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In the Know: Using Research to Support Teaching

Staying Current with Research

by Dr. Gaea Hock

For our last issue of 2023 we wanted to feature research being done at universities across the nation and how it impacts communities and classrooms. The theme editors for this issue worked hard to find and feature innovative research meant to help us all be better teachers.

As educators, we are naturally lifelong learners. We are constantly learning new technologies, pedagogical strategies, and behavior management techniques, not to mention the latest teenage slang. Putting into practice new methods and strategies is how we meet the unique needs of our students as they are constantly changing and evolving.

One of the most recent technological advancements, that will impact education, is the use of artificial intelligence. Numerous AI websites have emerged to assist teachers with creating assessments, presentations, assignments, rubrics, and other essential tasks. Research is occurring to determine the effectiveness of these tools in education. That research will help us utilize these new tools, while also considering the aspects that might negatively impact student learning. Findings from this research will eventually make it to classrooms and schools across the nation and world.

Teaching agriculture content requires us to also stay current with advancements in all areas of agriculture. This includes natural resources, environmental sciences, nutrition, and other related sciences. It is a challenge to stay up to date with all the advancements and challenges facing our industry in addition to keeping up with changes in the school system.

> Putting into practice new methods and strategies is how we meet the unique needs of our students as they are constantly changing and evolving.

Incorporating the newest research findings and recommendations can help you stay current with best practices. Here are a few pieces of advice on how you can work to stay current with the newest research studies and findings.

1. Subscribe to listservs which disseminate research. Your state's land grant university (and other agriculture universities) will have one (or many) to keep you updated on the latest research projects. Google Alerts and Magnetic Ag are two other options to help you stay current. I like Edutopia for pedagogical research updates.
2. Encourage your students to participate in the FFA Agriscience Fair (or other science fairs). This will allow you to also stay current with research methods, literature, and results.
3. Seek out opportunities to engage in professional development to enhance your research skills. Volunteer to participate in research projects offered by college professors. There are many grant projects which require current teachers and offer compensation for their time.
4. Participate in content-area workshops and seminars featuring the newest innovations. These are offered by your Extension office, commodity groups, and other agriculture organizations.
5. Utilize research disseminated by land grant and non-land grant universities. You can find research-based resources on their websites. Some documents may have a cost, but many are free to download.

When we update our teaching practices and incorporate research into our classes it helps keep our careers exciting and novel. It also allows us to be the best agricultural educators we can be. I hope this issue will motivate you to try new things and start asking your own research questions.

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In The Know: Using Research to Support Practice

by Dr. Becky Haddad, Dr. Brian Myers, & Dr. Mike Retallick

IYKYK. If you know, you know. Except sometimes it can be really hard to know, you know? Even in six little letters, an acronym we can spell out, the meaning can be wildly different. Among our students, this abbreviation says, "You should know. It's obvious." On social media, it can reference an inside joke understood by those who participated. Among Millennial Moms, it can mean, "We have solidarity in this experience. You know what I'm talking about." Among long-timers, it may mean, "I can't really tell you how I know. I just do, because I've been doing it for a long time." Those don't seem that different, but for an abbreviation that says, "It's so obvious the context doesn't really matter," there's usually a whole lot of context that makes a whole lot of difference.

That can often be the challenge of incorporating research into our classrooms. Teaching agriculture can feel incredibly context specific. The agriculture in our area is unique compared to anywhere else in the country. My kids are so unique and special, surely no one has an answer for exactly what they need. My community is unlike any other, you just don't understand. On the flipside, it can be intimidating to join the research conversation. Where do you look? Where do you start? How do you even read this stuff? What if you don't know?

This issue of the Ag Ed Magazine is full of resources to help you use research in your classroom. Our authors have shared about their work through full length articles and snapshots to help you integrate their research problem into classroom strategy. If you're looking to extend further, remember; research is just a problem someone explored. Often it comes to us in the alias of an industry magazine, a current event spotlight, or our local Extension professional. Many of these sources focus on research, hot topics, and current events. In addition to bringing resources to you, we hope this issue provides an inroad to the research conversation that continues as you reach out to authors to learn more about their work.

How often do we close off opportunities because we are looking for just the right thing that says, "IYKYK?" We put this issue together to put a whole bunch of those just right things in one handy place. From agriculture pathway specific articles to research snapshots connecting you with brief overviews of what Ag Ed researchers across the country are working on, you'll find ideas and connections to bring research into your practice. It was also a great place for us to make a shameless plug to follow our Owl Pellets: Tips for Ag Teachers Podcast, where we're always digesting research into pellets you can use in your classroom and practice.

We, as well as the researchers sharing in this issue, look forward to continuing the conversation with you.

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Classroom Strategies to Use Animal Science Research

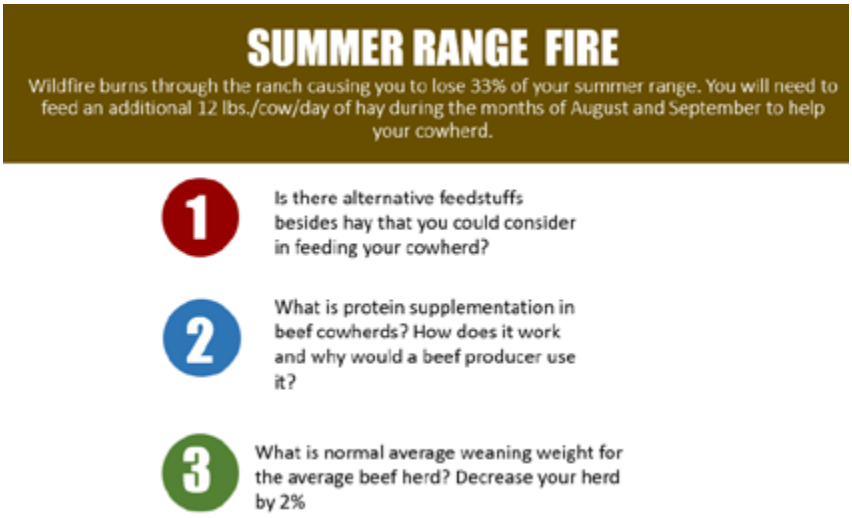
by Matt Kennedy

Just as research is done to answer questions that arise in animal production and management, the same can be done in how research can be used in teaching. In classrooms, teachers explain and instruct in the many types of production practices and methods used in animal care and management. But we as educators can ask, "what are the problems/concerns that come up in animal science?" and "how can those problems be addressed?" Following scientific inquiry and curiosity can help lead to developing classroom practices that support better teaching and student education.

Students can engage in scientific inquiry in animal science in a variety of ways. Asking students to explain how a certain practice is used in animals and using known research to prove it gets students started. Asking them to explain these practices and connect to the ways they are being improved takes it a step further. An example is use of antibiotics in animals to treat and prevent disease. Students can discover the history of antibiotics and their development, but also the different ways they have been administered such as injectable compared to feed-grade. Students not only see the new research to develop animal-specific antibiotics, but learn how evolving technology has led to more powerful drugs that require lower dosage and longer duration in the body.

In terms of the available research, there is an incredible amount of information available to students related to the most recent advances in animal science. There has been more work in the past 15—20 years looking at the complete system of science fields/studies in most domestic species that shows more and more how one field can greatly impact the others. With this type of research and work, it can promote several opportunities to help students see career opportunities and the ability to connect across fields and areas of interest. Students can search via Google Scholar, peer-reviewed journals such as *Journal of Animal Science*, and industry accepted nationally known magazines such as Drover's Journal. With these resources, students should be able to find numerous articles and studies looking at all fields of animal science including nutrition, animal behavior/handling, and genetics. Students can

(LEFT) Example of role-playing card in which students research and answer questions in response to a scenario. Students then discuss their answers among the class and see what current methods and research can do to help address scenario.
(RIGHT) Graduate student performing blood draw at research station. If within drivable distance, exposing students to hands-on research could lead to further knowledge development and opportunities that exist beyond high school.

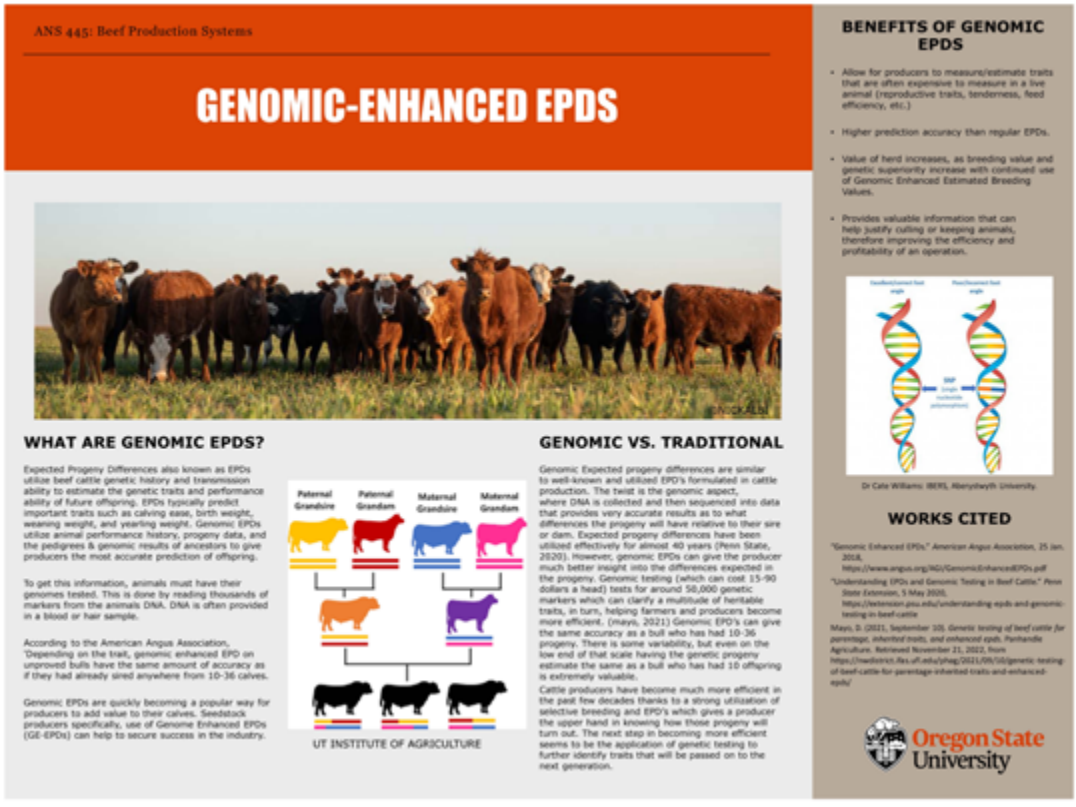


then use these articles to answer questions. Teachers can guide this practice in several ways to support students who have never used research before to help students use research independently. Often, we forget to acknowledge the ways our students are engaging in research with their problem solving. Pointing them to dig in on specific questions to solve problems asks them to engage in research. For example, a teacher might ask their students, "What are the factors that impact successful embryo implantation in the uterus of recipient dogs of embryo transplant?" Students can hypothesize the major factors and minor factors and rank them in order of importance and impact to success of implantation.

