster and presentation. This allowed students to take ownership of their research and to develop it for real-world solutions. Local industry leaders, news media, and school administrators were invited to evaluate and interact with the students to gain an unfiltered response to the projects.

Unique Elements of the Model

Career-driven project selection

The pilot class included eight students with two distinct career interests: agriculture and health sciences. The students were divided into two groups based on these interests and assigned a semester-long DBL project.

Developing and maintaining a classroom community

From the beginning, it was essential to build a connection between the two groups in the class rather than further the di-

vide between them. In the early weeks of the project, both groups brainstormed each of the problems. These groups were given similar learning materials, went on field trips together, and worked in the same laboratory. The students continued to discuss their projects between the groups and shared information that would advance each group in their endeavors. Ideas were shared across contexts, with health science students sharing ideas with the agricultural students and vice versa.

Teachers Role

The teacher's role shifted from teacher to facilitator. The teacher provided methods of organizing information, regrouping students to address the problems of the day, but very much put the steering wheel in the hands of the students.

With the role of the teacher becoming a facilitator, the mindset and the audience for the students changed. The teacher was not there to give them the answer; it was up to the students to find a solution to their problem. To develop problem-solving skills is to understand it is okay to fail. However, with failure come frustrations, and students hitting cognitive overload and giving up, is detrimental to the project. The teacher's facilitation skills encouraged students to find solutions to their problems, which was crucial to keep the project going in the face of failures.

The focused content of this course was to build a foundational understanding of biotechnology in agriculture. The teacher presented material which exhibited many opportunities in agriculture and how advances in biotechnology help solve real problems. Students naturally drew connections between the medical field and the agriculture field. This natural connection allowed the teacher to highlight the importance of agriculture, not only to students who were pursuing a career in agriculture but equally important to those who were looking to pursue careers outside of the content area.

Student Outcomes

The degree of learning, enthusiasm, and experience the teacher observed throughout the DBL projects was well above the typical classroom assignments. During the focus group, students discussed four primary outcomes from the experience.

Students developed the resiliency needed to thrive in problem-solving situations. Students problem solved ways to a solution, and while at times it appeared frustrating, they were able to persevere, not give up, try again and reach a solution.

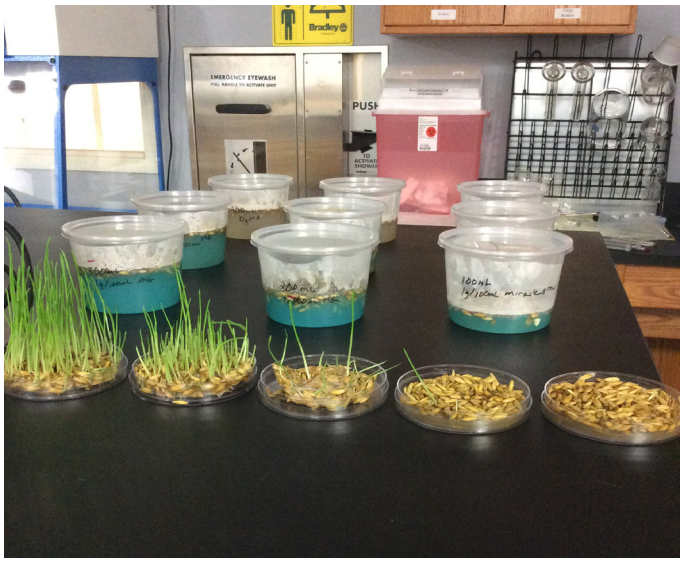
Both health science and agricultural students expressed a new-found appreciation of agriculture in biotechnology. The collaborative approach to managing the class changed student awareness and perceptions of the other group's field. Students gained an appreciation of agriculture and how it applies to more than just farming.