While asking students to hypothesize and rank factors gets them started, helping students work through problems moves them toward independence in understanding what they may find in a Google Scholar search. Students can turn to the available research with a specific problem they have seen and ask why it happens. Using this they could see what research was done to identify the root cause and what has been done to correct/prevent the situation. For example, students could explore genetic disorders in animals such as "Stargazing Syndrome/Wry Neck" in birds and see what can/has been done in research to help know more about the condition. Understanding this problem solving process and the available research around it helps students engage in the research of their own. When we can make research accessible to our learners, we help them problem-solve and engage in the field.

Once students are curious, there are many ways to continue engaging with the research process. Things like oral presentations and poster presentations are great starts, but using case studies and scenarios can also be great learning tools. For example, I give my students a scenario in which they are helping manage a ranch and need to find potential solutions to how to deal with summer range fire. The range fire impacts the rancher's property and causes the rancher to lose valuable grazing ground and feed for their cowherd. Students then need to figure out how to feed the cowherd without the grazing ground. By using peer-reviewed journals such as the Journal of Animal Science, they should be able to see the use of by-product feeds such as grass-seed straw or corn stalks in addition to protein supplementation feeding strategies using animal-based or plant-based protein sources. They'll also find ways to deliver alternative feeds to the herd and how the protein intake can affect overall feed intake. This helps make research more practical for students, and there are several opportunities to extend the case studies to problems students are facing on their home operations.

For a poster presentation, you could have students follow the scientific methods and find a common problem that faces animals and see what research has been done to address it. This could pair with FFA Agriscience Fair as a template, or be a standalone project. Students could also make a poster presentation looking into new and innovative ways to help production such as new technologies used. You can find examples from research conferences in Animal Science by searching for academic/scientific poster templates such as https://www.posterpresentations.com/free-poster-templates.html or https://www.posternerd.com/sciposters-templates. One example is



Example of poster in which students needed to look up current research done in beef cattle and how it applies to the cattle industry and its intended implications.

the use of genomic- enhanced Expected Progeny Differences (EPDs) in beef cattle breeding and selection to help increase the value of a beef producer's herd.

Of course, universities, extension agents, and research stations connect you directly with those who are conducting the research. Often, those connected with these outlets are willing to serve as in-person or virtual guest lecturers and resources. These folks are the link between the research world and the industry. They help address problems and find new ways to help in more efficient and effective animal management and production. There could be ways to involve your students with their research and/or educational programming that will help develop skills. A majority of their research tends to be very applied and hands-on which works well with younger learners. Examples here in Oregon include the use of interns to help carry out mineral supplementation strategies in eastern Oregon; a study for which they have hired/recruited high school students to help along with college students. During this trial, students further developed their work on essential skills and understood the importance of record keeping and communication -oral and written- while working on animal handling and lab skills such as blood collection of animals and chemical titration in the lab. You can also connect with the species specialists to help address certain teaching units and current issues. For most states, these specialists are located on campus but do travel throughout respective states throughout the year providing educational opportunities.

Getting the link established with a local producer or company could lead to helping them research ways to employ some simple changes in management or practices. They may be willing to help fund and support small trials and studies your students can carry out especially if it will help them in the long run. Students will develop a relationship that they may potentially use later as a job reference while working on the essential skills needed in today's workforce while helping solve real-world problems.

There are several other ways than those discussed to get animal science research into the classroom to help further your student's education. Don't be afraid to work outside the box and try new things.

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National Cooperative Extension; https://extension.org/; This website has search engines, links to each state's extension service, articles, and more

Google Scholar; https://scholar.google.com/; Access to articles, theses, dissertations, and more on a global basis

The following are the respected professional societies for the major fields of animal related research for different species. Depending on your school's and/or district's subscriptions, you may have the ability to access the full articles.

American Society of Animal Science
https://www.asas.org/

American Meat Science Association
https://meatscience.org/

American Poultry Association
https://amerpoultryassn.com/

American Dairy Science Association
https://www.adsa.org/

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Cheaters Will Betray Each Other Every Time For a Better Grade

by Dr. Jeffrey Young & Dr. Kristie Guffey

As the 2020 pandemic pushed education to online platforms, many educators witnessed academic dishonesty and unethical practices. Online education is growing consistently across the globe (Allen and Seaman, 2011; Arnold, 2016). Post pandemic continued to see a rise in online learning as this opened the door for more students and more opportunities for growth and expansion. Various platforms are still being used such as: Canvas, Blackboard, Infinite Campus, Google Classroom, and more. The usage of these software tools allows for expedited grading, ease of access, and an opportunity to teach with non-traditional instructional (NTI) days. With this rise in e-learning, this can also present problems such as: cheating, buying answers to exams, artificial intelligence (AI), systematic "bugs" in online quizzes and tests, and the list could go on and on. Hard, Conway, and Moran (2006) discussed how students are exploiting those gaps to advance their academic careers. Meanwhile, teachers across the country are baffled at how best to combat these issues of academic dishonesty.

A study conducted by Jeffrey S. Young (2020) looked into ways to reduce cheating in online classes by using the widely known game theory application of "Prisoner's Dilemma." The strategy lies in pitting the students against one another, relying on them choosing self-interest. A cheating student can confess they were collaborating with another student, and in doing so will gain a reward. They can also choose to be silent and risk the other student turning them in out of self-interest. The chief goal is more for students to reveal how they are cheating rather than who specifically is cheating.

The creativity of students to design and develop methods of cheating continues to evolve rapidly. A favorite example of such creativity is the "scapegoat method," which inspired the study by Young (2020). This is where a student will volunteer to take the exam first, taking notes and collecting answers to help the other students succeed with a higher score. If the correct answers were revealed, the other students would have the opportunity to get a perfect score. This method would rotate roles throughout the group, thus ensuring that no one is at a disadvantage through repeated selection.

Young's (2020) method established that if two students were cheating on exams and neither one confesses (that is, both continue their collusion), a 10% grade reduction would incur. If one cheater defects, then the confessor would be granted a 5% grade boost. If both students come forward and defect from cheating, then they are awarded a 1% increase to their grades. Now suppose these students are students with a course grade of 70%. They can drop their scores even lower by colluding (their understanding of the course is insufficient already), or they can defect from the cheating arrangement in seeking an increase in their grade. Both would, in self-interest, hope that the other partner does not also defect so that they can achieve the maximum grade bonus. This incentive structure is designed in hopes for the student to no longer cheat, given the incentive structure, and for the instructor to learn how they cheated (and if possible, correct the issues which led to cheating in the future).

In Table 1, if we assume students begin as indifferent between colluding and defecting (the probability of either choice is 50%), then on average, either student's grade is strictly higher upon choosing to defect (+3.5% versus -1.5%). This is the Nash Equilibrium solution whereby neither student would change their strategy if they could "go back and do it all over again." Therefore, with the correct incentive structure in place, cheating

Table 1 displays the Nash Equilibrium solution whereby neither student would change their strategy to collude or defect if they could "go back and do it all over again."

Table 1. Example Game

		Student B	
		Collude	Defect
Student A	Collude	(7,7)	(−10,5)
	Defect	(5, −10)	(1,1)

Note: The numbers in parentheses denote (A's payoff, B's payoff)

students are expected to defect, thus doing the teacher's work for them when it may not otherwise be possible.

The principle that cheating is wrong and unethical is not a new concept however, it appears to be an insufficient reason for students to not cheat (Etter et al., 2006, Larking & Mintu-Wimsatt, 2015). Indeed, many students openly acknowledged the general presence of cheating, obviously without any self-incrimination. It is therefore implausible that this behavior will be rectified in the future, and all the more crucial to find a feasible solution for educators.

In the Spring 2020 semester when this study was initiated, only a few of these appeared to harbor interest in defecting to receive the grade boost—likely waiting to see how their grades fared throughout the semester until midterm grades had posted. However, it was around the time of midterms when universities responded to the coronavirus pandemic by moving instruction to an online format. Institutions also switched to a pass-fail grading system as a concession to the students (Leingang, 2020). Unsurprisingly, the students who expressed an interest in defecting—in the hope of moving as much as a letter grade higher—ceased to show that interest, and hurriedly applied for a pass-fail grade conversion. In the years since this measure was first implemented, Young reports a near zero cheating rate in all classes (2 suspected instances out of 529 total students).

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> The creativity of students to design and develop methods of cheating continues to evolve rapidly.

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A Rose by Any Other Name: Issue Leadership Development in a Plant Science Context

by Dr. Kevan Lamm

Teacher: "What does a plant need to grow?"

8 Year Old Elementary Student: "Water, sunlight, and love!"

Much like the interaction above, at the most fundamental level leadership development also shares many of the same characteristics. Students need to be given the proper environment to thrive as well as the support to do so. However, it is easy to focus on the details and sophistication associated with leadership development while forgetting that the fundamentals are what will likely have the greatest impact. There are a few entry conditions which we must ensure are met in order to provide our students the greatest possibility for leadership development success. I will use the plant life cycle (preparation, seed, germination, seedling, mature plant) as a framework for leadership development integration and how we as educators can use topics such as Plant Science for leadership development. I'll briefly cover how we can help cultivate environments where our students can grow and thrive.

Preparation: Prior to planting seeds and expecting plants to grow we must take the time to ensure the environment is appropriate. For example, we need to ensure that there is adequate space for planting, access to water, a light source, soil, and so

(LEFT) Plants will naturally seek sunlight to develop, emerging leaders will also seek opportunities to grow. (RIGHT) Similar to the unique needs of plants, as educators we need to identify the needs of our learners and help provide the right environment for development.

forth. What we know from leadership research is the importance of environmental preparation is paramount. Specifically, leadership development requires planning, guidance, and space. Expecting leadership development to emerge on its own, while possible, is less likely than planned experiences. A recommendation would be for educators to think about the specific leadership characteristics or competencies they hope to instill in their students. For example, the *Issue Leadership* model focuses on 7 primary factors: strategic planning, communication, change, relationships and character, supporting, coordinating, and action. A recommendation would be to think about how you might integrate each of these factors into lesson plans. For example, if you had a class where students were working in a school garden environment you could consider integrating activities which were directly related to the *Issue Leadership* factors. You might begin the class by having students stand up and give a brief overview of their experiences working in a garden. A small activity such as this provides students a chance to develop their communication skills. Later in the semester you may wish to have students decide amongst themselves what they would like to plant and why. This activity could be completed in teams tasked with researching different garden options (strategic planning), developing a brief written summary of their proposal (communication), and then deciding as a class how they plan to proceed (supporting others and conflict management). Although many of these conversations may occur naturally, being purposeful will ensure students have the environment and support necessary for success.

Seed: Fundamentally, a seed represents potential. Similarly many students may not have had any previous formal experience with leadership development and therefore also represent potential. As educators it is important for us to remember that the experiences, knowledge, and wisdom we have acquired over the years may not be readily available for our students. Therefore, we need to be very intentional in encouraging students to recognize their potential as leaders. This process of identity development has been well established in the leadership literature. Individuals need to be able to see themselves as having the potential to become the leaders they aspire to be, even if they may not be there today. Therefore, at the early stages of the curriculum a recommendation would be for students to have time to not only reflect on their current state of leadership and plant science competence but to also take the time to develop goals for themselves over the duration of the course. For example, you may wish to provide students a short document asking them to write down a specific goal which they hope to achieve as it relates to the course content (plant science), as well as a specific goal related to their own personal leadership development. The use of self-determined goals in educational settings has been shown to increase student persistence and levels of perceived satisfaction associated with course tasks.

Even a 300 foot redwood tree starts from a tiny seed (about the size of a tomato seed), learners too need time to develop into mature leaders.

At this stage in the process, a recommendation is to provide considerable guidance, structure, and clear directions to students to help them become established.

Germination: As students begin to acquire foundational knowledge related to plant science, with leadership development activities integrated within the curriculum, the concept of identity emergence is expected. When cultivated in an appropriate environment, the seed begins to transition and move from static potential to dynamic entity. Similarly, we would expect to see students begin to develop their own leadership identities based on a supportive learning environment. At this stage during the class a recommendation would be to look for opportunities to reduce highly structured guidelines and to begin to empower learners to make some decisions independently. Providing opportunities for independence and self-direction should increase levels of intrinsic motivation and students desire to learn not only for the purpose of grade attainment, but also hopefully for the purposes of individual interest. Self-directed learning and intrinsic motivation have both been well established as positive teaching techniques in the leadership development literature. For example, you could introduce the concept of critical thinking and problem solving as it relates to strategic planning in the classroom garden. You may wish to use environmental conditions to have a class-based discussion on the best ways to address pests which are starting to show up. Do students think it would be best to use chemical control techniques in the form of insecticides? Or do students think it would be better to use organic approaches? Why or why not? Linking these management decisions to the ultimate consumption and marketability of garden produce should also help to develop critical thinking skills. In these early discussions encouraging effort and participation is much more important than determining the correct answer. A growth mindset approach needs to be facilitated by the educator and is paramount during the emergence stages of leadership development. An additional recommendation is to include time to debrief any such discussions and to address not only outcomes but more importantly the process. What worked well? What would students do differently next time?

Seedling: The transition from the germinated seed to seedling represents the further establishment of the plant, at this stage the plant is more resilient and robust, has begun to develop a root system and is capable of existing in a wider range of environmental conditions. Similarly, as individuals become more confident as leaders, we would expect them to take on similar characteristics. For example, whereas at the seed stage high levels of structure and guidance are recommended, the germination stage the levels of structure are reduced but the fundamental direction and expectations are still provided by the educator, as we move into the seedling stage a goal would be to begin empowering learners to take on more individual responsibility and began proposing their own questions, solutions, and implications. At this point the educator is more of a trusted guide. It is important to note it may not be reasonable to expect students to acquire and integrate all the leadership skills and competencies in a single class, or even a series of classes. However, this would be the progression we would hope to see if we had the opportunity to engage with learners over an appropriate amount of time. For example, whereas at the germination stage the educator would propose the question the students needed to address, such as the best way to deal with pests, at the seedling stage the educator might ask the students to think about how they would market their produce to maximize profit upon harvest. This question should then encourage learners to think about all the various inputs which they have been learning about in the class and how each one of these inputs contributes to the ultimate question. Considerations such as labor costs and time, input costs, environmental costs, market acceptance, and so forth should all be considered. Rather than defining each of these inputs for learners the goal would be for learners to uncover these aspects themselves. This type of activity would encourage individuals to develop characteristics such as confidence, initiative, and motivation which all contribute to the *Issue Leadership* factor of relationships and character.

> A growth mindset approach needs to be facilitated by the educator and is paramount during the emergence stages of leadership development.

Mature Plant: Once a plant reaches maturity there is an expectation for a certain amount of independence, robustness, and persistence. Similarly, when learners move through the various leadership development stages an expectation would be for individuals to become more independent, self-directed and confident in their leadership abilities with much less direction and guidance required by an educator. Ideally content-based classes, such as those focused on plant science, will also provide opportunities for

learners to engage in leadership development as well. Similar to the seedling note above, it is highly unlikely a learner would be able to reach a level of leadership maturity after only a single class or even a series of classes. However, if done correctly, iteratively, and consistently over time, we would expect to see students develop their own leadership identities which are then transferable across many different contexts. At the maturity level is when we would expect to see students be able to take on tasks with much more independence. For example, you may wish to provide students an opportunity to develop a brief business plan describing how they would create a for profit garden enterprise based on all of their accumulated knowledge regarding inputs, environmental conditions, expected outputs, and other criteria. This level of independence and competence would indicate that learners were at a mature level of leadership where they were confident in taking action, supporting others and coordinating the efforts of others with limited direct guidance required by an educator. As learners accumulate leadership knowledge which they can apply through planned experiences and are given an opportunity to reflect and plan for future situations, they are developing leadership wisdom as well as personal judgment. The experiential learning model provides a very well-established framework for this type of planned development.

Final Thoughts: According to a very well-known proverb, "if you wish to sit under the shade of a tree the best time to plant it is 20 years ago, the next best time is today." Leadership development shares many of these same characteristics. It is not possible to develop leadership potential, identity, robustness, and independence overnight. There is a process which is expected and needed. However, there are many opportunities to help students develop their leadership capacity in a variety of course contexts. A little extra preparation and application of established educational techniques, can help students acquire the experiences necessary for their development as a leader. The *Issue Leadership* model provides one framework which educators may wish to consider using to guide and inform their lesson planning and curriculum. However, there are a variety of leadership models and theories which are also readily available and applicable in various contexts. Expecting leadership development to manifest without planning and providing a supportive time and space is highly unlikely. The most important take away is the need to begin integrating leadership development into the classroom as soon as possible to help support the growth of the leaders of tomorrow.

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Integrating Agricultural Communications Research into Agriscience Classes

by Dr. Ricky Telg

A key quality of being a good agricultural communicator is being a good researcher.

Good agricultural communicators are inquisitive. They like to dig deep into topics. Agricultural communicators ask good questions to guide their interviews and their investigation into topics. And they use appropriate communication technology, such as video, audio, or social media, to communicate their message.

Likewise, agricultural communications researchers need to be curious. They must use appropriate research tools or methods, such as surveys, focus groups, and interviews, to answer their questions. And agricultural communications researchers try to identify the media, messages, and information sources their research participants regularly use and find credible and trustworthy.

Teaching students agricultural communications research methods and the importance of researching how agriculture is communicated will help them be good agricultural communicators and good consumers of information. This article provides ideas for integrating agricultural communications research into agriscience classes.

Social science research methods

Social science research methods used by agricultural communications researchers are generally categorized into quantitative research and qualitative research approaches. Quantitative research methods typically use surveys to gather data. Qualitative methods include interviews, focus groups, and observations as the sources of data. Content analysis of media messages, such as videos, audio clips, written materials, and social media content, can be done both qualitatively and quantitatively. The rationale for selecting a method – qualitative, quantitative, or a mixed-method approach using both – should be based on the questions you want to answer. For more information about communications research, please refer to the chapter *Research Methods in Communications* in the new e-textbook *Agricultural and Natural Resources Communications* (https://anrcommunications.org/).

> Understanding that every piece of a video is "constructed" to elicit a response, usually an emotional response, helps my students analyze the messages and content in the videos.

The importance of agricultural communications research

Each of us is bombarded by media messages from various information sources through different communications technology every day. People of different ages prefer different media. Specific images may appeal to one audience but not to another. People complain about "fake news" and untrustworthy information sources. How do we make sense of it all?

That's where communications research comes in and, in this case, specifically, agricultural communications research. Agricultural communications research takes a wide range of interest areas – from media literacy, audience analysis, crisis communication, framing, and many others – and helps us understand how audiences perceive agriculture-related issues, how these issues are communicated, and what impact communication messages have on recipients of these messages. By being able to analyze issues, media, and messages, we become good consumers of information.

Take the research topic area of "media literacy," for example. In my introductory digital media production course at the University of Florida, I teach a section on media literacy, which is the ability to analyze, evaluate, and critically think about media. I focus on how messages are communicated using online videos, advertisements, and documentaries. Students watch these videos, analyzing them for the number and types of video transitions (cuts, dissolves, fades) used, the rhythm and pace of music clips, the information source (title, position, company), specific words that are used, special video effects, and what information is included and, presumably, not being included in the videos. These components and many others can persuade

viewers, so students critically think about how these components in the videos are being used to persuade them. As I tell my students, "All media messages are *constructed*," meaning there is a reason for everything you see, hear, and read in a video. Understanding that every piece of a video is "constructed" to elicit a response, usually an emotional response, helps my students analyze the messages and content in the videos. These media literacy skills to analyze content and visual messages are similar to the skills agricultural communications researchers employ in their studies as they analyze messages, media, issues, and audiences.