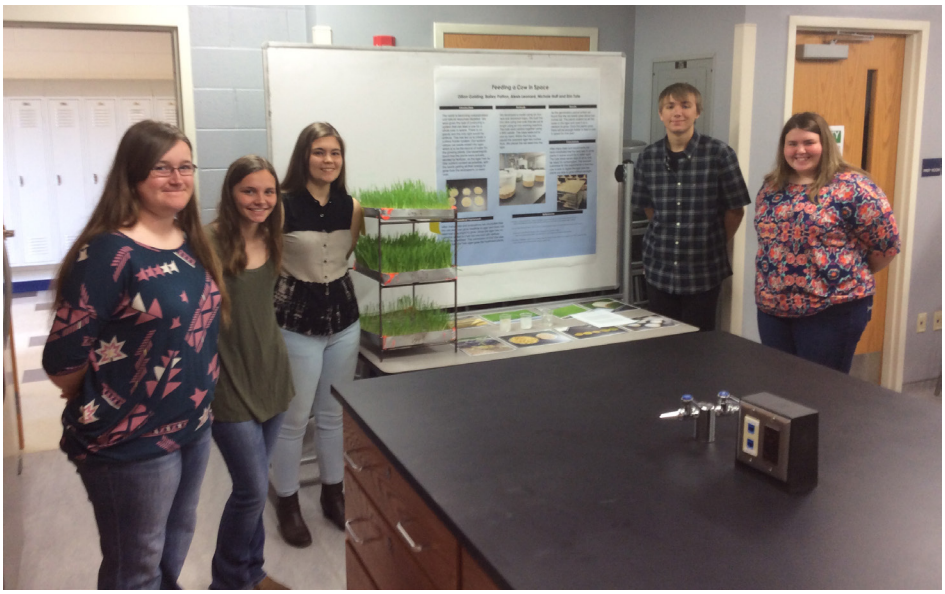
Students increased their communication skills. Students developed skills to work as a team and presented their research to a bigger audience than just their teacher. Instead of only communicating what the students knew to the teacher, they communicated with each other. The dynamics within each group was not always easy but showed growth in their ability to work together.

Students developed research skills and applications. Students expanded their knowledge and process of finding credible resources and conducting relevant research, especially when conducting the literature review portion of the project. For many, this was the first time they were required to identify credible research related to their topics in scientific journals. Although frustrating at first, the students began to develop better research skills, understand the process of scientific research, and were better able to locate reliable and credible resources.

Conclusions

The development of a community of learners in the classroom through an invested interest in each other's group projects was evident in the communication between the groups. Field trips also added to the relevance of the





class. This was beneficial to both groups, as they were able to see and ask questions related to their projects. The course transformed as changes occurred and content was added to the core biotechnology curriculum as students' needs became relevant. The focus remained on biotechnology in agriculture, but the learning community could relate to the science involved in the content.

The teacher's role as the facilitator encouraged the groups not to give up, and he supported them as they learned that it was okay to fail. They were encouraged to look at it, make changes to their methods, and try again. This seemed to strengthen the student's problem-solving skills as they moved forward.

Testing the Model

The model developed from this process was used to guide the second year of the course. With different students enrolled in the course and changes in career choices from the previous year, the research interest took on a different persona. To facilitate this difference, the teacher needed to bring in a new outside resource. Again, the model above was used to guide the projects, the teacher facilitated the resources needed to complete the research. The results were like the previous year, with student outcomes in learning and problem solving remaining consistent from year to year. The results of the second year indicated that the model is robust and that it could be shared with other programs to guide them in facilitating DBL projects in agricultural courses.

Acknowledgments

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References

Wells, J. G. (2015). Design Based Biotechnology Literacy, Teaching Guide 2015. Blacksburg, VA: BIOSENS.