Ideas for integrating agricultural communications research in agriscience classes

Following are some ideas to integrate agricultural communications research into agriscience courses:

Surveys: Have students create a 10- to 15-question survey to find out what people think about a current event or agriculture-focused issue and administer the survey to 10 to 20 individuals appropriate to answer the survey questions. Use a variety of question types (rating, ranking, open-ended). Refer to the previously mentioned *Research Methods in Communications* chapter in the new e-textbook *Agricultural and Natural Resources Communications* for suggestions on writing specific questions. Based on the survey results, have the students write a news article or develop a social media campaign to better explain the topic being researched.

Focus groups and interviews: Similarly, have students conduct either a focus group or a series of interviews on an agriculture topic, with the result being a product – a news story, social media posts, or an information campaign – that helps explain the topic.

Media literacy: As noted previously, media literacy is an important skill, analyzing various media (social media, video, audio, print/design) and different audiences (youth, older adults, children, gender). Have students watch an advertisement or documentary on a food or agriculture-related topic. As they watch the video, have them analyze it, focusing on components mentioned in the previous section, as well as the trustworthiness and credibility of the main information source. Ask students to consider their backgrounds and life experiences and assess how their background influences their perception of the content in the advertisement or documentary.

Audience analysis: Ask students to analyze audiences based on gender, education, age, or other demographic categories and how these differences in audience characteristics could impact different audiences' perceptions of messages and use of communication technologies. In particular, have them analyze audiences, messages, and communication technologies as they relate to a food or agriculture-related topic.

Content analysis: Identify a crisis in the news and have students conduct a content analysis of how the crisis is being covered. A search of the *Journal of Applied Communications* using the keywords "crisis communications," for example, will generate several peer-reviewed journal articles that analyze how agriculture- and food-related crises were handled or covered. These articles could be discussed in class to compare how a current crisis is reported in the news.

Source credibility and trust: Ask students to research an information source – a company or an individual – that provides content on a food or agriculture-related topic. Students could conduct a survey, focus group, or interviews to identify the perceived credibility and trustworthiness people have of the information source.

Opinion polls: Have students evaluate an opinion poll. The Pew Research Center has opinion poll results on a variety of topics that you may want to review and evaluate (https://www.pewresearch.org/). Some specific questions to include as students analyze the polls could include the following: How many people were polled?

A focus group, as pictured here, is a group interview technique where an objective moderator asks questions to a small group. A focus group is one research method agricultural communications researchers use to gather information.

What is the margin of error? Who commissioned the survey? How are the questions worded? In what order were the questions asked? Pew Research also has a very detailed resource on analyzing polling data that you may want to utilize: https://www.pewresearch.org/course/public-opinion-polling-basics/.

Conclusion

Implementing opportunities for students to learn agricultural communications research skills will strengthen their abilities as agricultural communicators and prepare them to be better consumers of information. They will be able to ask better questions and seek out better sources of information for their news stories and other communication products. They will also be better able to assess information sources for trustworthiness, identify which communication technologies are better suited for specific audiences, and recognize how the media messages they are exposed to daily are "constructed."

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Agricultural Communications Research Resources

The following are suggested resources to be incorporated into lessons introducing agriscience students to agricultural communications research:

Doerfert, D., Qu, S., & Rutherford, T. (2022). Research methods in communications. In R.W. Telg, T. Irani, K. Kent, & L. Lundy (Eds.), Agricultural and Natural Resources Communications. https://anrcommunications.org/. This chapter highlights social science research methods utilized in agricultural communications research.

Fischer, L., Telg, R., & Irani, T. (2013). Persuasion in messages. doi.org/10.32473/edis-wc145-2013. This publication explains the different ways that the mass media use persuasion and how persuasion encourages audiences to change their attitudes or behavior.

Fry, K.G. (2017). What do we mean by fake? What do we mean by news? Spectra, 53(4), 8-13. https://www.natcom.org/publications/spectra/november-2017. This magazine article provides an overview of media literacy, particularly in a news media context.

Journal of Applied Communications (https://newprairiepress.org/jac/). This journal focuses specifically on issues and topics relevant to agricultural and applied communication professionals.

Keeter, S. (2023). Public opinion polling basics. Pew Research Center. https://www.pewresearch.org/course/public-opinion-polling-basics/. This source explains how opinion polls are developed and how to analyze them.

Miller, H., Kesler, K., & Lawson, C. (2022). Persuasion and persuasive informational and educational campaigns. In R.W. Telg, T. Irani, K. Kent, & L. Lundy (Eds.), Agricultural and Natural Resources Communications. https://anrcommunications.org/. This chapter highlights how elements of persuasion can be integrated into media messages.

Pew Research Center (2023). https://www.pewresearch.org/. Pew Research conducts many opinion polls each year. This site archives the Pew Research Center's opinion polling results.

Scheibe, C.L. & Rogow, D. (2012). The teacher's guide to media literacy: Critical thinking in a multimedia world. Thousand Oaks, CA: Corwin. This book provides suggestions on how to integrate media literacy across the curriculum and teach students to be independent, skilled, and reflective thinkers.

Whole Learning with Agricultural Innovation: A Teaching Case on Adding an Anaerobic Digester to an Iowa Farm

by Maria Florencia Giuliani, Sebastian Horacio Villarino, & Lisa Schulte Moore

In 2009 David Perkins, an influential educator and author from Harvard School of Education, posited a new approach to learning. He proposed that to accomplish deep and meaningful learning experiences, teachers should design Whole Learning experiences. In his book, he describes seven principles that facilitate this experience. Although it has been almost fifteen years since the book's publication, promoting *Whole Learning* experiences in the classroom is still challenging. The aim of this article is to link several of the principles to make learning whole with a real-life teaching case, an agronomic innovation on a farm in Iowa, USA. We first present the broad, societal context for a real-world case in agricultural innovation, then detail and interpret the case according to the Whole Learning framework. We hope this case will provide a means to lower barriers that separate the classrooms from the outside world and support teachers toward improved student learning.

Learning Context

Land degradation, food insecurity, and climate change have been among society's major concerns over the last 50 years. These issues jeopardize the stability and sustainability of human civilization and are strongly interlinked. Land degradation contributes to food insecurity and climate change and can be exacerbated or reversed through agricultural management.

The degradation of agricultural lands compromises their ability to perform multiple beneficial functions for society. Degradation is often measured in terms of soil organic carbon (SOC) and soil nutrients (i.e., nitrogen, phosphorus, potassium, and other nutrients) levels compared to a historical baseline for the soil type. Degraded agricultural lands cannot support crop production, thus addressing food insecurity. Soil, further, plays a key role in global climate change, representing the main terrestrial carbon reservoir. Loss of SOC is particularly concerning because it affects almost all soil properties related to ecosystem functioning and is slow to improve with management changes. SOC loss through decomposition leads to carbon dioxide emissions (under aerobic conditions) and methane emissions (under anaerobic conditions). Consequently, addressing the maintenance and restoration of SOC and soil nutrients is crucial to addressing the interlinked global crises.

Real World Case in Agricultural Innovation

In eastern Iowa, Sievers Family Farms produces corn, soybeans, wheat, rye, beef, and energy. Owner/operators Bryan and Lisa Sievers are 5th-generation farmers: sustaining the land's productivity, feeding people, and environmental stewardship are all longstanding ethics for the family. In 2009, they considered expanding their beef-cattle feedlot to improve farm finances but were concerned about the environmental impacts. Their solution was to redesign their entire farm system around circularity, with the outputs of one component providing the inputs to another (Figure 1). Adding two *anaerobic digesters* was central to creating a more circular farming system. Anaerobic digesters can come in many forms and process many types of materials. On the Sievers Family Farms, the anaerobic digesters are large tanks in which manure and soiled bedding from their cattle operation is mixed with other biomass sources, including crop residues and food waste from nearby processing facilities. Under the anaerobic conditions in the tanks, microbial processes convert these organic materials into biogas, which are burned to produce energy. The material following anaerobic digestion is called digestate and has solid and liquid portions. Digestate solids are mostly composed of carbon and are applied to crop fields as a soil amendment to boost soil organic matter. The liquid portion is nutrient-dense and is used to fertilize their crops; the Sievers have thereby been able to reduce their dependence on purchased fertilizer. We are studying changes in SOC and soil nutrients at Sievers Family Farms and observing increasing in fields receiving digestates. However, some nutrients might be increasing too much, like soil phosphorus. Consequences like these must be managed carefully, given the risk of stream water pollution related to nutrient excess.

Anaerobic digestion is an innovative strategy proposed to simultaneously address all three crises—land degradation, food security, and climate change. Meat is a reliable source of nutrition globally, but animal agriculture can have detrimental environmental impacts when poorly managed, including negative climate impacts. Anaerobic digestion is an effective manure management strategy that reduces greenhouse gas emissions from manure by 50 % while also generating energy that can reduce dependence on fossil energy. The by-products of anaerobic digestion, the solid and liquid digestates, are used as organic amendments to enhance soil health and increase soil nutrients, thereby addressing land degradation. These points are crucial since, on the one hand, conventional agricultural systems heavily rely on external inputs of nutrients and energy. On the other hand, degradation processes, such as SOC depletion, are commonly observed in croplands. Anaerobic digestion is a keystone technology for more sustainable agricultural systems. Currently, 248 anaerobic digesters are operating on livestock farms in the United States, but there is a capacity for 8000 more. We believe this is an interesting situation to analyze in the classroom.

Interpretation of the Case According to Whole Learning Concepts

The Whole Learning approach proposes two principles, *Play the whole game* and *Make the game worth playing*. The first posits that teaching should go beyond presenting elements and facts and instead focus on presenting holistic situations and processes. By focusing on real-world challenges—in this case, land degradation, food insecurity, and climate change—learners immediately perceive the relevance and practical applications of the topic, increasing their motivation to learn and facilitating the impetus to make the cognitive effort to build a more comprehensive understanding of a subject to *Make the game worth playing*. In Perkins's words: "*Playing the whole game clarifies what makes the game worth playing, because you see right away how things fit together*" (Perkins, 2009, p.27). These topics may be culturally relevant and meaningful for the students in rural school settings, given it is presented within the agricultural context of a farm. It is also important for urban learners to understand production and environmental challenges where their food comes from, and how farmers are innovating to address them.

To *Play the whole game*, this approach recommends that real-world challenges are presented in a simplified scenario, where some key features of the real situation are prominent. The scenario should be simpler from a technical point of view and shorter or settled on a limited time frame. While Sievers Family Farms is complex in operation involving crop, livestock, and energy production, we have focused on the linkages between the anaerobic digester and soil properties to simplify. In particular, we highlight two aspects of the problem—SOC dynamics and nutrient availability—and set aside other related but more complex ones, like soil physical properties and the life cycle assessment of agricultural and energy outputs. By presenting a simplified yet real-life situation, we increase the chances of fostering intrinsic motivation in students. To deepen learning, the teaching case could be expanded to interview farmers or visit farms to see how innovation can be both beneficial and challenging.

Figure 1. Sievers Family Farms, located near Stockton, Iowa. Cattle are finished for market in the monoslope barns (mid, left in image) using grain produced on the farms' crop fields (image background). Manure and soiled bedding are continuously moved from the barns into anaerobic digesters (image foreground), thereby improving air quality and reducing greenhouse gas emissions. Food waste from nearby processing facilities is also added to the digesters. Microbes in the digesters breakdown the organic material and form biogas used for energy, solid digestates used to boost soil organic matter, and liquid digestate used as fertilizer. The purposeful cycling of carbon and nutrients among crop, livestock, and energy components of the farm make it more sustainable by reducing the need for purchased inputs and improving environmental performance.

> Teaching should go beyond presenting elements and facts and instead focus on presenting holistic situations and processes.

A third principle to achieve Whole Learning is to *Play out of town*. This refers to the focus on transferring knowledge to different situations and can promote a more comprehensive understanding and flexibility of thought. Teachers should promote two types of knowledge transfer: low and high. Low transference is accomplished by making connections between superficial characteristics of different situations. For instance, if students visited a farm, they could respond later to this question as a project "What would need to be done to make the farm you visited work with a more circular system?" High transference refers to creating bridges to connect more distant concepts and situations. In this case, for instance, it is possible to create a bridge from agricultural innovation to global policy. Simulations are a great way to foster this kind of knowledge transfer: "Imagine you are a US expert at the Food and Agriculture Organization of the United Nations, write a five-minute speech to convince your colleagues from other countries about the need to make agriculture more sustainable using circular farming systems. You must argue in favor of this kind of innovation, including both its positive social and environmental impact."

A fourth principle of the Whole Learning approach that can be applied to the teaching case is to *Learn from the team*. From a social perspective, learning and thinking develop in a sociocultural context. Conversations, teamwork, and project development are essential to deep learning. Working with such complex cases can provide an opportunity to promote different participation structures, where each student has roles (i.e., crop farmer, livestock producer, anaerobic digester operator, environmental specialist) and responsibilities (i.e., crop production, beef production, electricity production, soil health and fertility assessment) that can be chosen according to authentic personal interests and identities. If some students have farming experience and others do not, the experts can mentor the novices in learning about the dynamics of agricultural production. Students from farming families could be asked to apply the innovative system to their farm, working in tandem with a novice on situation analysis and problem-solving. Participants who were particularly engaged in the activity might participate in a community of practice to continue and extend these projects.

Finally, the principle *Learn the game of learning* can be effectively applied in this teaching case, explicitly teaching skills and strategies for effective learning. Encouraging learners to become more self-directed and autonomous in their educational journeys is a key aspect of this approach. To implement this principle, learners could be free to choose between different suitable learning goals based on their individual interests. For instance, some students might prefer to focus on the anaerobic digester, while others might be more interested in exploring soil properties or social and environmental impact. To facilitate students' self-monitoring of the learning process, teachers can provide progress checklists and incorporate thinking routines related to each learning goal daily or weekly. Regularly assessing their progress will enable students to identify their strengths and areas for improvement. It will also help teachers to offer necessary support and scaffolding as needed.

Conclusion

In conclusion, the Whole Learning approach, as proposed by David Perkins, presents a powerful framework for designing deep and meaningful learning experiences. Through a real-life teaching case, such as the agronomic innovation at Sievers Family Farms, the application of Whole Learning principles becomes tangible and relevant. By presenting students with real-world challenges related to land degradation, food insecurity, and climate change, they can immediately grasp the practical applications and relevance of the subject matter, fostering intrinsic motivation and a more comprehensive understanding of the topics at hand. This approach bridges the gap between classroom learning and real-world applications, nurtures a passion for learning, and equips students with valuable skills for future endeavors.

Acknowledgments

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Schunk, D. H., & Zimmerman, B. J. (Eds.). (2012). Motivation and self-regulated learning: Theory, research, and applications. Routledge.

Additional Links:

Webinar about on-Farm biogas system opportunities
https://extension.psu.edu/on-farm-biogas-system-opportunities-increase-farm-sustainability-with-biogas-production

Infographic about anaerobic digestion
https://www.iowalearningfarms.org/resources/infographic-what-is-anaerobic-digestion

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Teach Locally and Think Globally? Using Community to Prepare the Next Generation

by Dr. Carson Letot, Dr. Daniel Foster Dr. Kevin Wylie Curry, Jr., Dr. Melanie Miller Foster, Dr. John Ewing, & Dr. Priya Sharma

There are over 13,000 agricultural educators across the United States (NAAE, 2022). We teach in diverse locations from small villages to large cities and everything in between. We teach in varied environments from classrooms to diverse laboratories including greenhouses, agricultural mechanics shops, and large animal facilities. We work with diverse populations and topics from children to adults exploring plants, animals, streams, solar panels, and everything in between. No matter the place or pupil, we all share in the gift that teaching agriculture affords us: our classroom is the world, and what matters locally, becomes our curriculum. Our enduring goal is to ensure that every student leaves our program career ready, but what does it mean to be career ready in 2023? Is it passing our classes? Running an experiment? Keeping a budget? Perhaps it's not solely the skills imparted, but the dispositions acquired. More and more sectors are placing a value on intercultural and global competence. The next generation must be prepared to enter an ever-evolving and globally connected economy. While we must continue to teach locally, as agricultural educators we must also acknowledge that we are tasked to prepare our learners to think globally.

> The next generation must be prepared to enter an ever-evolving and globally connected economy.

Resources

The calls for global learning integration are echoing in every instructional subject area. Some subjects like foreign languages and social studies have advantages of foundational instructional obligations on the study of different cultures for the improvement of global perspectives (Gibson et al., 2008). At first glance, agriculture seems to be a subject area with hurdles to go global, but agriculture is surprisingly very well situated to do so.

Take for example the work of some educators who are adapting their curriculum to follow frameworks like that of the United Nation's Sustainable Development Goals (Cochran et al., 2020; Knobloch et al., 2020; Petillion et al., 2019;). The 17 goals for the 2030 Agenda are each designed to lay out targets and indicators for meeting global challenges. Many of the goals turn their attention directly toward our agricultural systems, and all of the goals are connected within a degree of separation in some way.

An agricultural educator working in a small town can introduce a global issue, connect it to the relevant Sustainable Development Goal (SDG), and bring the topic down to the local level by highlighting the connection to the challenges students see every day around them. SDG 14: Life Under Water may seem beyond the grasp of the student whose house is surrounded by a corn field, but when the connection between aquatic habitats in one corner of the world becomes real when compared to the creek that borders one of the corn fields, the comparison becomes clear.

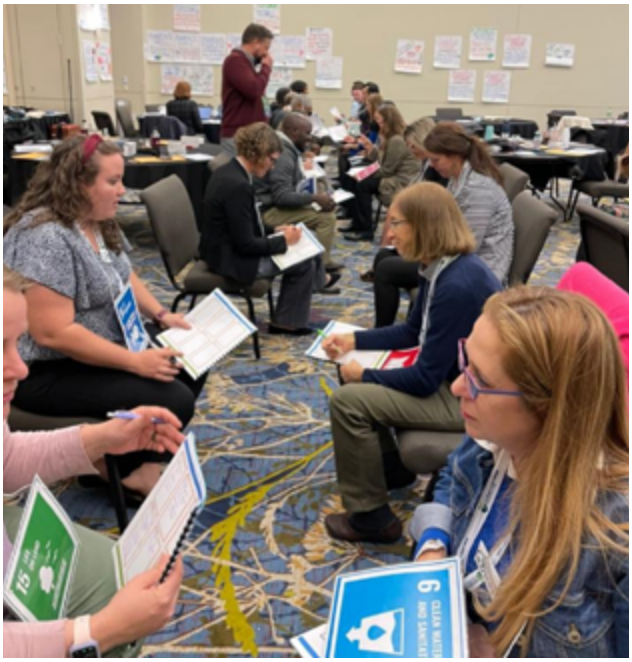
Another example could be an agricultural educator who teaches a unit on staple food crops where rice can connect a student in Louisiana to the Mekong River Delta in Vietnam (Minh et al., 2022). Students in Texas studying wind turbine installation on farms can learn from producers in the state of Gujarat in India who are doing the same. Resources tied to the SDGs are plentiful and starting with the United Nation's website for the goals and working outwards towards texts like "Empowering Students to Improve the World in Sixty Lessons" by Fernando Reimers are tangible steps for us to take our instruction global. Training and support can help us as agricultural educators advance this cause.

Community

Professional organizations are offering training and support to help us think globally. The National Association of Agricultural Educators (NAAE) in partnership with the Global Teach Ag Network devoted an entire pathway for glob-

al learning in agriculture at this past NAAE Convention. Participating educators each day of the convention were guided through workshops covering topics from virtual immersion experiences to a primer for the Global Youth Institute from the World Food Prize Foundation (WFPF). WFPF's Global Youth Institute is a week-long conference focused on youth and global food security efforts, but it's not just an opportunity exclusively for those who can make the trip to Iowa (World Food Prize Foundation, 2022). They also work with state leaders to manage a nationwide effort where each state holds institutes to provide a stage for students to discuss their research and support educators who want to give their students who think globally a chance to learn from leaders about diverse agricultural systems, climate change, and sustainability.

Between professional development and outlets for student success, we have options and opportunities to plug in, but studies comment that a professional learning community can mean



(TOP) Teachers in a global learning workshop at NAAE work through a planning exercise for Global Youth Institute submissions. Led by Abby Turner with the World Food Prize Foundation, teachers learned about the program and gained insight into the process for selecting a country and issue to focus a research study towards.
(MIDDLE) Students stand on El Castillo at the ancient Maya site of Xunantunich during their trip to Belize as part of #AgEd2Belize. As part of a combined effort between CELA Belize, GTAN, and the Center for Professional Personal Development at Penn State, students enrolled in an embedded course on Indigenous Knowledge and Agricultural Education that was capped off with an experiential component abroad.
(BOTTOM) Teachers in the fourth cohort of World Food Prize Foundation Global Guides program exchange ideas on local contexts and connections to the United Nation's Sustainable Development Goals. Educators from around the world applied to become a Global Guide and transform their instructional design and delivery through a commitment to a global perspective and the community of educators supporting global learning in agriculture.

the difference between trying something once and committing to a sustained effort (Snow-Gerono, 2005). The Global Learning in Agriculture (GLAG) community facilitated by the Global Teach Ag Network (GTAN) brings together member educators representing over 46 countries. Professional learning takes place in the digital platform (available both in the browers and on the app) bringing together educators from all contexts and disciplines to connect in a way that helps make global learning impactful and meaningful. There is opportunity for members to explore the complementary programs for global learning advancement including GLAGjr., GLAGreads, and GLAGcreates.