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Leveraging Agricultural Technologies to Facilitate Integrated STEM Collaboration

by Hui-Hui Wang, Bryanna Nelson, Neil Knobloch, Petrus Langenhoven, Yaohua "Betty" Feng, and Roger Tormoehlen

Have you been hearing about STEM education but have been puzzled by the acronyms STEM (or STEAM)? STEM is an abbreviation that stands for science, technology, engineering, and mathematics. Some teachers add Art into the acronym to become STEAM. As for others, like agriculture teachers, the "A," stands for Agriculture (NRC, 2009). STEM education in K-12 should be taught in an integrated way because STEM subjects don't exist in isolation in the real world. For example, 45 states have formally included engineering design as part of their state science academic standards. This educational movement indicates when teachers teach science, they should also teach engineering design concepts. Integrated STEM (iSTEM) is "a holistic approach that links disciplines so learning becomes connected, focused, meaningful, and relevant to learners (Smith and Karr-Kidwell, 2000, p. 22)." Using an iSTEM approach to teach STEM subjects has been identified to bring real-world, authentic design problems to K-12 classrooms. Integrated STEM instructions should incorporate essential concepts and align with important skills, such as systems thinking, creativity, collaboration, and communication (Wang & Knobloch, 2018; Wang et al., 2020) when having students apply their STEM knowledge and skills to solve a real-world design problem.

Agriculture isn't always at the top of the list in K-12 education when it comes to talking about STEM education. However, agriculture is an excellent option for teachers to engage student learning by adapting iSTEM instructions and facilitate interdisciplinary collaboration. Utilizing agriculture, as a context, provides authentic and relevant iSTEM real-world problems. Moreover, agriculture is a form of technology to adapt the natural world to meet human needs (ITEA, 2007). Technology means the act of making or crafting (ITEA, 2007), which is evident in how agriculturalists capture energy from the sun to generate products people can use for food, clothing, shelter, and biofuels. Students apply STEM knowledge and skills to solve 21st-century agriculture grand challenges that have impacts on their everyday lives. Also, agricultural technologies can serve as a "driver" for STEM interdisciplinary collaborations (Vallera & Bodzin, 2020; Wang et al., 2020). In this article, we describe cases in which STEM and agriculture teachers leverage agricultural technologies, e.g., hydroponics, agricultural robotics, and food technology, for iSTEM instruction, and facilitate interdisciplinary collaboration to help students make interdisciplinary connections. Additionally, we provide collaboration strategies to shine a light on how agricultural educators can serve as experts on new and innovative technologies in agriculture, food, and natural resources, and lead the integrated STEM collaboration at the end of this article.

Hydroponics Example

Hydroponics is a complex system, which provides accessible entry points for integrated STEM learning. To create and maintain a healthy and productive hydroponic system, it involves concepts from STEM subjects, such as photosynthesis, energy conservation, plant nutrients and solutions, and so on. A mathematics and an agriculture teacher worked together as an interdisciplinary team to co-develop integrated STEM lessons and instruction by using hydroponics at Westville High School in LaPorte, Indiana. The mathematics topics included measurement and proportional reasoning and exponential functions and summarizing statistical data. The agricultural topics included plant physiology, fertilizers, and hydroponics. The two teachers mainly used an 11th to 12th grade Math Ready class as their integrated STEM collaboration instruction site. The design challenge for these students was to modify an existing 500-gallon fish tank in the Agriculture classroom to become a hydroponics system. Before the lesson, the students had an opportunity to visit the agriculture teacher to see the fish tank and ask questions. After that, the mathematics teacher taught scale drawing, miniature model construction, budget proposal, germinating seeds, and plant experiments. In total, she taught five lessons to her Math Ready students. In her class, five students were in both Math Ready and Agriculture classes. These students worked on modifying the

actual fish tank in the Agriculture classroom based on the miniature model and budget proposal they had developed in the Math Ready classroom. These students also acted as student teachers, who helped the mathematics teacher teach the concept of growing food with hydroponics, and collected and shared data with their peers, so students who only took the Math Ready class could utilize these data in the Math Ready classroom.

AgRobotics Example

Because Ag Robotics is applicable to many areas of agriculture, it's not surprising there are numerous ways to integrate it. As much as agriculture teachers would like to have an autonomous tractor or robotic weed puller for schools and home farms, large scale robotics are difficult to access for classroom use. To apply the same principles, and start where the experts do, small-scale table bots are used for modeling and development for large scale robotics. A biology, technology, and agriculture teacher worked as an interdisciplinary team to co-develop STEM lessons utilizing ag robotics at Frontier High School in Chalmers, Indiana. The team developed lessons related to conservation and resource management that were related to a freshman biology class. Students received specialized instruction each week from one of the three teachers relating to the conservation of resources, animal and land surveying using technology, and finally, planning and developing a robot. The robot was designed to be autonomous and follow a specific path to retrieve wildlife cameras from a designated area and return them.