GTAN also offers opportunities to in-service educators to participate in a comprehensive professional development program through the WFPF Global Guides program which is starting its fifth cohort. We don't need to leave our country to improve global perceptions and become better equipped to teach globally, but the proof is in the research, and immersion experiences increase confidence in educators to integrate global learning into their instruction. GTAN works with partners to provide contextually-relevant experiences for agricultural educators.

Landing

Global Agriculture is a big topic and we often pause when approaching how to bring such a large conversation into our classrooms, but the topic becomes manageable with the help of a community. Our first steps toward going global can include:

1. **Heading over to the United Nation's Sustainable Development Goals website at** https://sdgs.un.org/goals.
2. Check out each goal, identify those that have pressing local relevance, and allow students to explore ways they can address the goals through local programs and partnerships. A Supervised Agricultural Experience can integrate an SDG very easily!
3. **Attending professional development opportunities with professional associations like NAAE.** One workshop with exposure and training with one resource is a step in the right direction to build confidence in teaching globally. Professional development opens the door to other opportunities once you know what to look for in continuing professional education needs.
4. **Participating in the World Food Prize Foundation's Global Youth Institute.** By giving your students the chance to write a research paper that can take them from your classroom to the Global Youth Institute in Iowa. One paper can unlock a global mindset in a student who might be the next World Food Prize winner.
5. **Joining the Global Learning in Agriculture Community facilitated by the Global Teach Ag Network.** Joining gives you access to great programs and a community of professionals who can help you build connections and gain the resources you need to open your classroom to the world. Joining GTAN, unlocking the GLAGjr. modules, and applying to be a Global Guide can be done in an afternoon and is for educators of any discipline, context, and geographic region!

The model for Global Competency from the Asia Society (2005) describes a journey from the investigation of the world, to recognizing perspectives, communicating ideas, and taking action. We must continue to take action in preparing our students for career readiness, and given the continual prominence of global connectivity, it's vital that we act now. From resources to communities, the tools are out there. The question is: what will it take to give our students a chance to leave our programs with a global perspective? Our answer is to teach locally and think globally.

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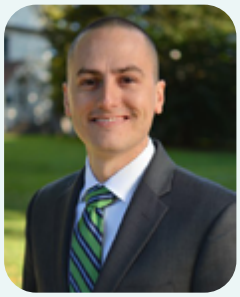

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Nutrition and Food Literacy in High School Classrooms: Empowering Students by Building on Food Systems Education

by Erin Bergquist

Agricultural educators have a unique opportunity to explore environmental, agricultural, nutritional, and health-related issues. While many agricultural education classrooms cover topics associated with agriculture and food systems, as well as nutrition and health, bridging the gap between food choices, personal health, and environmental impact remains challenging (Colatruglio & Slater, 2014; Smith et al., 2022). Nationally, less than 10% of youth meet USDA-recommended servings of fruits (7.1%) and vegetables (2.0%) per day (Lange et al., 2021). However, studies suggest that youth with greater nutrition and food literacy possess healthier dietary practices and make more nutritious decisions (Bailey et al., 2019). Moreover, nutrition and food education during adolescence has the potential to positively influence nutrition behaviors that endure into adulthood (Bailey et al., 2019; Utter et al., 2018; Worsley et al., 2015). Considering that pro-environmental attitudes and behaviors develop in childhood and evolve throughout early adulthood (Otto et al., 2019), high school provides an ideal platform to nurture knowledge, attitudes, skills, and habits that support individual well-being and planetary health. By including nutrition and food literacy in the classroom, educators can empower adolescents to consciously navigate their food environment. This article explores tools and strategies that can be implemented in high school classrooms to foster nutrition and food literacy, while building on a food systems foundation.

Understanding Nutrition and Food Literacy

Nutrition literacy focuses on a person's access to information and skills to help make nutritious decisions (Silk et al., 2008). Cullen et al. (2015) define food literacy as

> *"the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan to navigate, engage, and participate within a complex food system. It is the ability to make decisions to support personal health and a sustainable food system considering environmental, social, economic, cultural, and political components (p. 143)."*

Nutrition literacy focuses on knowledge and skills that offer a stepping stone toward competence in food literacy (Krause et al., 2016). Research in food literacy shows the integration of knowledge, skills, attitudes, and habits in daily life are essential factors for healthy lifestyles (Contento, 2008; Krause et al., 2016). While nutrition and food literacy include a wide variety of dimensions and aspects, most studies agree that both critical knowledge (i.e., emphasizing information acquisition and understanding) and functional conceptions (i.e., skills and choice-making abilities) are essential elements (Truman et al., 2017). In addition, interactive food literacy (i.e., knowledge builds skills, which then improve health) (Slater, 2013)), which includes activities such as cooperative learning, storytelling, sharing meals, and creating community are supported by the literature (Krause et al., 2016). Figure 1 presents dimensions that should be addressed in nutrition and food literacy and a conceptual model of where food literacy can fit into a food systems framework.

Research-Based Classroom Practices to Foster Nutrition and Food Literacy

- Include key nutrition and food literacy constructs. Five major topic areas of including basic knowledge of the food system and food supply chain; skills in cooking, planning, and budgeting for nutritious food; understanding the nutrition facts label and having a basic understanding of the composition of food; understanding of the impact of food choices on both human and planetary health; and finally, a social understanding of the influence of cultural aspects of eating habits (Krause et al., 2016).
- Consider a constructivist teaching approach. Research suggests that when nutrition literacy is taught using examples that build on students' previous knowledge and real-life examples that surround them, students have a more positive learning experience (Jack & Lin, 2017; Kurt et al., 2022). Integrating nutrition and food literacy into school gardening and cooking activities has increased food literacy competency and improved aspects of participants' personal and mental health (Lam et al., 2019).

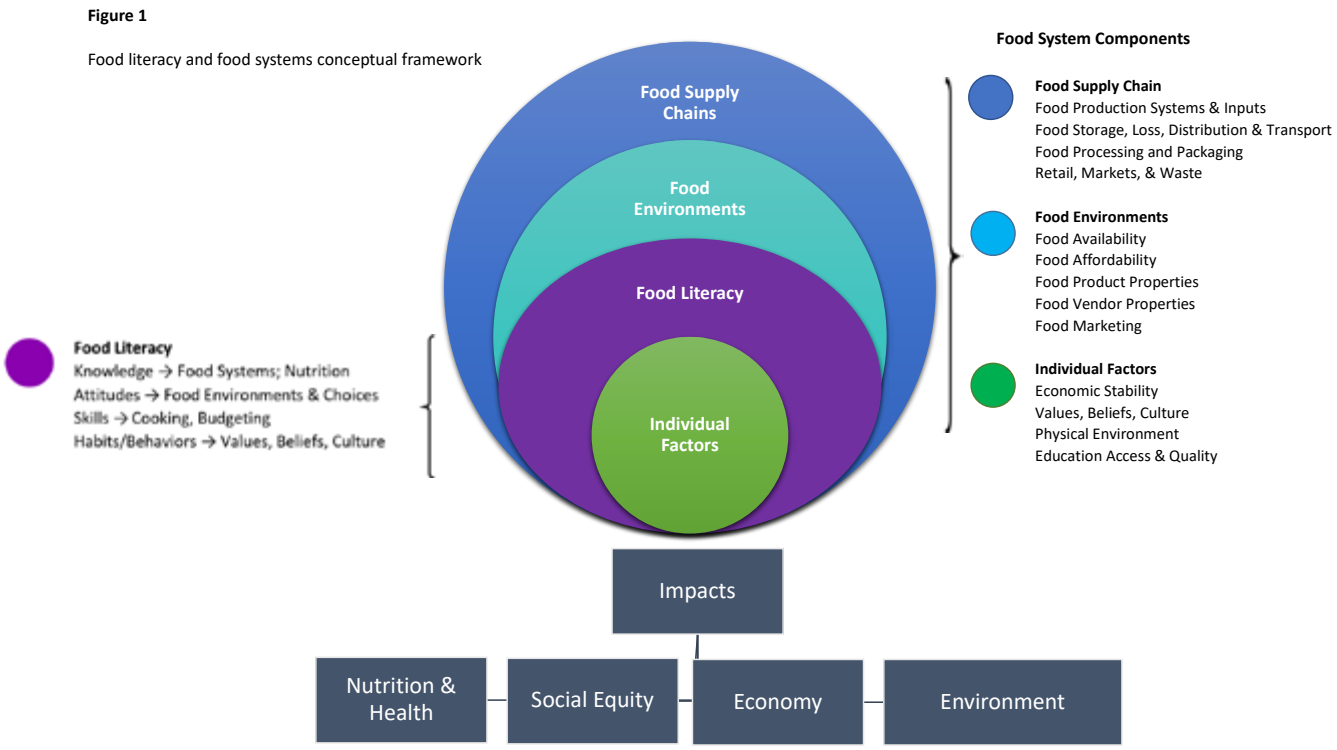

Figure 1. Food literacy and food systems conceptual framework to assist with planning effective educational programs.

– Adapt an assessment tool. While numerous validated tools exist to assess nutrition and food literacy, there is a lack of tools specifically developed for youth in the U.S. Nevertheless, tools developed and validated for young adults in Denmark (Stjernqvist et al., 2021) and Iran (Ashoori et al., 2020) could be modified for use in the U.S. Using an instrument to collect data about current food literacy levels empowers educators to tailor instruction and interventions, providing better support for students' needs. Additionally, the data collected can be used to evaluate the impact of nutrition literacy interventions over time.

Curricular Options and Resources

Nutrition and food literacy curricular options can be implemented in part, or in whole in the high school classroom. Teens CAN: Comprehensive Food Literacy in Cooking, Agriculture, and Nutrition (Grades 9-12), is a food literacy curriculum designed to be used with agricultural and cooking spaces. Three modules are designed to stand-alone but can also be used as part of a comprehensive curriculum. Using an inquiry-based teaching style, the facilitator leads learners in discovering concepts (Ruiz et al., 2021). Teen Food Literacy Curriculum includes discussion guides and instructions for facilitating a 16-session course, including food literacy, advocacy, and leadership. The curriculum aims to help develop teen mentors and leaders equipped to support their peers around issues related to food equity and security (Lipman et al., 2019).

The Food Literacy Center in Sacramento, California, teaches nutrition and gardening skills to children in 16 under-resourced elementary schools. Aimed at elementary school-aged children, their Lessons & Curriculum tab offers ideas to be adapted for older students (*Food Literacy Center*, n.d.). The Food Literacy Project's Youth Community Agriculture Program provides food-based education for immigrant and refugee students in Louisville, Kentucky. Their resources tab lists various hands-on activities to engage in nutrition and food literacy activities (*The Food Literacy Project*, n.d.).

Conclusion

By building on the foundation of food systems education, high school agricultural educators can effectively foster nutrition and food literacy in their classrooms. Equipping students with the knowledge, attitudes, skills, and behaviors to make informed and healthful food choices positively influences their individual well-being and contributes to our planet's sustainability. Utilizing research-based classroom practices and validat-

ed assessment tools ensures a comprehensive and meaningful approach to nutrition and food literacy education. As educators, we have the opportunity and responsibility to inspire a knowledgeable and empowered generation to shape a healthier and more sustainable future for themselves and the world around them.

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Journey of a Gene: A Resource to Teach Genetic Engineering in Plant Science

by Leah Sandall, Dr. Luqi Li, & McKinzie Sutter

As teachers, we know teaching a new topic isn't as easy as deciding to bring it into the classroom one day. Adding a new topic to a class takes some serious preparation whether that's improving your own knowledge, finding resources and lesson plans for the topic, or creating a lesson from scratch. Depending on what you know about the subject and how many resources you're able to find, this could be a large time investment! There's often not enough time in a high school teacher's schedule between the requirement to address specific education standards, curriculum and classroom limitations, multiple course preparations, and balancing other extra-curricular responsibilities to add a new topic to their classroom. So even with the desire to incorporate new topics, it may be difficult to do unless there are high-quality preexisting resources to use.

Back in the early 2000's, teachers searching for science-based genetic engineering lessons for high school classrooms were likely to encounter resources on the pros and cons of using genetic engineering and not as likely to find resources on the laboratory and field processes associated with creating genetically engineered organisms. This meant many teachers added GMO debate-type lessons to their classroom rather than lessons on the scientific methods used to create genetically engineered plants.

Images such as these are included in the resource to help convey the steps in the process.

Creation of the resource

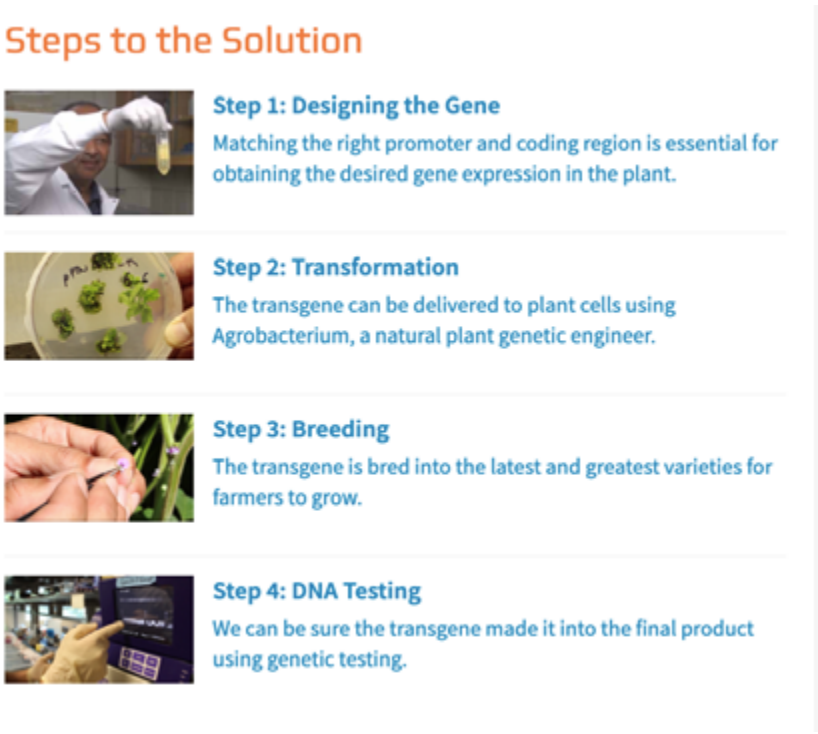
The journey of making science-based genetic engineering resources for teachers started in 2013, when a graduate student, Grace Troupe, thought to herself that there must be a way to empower high school teachers to teach genetic engineering of plants beyond the usual GMO classroom debates. Grace accomplished this thanks to a grant between Iowa State University and the University of Nebraska-Lincoln and the collaboration among computer programmers, plant breeders, genetic engineers, videographers, and teachers. The primary objective was to create a scientifically accurate resource that explained the genetic engineering process at a level that was approachable for high school students and the public and to make it available for free. The result was the *Genetic Engineering: Journey of a Gene* (https://ge.unl.edu/journey-of-a-gene/) resource!

Design of the resource

The Journey of a Gene centers around the issue of Sudden Death Syndrome in soybeans and how genetic engineering can be used to address this plant disease. Grace intentionally designed the *Journey of a Gene* platform to be accessible on all devices and with a consistent layout for easy navigation by the learner. *The Journey of a Gene* consists of 4 steps:

1. Designing the gene
2. Transformation
3. Breeding
4. DNA Testing

Each section has short videos (15 minutes or less) that teach the genetics concepts behind that step of the process, a video that



helps students learn about the processes that happen in the lab or in the field, a glossary list, and a quiz students can complete and send to an email address (e.g. teacher's email). These features were carefully chosen based on indications from teachers that students needed shorter videos to help maintain attention, that glossary lists were a foundation for learning during the introduction to new topics, and the teachers needed something easily graded or auto-graded for assessment purposes in their classroom.

Research supporting the use of the resource

The impact of *The Journey of a Gene* on both the students and teachers was measured to determine the benefit to each.

Teacher perspectives

At the outset of Grace's project, it was clear high school teachers had an interest in teaching genetic engineering in their classrooms, though something was preventing them from doing so. Through informal discussions with teachers, a few themes came up – limited knowledge, time, and money. Scientific literature also pointed to these same broad barriers of knowledge, time, and money.

Many teachers hadn't received instruction on genetic engineering, which prevented them from creating lessons themselves and left them feeling uncertain about adopting lesson plans that required pre-existing knowledge of genetic engineering. In other words, they needed a lesson that taught the concept fully and didn't rely upon the teacher having background knowledge in genetic engineering. Teachers noted they struggled to find time to plan or create lessons as well as the time to fit them into the curriculum, which meant they needed a ready-made plant genetic engineering resource that was complete and one they could easily tailor to their classroom needs. Teachers also lacked funding for biotechnology activities, so whatever genetic engineering lessons they taught needed to be free. And finally, some teachers thought genetic engineering was too advanced to teach at a high school level and therefore hadn't considered teaching it. *The Journey of a Gene* was designed to address these barriers.

While working with teachers across the Midwest on genetic engineering education, Troupe et al. (2018) found the lack of time to gain knowledge and lack of confidence in their own knowledge were the primary barriers that prevented teachers from including the science of genetic engineering in their curriculum. Troupe et al. (2018) conducted surveys evaluating confidence of agriculture teachers across Nebraska, Iowa, and South Dakota and investigated how learning with *The Journey of a Gene* impacted their instruction. A pre-interview was conducted with agriculture teachers to learn about prior genetic engineering teaching. Interviewees then explored *The Journey of a Gene* and completed a check-in interview shortly after. A post-interview was conducted 7-11 months after the lesson was taught using T*he Journey of a Gene* in the classroom to evaluate impacts on teaching practices. Results from the study show that most teachers increased the amount of time spent teaching genetic engineering after exploring *The Journey of a Gene* as the teachers gained more knowledge related to the topic (Troupe et al., 2018). *The Journey of a Gene* also positively impacted instruction quality and improved teacher knowledge and confidence in teaching (Troupe et al., 2018).

Troupe et al. (2018) compared teachers' interview responses before and after completing *The Journey of a Gene*. When asked about the difference between a transgenic crop and a non-transgenic crop, one interviewee responded, "*The only difference is that at a genetic level, the genes themselves are different. Everything else is the same*." After completing *The Journey of a Gene*, the interviewee responded, "*A transgenic crop has genes from another organism inserted into the DNA as the desirable plant that you're working with. A nontransgenic has just regular DNA. Take corn for example. Their corn DNA is just corn DNA, and doesn't have any other DNA from another organism*." In addition, when asked about their knowledge gain, an interviewee reported, "*I had a basic idea of what happened. But as far as the actual, how does this gene get from this plant and how do they replicate it and test for it? And things like that? That was something I didn't really understand. Learned a lot about through this The Journey of the Gene*."

Student perspective

Troupe et al. (2016 & 2018) surveyed nearly 900 students from four college science courses (biology, genetics, plant science, and biotechnology) and found that *The Journey of a Gene* was effective in increasing student knowledge and shifting student attitudes to become more accepting of genetic engineering technology. The study measured attitudes towards genetically engineered organisms (GMOs) and knowledge about the process of creating GMOs. Half of the students were given a pre-survey prior to learning T*he Journey of a Gene*, and a post-survey was completed by the other half of the students. They found an increase in scores across questions asked in the post-survey, suggesting that the online learning through *The Journey of a Gene* was effective in improving basic knowledge about genetic engineering. Although results varied by gender, background, trust in government safety regulation and primary information source

on genetic engineering, an overall increase in accepting attitudes toward GMOs was found among students who experienced *The Journey of a Gene*. The results from Troupe et al. (2016) demonstrate that genetic engineering attitudes are not static among learners but can become more positive through education.

Using The Journey of a Gene in your classroom

In 2020, the Sudden Death Syndrome story in *Journey of a Gene*, and the companion resource Enviropig, were published in Natural Sciences Education journal.