Food Safety Example

Food Safety and Science encompasses a large number of topics, including food product development, farm and factory practices, consumer marketing and relations, and even home cooking practices. Food safety goes beyond making sure you wash your hands (despite being a relevant topic this year with the COVID-19 virus) and avoid cross-contamination. Three teachers, two agriculture and one science teacher from Tri-County High School in Wolcott, Indiana, collaborated to develop STEM lessons related to food safety and science. They implemented them in their classrooms, resulting in three different classrooms receiving similar lessons and integration. Topics varied slightly between the classrooms, but teachers focused on proper handwashing, how germs grow and spread, preventing foodborne illness, and how to create a food safety plan to prevent foodborne illness. The classes focused on creating a Hazard Analysis Critical Control Point plan (HACCP) for a product of their choosing. Students worked through creating a HACCP plan just like industry experts do.

Tips for Collaboration Strategies

The authors worked with cross-disciplinary teams of teachers at LaPorte, Frontier, and Tri-County High Schools. Based on the interactions with these teams, we highlighted several tips to help promote teacher collaboration and iSTEM learning across different and complementary content areas.

1. Provide teachers and their students a project to engage in hands-on learning and practice iSTEM skills.
2. Provide teachers professional development training so they can discuss ways their content areas complement each other by engaging collaboratively around a common project.
3. Encourage and create structures for teachers to communicate with each other. In doing so, teachers can leverage their complementary strengths to contribute to interdisciplinary student learning around a collaborative iSTEM project.
4. Focus on solving a problem driven by the iSTEM project that encourages cross-disciplinary communications and collaboration.
5. Connect problem-solving and iSTEM learning to support content learning. Encourage teachers and students to see the interplay among problem-solving, context, content areas, and cross-disciplinary connections.
6. Highlight the ways of knowing (aka, expert thinking) of scientists, technologists, engineers, mathematicians, and agriculturalists. For example, scientists use inquiry to solve problems; technologists and engineers use design to solve problems; mathematicians use modeling; and, agriculturalists use systems thinking.
7. Consider how each content area teacher and their students contribute to interdisciplinary and collaborative iSTEM learning. Wang and Knobloch's (2018) framework outlines a rubric teachers can use to focus on defining, designing, implementing,

and evaluating iSTEM learning experiences.

8. Encourage teachers to help students apply knowledge through solving problems based on real-world settings. Encourage teachers to share which outcomes students developed, especially the essential skills needed in the 21st century.

References

International Technology Education Association. (2007). Standards for technological literacy: Content for the study of technology (3rd edition). Reston, VA: Author.

National Research Council (2009). Transforming agricultural education for a changing world. Washington, DC: The National Academies Press.

Smith, J., & Karr-Kidwell, P. (2000). The interdisciplinary curriculum: A literary review and a manual for administrators and teachers. Retrieved from https://eric.ed.gov/?id=ED443172

Vallera, F. L., & Bodzin, A. M. (2020). Integrating STEM with AgLIT (Agricultural Literacy Through Innovative Technology): The efficacy of a project-based curriculum for upper-primary students. International Journal of Science and Mathematics Education, 18, 419-439. https://doi.org/10.1007/s10763-019-09979-y

Wang, H. H., Charoenmuang, M., Knobloch, N. A., & Tormoehlen, R. L. (2020). Defining interdisciplinary collaboration at high school settings through teachers' beliefs and practices of STEM integration by using a complex designed system. International Journal of STEM Education, 7:3. https://doi.org/10.1186/s40594-019-0201-4

Wang, H. H., & Knobloch, N. A. (2018). Levels of STEM integration through Agriculture, Food, and Natural Resources, Journal of Agricultural Education, 59(3), 258-277. https://doi.org/10.5032/jae.2018.03258

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