The Journey of a Gene resource is full of learning opportunities for students and teachers. A few ways it can be used in the classroom include:

- Self-paced learning activity for students to go through the steps of the genetic engineering process – students can be assigned the four primary steps and complete the associated quizzes in each step outside of class time.
- Teachers can use individual videos (presentations or in the field or lab) in the classroom as a support for live instruction.
- The Risks and Benefits section can expand the structure of debating pros and cons of GMOs beyond the usual classroom debate.
- Lesson plans using *Journey of a Gene* – See lesson plans 10 and 11 at https://go.unl.edu/biotechlessonplans. Additional biotechnology lesson plans are located on this webpage.

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Tools for Building Empathy in the Classroom and Navigating Conversations About Controversial Agricultural Issues

by Dr. Jean A. Parrella, Carrie N. Baker, Dr. Holli R. Leggette, & Dr. Deb W. Dunsford

Certain food, agricultural, and natural resource-related issues have become increasingly polarized. Conversations around these issues often elicit emotional responses that incite debate and create division between agricultural and non-agricultural audiences. As agricultural educators, it is our responsibility to prepare students as effective, informed representatives of the industry. Therefore, we must equip students with tools necessary for engaging in civil conversation about polarized issues. Research suggests that active role-play exercises can improve empathy and communication skills. For two semesters, we developed and implemented four active role-play exercises about controversial case studies in two agricultural communications courses. We provided students with resources representing opposing views of each case. Students in the treatment group adopted a persona representing one view and engaged in a conversation with a partner who adopted a persona representing the opposing view (e.g., company representative vs. consumer affected by food-borne illness). Students in the control group engaged in a class-wide discussion after reviewing the same resources. Despite their personal views, we challenged students to engage in civil discourse, or discuss how they would engage, using communication strategies learned in lecture and guiding, reflective questions. Paired-role play exercises and class-wide discussions both significantly increased students' (n = 53) cognitive empathy skills. Role-play exercises can easily be adapted to address many issues that require empathic skills during discussion. Because of their active, playful nature, role-play exercises would be well-suited for middle and high school agricultural education students.

For more information:

For more details about the case studies, lecture materials, and role plays read our *Journal of Applied Communications* article, Improvisation for Agricultural Communicators: Investigating the Effect of Paired Role-Play Discussions On Students' Empathy Development Using a Quasi-Experiment.

– https://doi.org/10.4148/1051-0834.2444

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Girls' & Young Women's Leader Identity Development: A Scoping Review

by Sakina T. S. Dixon & Dr. Jera Niewoehner-Green

Leadership development is an important part of agricultural education to support the next generation of food system leaders. However, girls and women can feel isolated from agricultural careers. We conducted a scoping review of the research to assess how girls and young women grow to see themselves as leaders. We found that their leader identity is related to four things: relationships, personal characteristics, meaningful engagement, and social identities.

There are several strategies agricultural educators can use to help girls develop as leaders.

- **Be a positive and caring influence**. Some students do not have many supportive adults in their lives. Your encouraging feedback could be the first time a student thinks of herself as a leader.
- **Reinforce the idea that girls are leaders.** Small acts like assigning girls to be group leaders or using their work as an exemplar to show the rest of the class can help their peers to see them as leaders too.
- **Address students' prior beliefs about leaders.** All students receive messages about what an ideal leader looks like from an early age. Having discussions about their beliefs and the experiences that led to those ideas is especially important for girls.
- **Involve parents and families.** We found that parents and family members were often the first people to see girls as leaders. Involve families in leadership development activities and ask students to talk with their families about the leadership qualities they see in them.

For more information about this study published in Gender in Management visit

- https://doi.org/10.1108/GM-03-2022-0108

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Instruction Based on Self-Efficacy Theory is Effective with Novices Learning Technical Subjects

by Dr. Christopher M. Estepp, Dr. Michael L. Pate, Dr. Donald M. Johnson, Dr. George W. Wardlow, & Grant T. Hood

Students can have issues mastering technical skills, such as those found in agricultural systems coursework. However, increasing students' self-efficacy (Bandura, 1986), or confidence in their ability to perform a task, has been shown to enhance students' learning, interest, and performance in technical skills. Self-efficacy can be developed via three types of experiences: 1) mastery experiences, 2) vicarious experiences, or 3) social persuasion experiences. Classroom instruction can be structured to provide all three types of experiences. Mastery experiences occur when a student successfully completes a task. Mastery experiences can be provided by breaking larger technical skills into smaller activities where students are able to achieve incremental success. These activities should provide appropriate challenge and support to help students achieve mastery. Vicarious experiences are when a student witnesses peers be successful at a task. These experiences can be provided by allowing students to work on technical skills in small groups or pairs and by announcing to the class when individual students have successfully completed an activity. Lastly, social persuasion is when a trusted individual provides encouragement and expresses confidence in a student's ability to perform a task. Social persuasion can be provided in the form of encouragement to students as they work on technical skills. We recently found (Johnson et al., 2023) that lessons using mastery, vicarious, and social persuasion experiences to foster self-efficacy increased students' interest, self-efficacy, and knowledge as they performed technical skills.

For more information about this study:

– https://doi.org/10.9741/2578-2118.1125

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Grant T. Hood – University of Arkansas

Conducting Research Near and From a Far: Agricultural Education in International Settings!

by Dr. Paula E. Faulkner, JaQuan Battle, Tamirrah Cox, Dr. Jeanelle Joseph, & Dr. Robert Cobb, Jr.

Experiential learning provides students with a wealth of experiences. One example is research, which allows students to gain critical thinking and problem-solving skills while also honing their communication (written and oral) and technology skills. Inside and outside of our agricultural education classrooms, students (graduate and undergraduate) gain research skills. From conducting literature reviews, using APA to cite sources and list references, and completing CITI training for human subjects research to conducting interviews (qualitative) students explore various research topics to also research similarities and differences between U.S. and international agriculture topics during a study abroad.

To prepare for the study abroad with a main goal to put research into practice, the undergraduate students were paired with a research mentor based agriculture disciplines (Agricultural education, Animal Science, Sustainable and Land Systems and Animal Science). We began the research experience by holding a zoom session for students and research mentors to be introduced. The overall goal was for students to learn about and then present research findings on tropical agriculture in a tropical setting. We collaborated with researchers from the Faculty of Food and Agriculture at The University of the West Indies (UWI)-St. Augustine campus during the 2023 spring semester. Mentoring sessions were held virtually via Zoom and at times via email correspondences. For example, undergraduate agriculture education student JaQuan Battle, was mentored by Dr. Jeanelle Joseph of UWI to conduct research on the benefits of summer enrichment programs for Trinidadian and American youth. This research experience allowed JaQuan to be ready to present his research findings during the weeklong study abroad to T.A. Marryshow Community College (St. George's, Grenada) in May 2023. The other agriculture students researched topics focused on studying the practice for domesticating Capybara to gaining knowledge about ornamental production practices of Trinidian youth. As a result, each student expressed how beneficial they found the research experience for improving their problem-solving skills especially by presenting their findings in a setting different from their own and to individuals who have the knowledge of the research they conducted.

For additional information:

- https://nowgrenada.com/2023/05/tamcc-hosts-tropical-agriculture-study-abroad-mission/

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JaQuan Battle – North Carolina Agricultural and Technical State University

Tamirrah Cox – North Carolina Agricultural and Technical State University

Dr. Jeanelle Joseph – North Carolina Agricultural and Technical State University

Dr. Robert Cobb, Jr. – Associate Professor, North Carolina Agricultural and Technical State University

Bringing Science to Light for Agriscience Teachers and their Students through Content-Specific Professional Development

by Dr. Natalie K. Ferand & Dr. Catherine A. DiBenedetto

We know students need to be scientifically literate citizens, but sometimes their science classes are taught in a way that leaves them puzzled about how to apply what they learned to their daily life. Agricultural education is the vessel through which technical skills, agricultural content and core science concepts can be taught in unison. Science illumination, or the ability of a teacher to teach technical agriculture content and core scientific ideas in unison, has been found to positively impact students' achievement in both science and agriculture concepts, while also influencing students' desire to learn science in agriculture. However, in order to be an effective illuminator, agriscience teachers must understand both the science and agriculture concepts. Science illumination can occur across an entire course, one unit of instruction or even in small increments as a single activity within a daily lesson. No matter the format, illuminating science within agriculture is beneficial for students to become scientifically literate citizens to transfer and apply what they learn to their life and future careers. Content-specific professional development can help agriscience teachers deepen their knowledge of the science in agriculture and learn to illuminate science in their daily teaching practices.

For more information:

Ferand, N. K., DiBenedetto, C. A., Myers, B. E., & Barry, D. M. (2022). Implications of science illumination on student content knowledge of technical floriculture and core scientific ideas. Journal of Agricultural Education, 63(2), 169–185. https://doi.org/10.5032/jae.2022.02169

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Included additional information:

Program YouTube video

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Dr. Catherine A. DiBenedetto – Associate Professor of Agricultural Education, Clemson University

Integrated School Gardens Increase Student Learning Outcomes

by Jade Frederickson & Dr. Jason Peake

Our work focuses on how teachers use school gardens in their elementary agricultural education classrooms. We found that most teachers said administrative support was crucial to their garden's success. They also relied on community organization resources to support their school garden (e.g., garden bed construction supplies). Several teachers experienced frustration inheriting a garden not suitable for teaching (e.g., far from classroom). A few teachers indicated caring for the garden over the summer was a challenge. Despite these frustrations, teachers stated students enjoyed the tasting component of the garden. Incorporating cooking time with the garden harvest introduces nutrition education.

Generally, this work revealed several key themes that educators looking to start a garden should know:

- **Administration** – Be sure to get the administration on board. Often, they provide a crucial connection to other resources that will help sustain the garden in the long term.
- **Champion** – Remember to establish a team who will care for the garden. Life changes, and when you or whoever oversees the garden moves on, a plan must be in place.
- **Resources** – Don't forget to create a funding plan. Small grants can help kickstart the program, and local businesses are often generous in providing material support!
- **Standards** – Well-integrated gardens are used throughout the school. Work with other teachers to establish how the garden can be used in their classrooms.
- **Time** – Gardens are a wonderful learning opportunity, but before starting, ask who will maintain the garden and how it will be cared for in the summer.

For more information:

- https://doi.org/10.37433/aad.v4i1.281

Jade Frederickson – Research Assistant, University of Georgia

Dr. Jason Peake – Professor of Agricultural Education, University of Georgia

Roll For Initiative: Using Game-Based Learning in the Classroom

by Garrett Hancock

"How do you want to do this?" is one of my favorite phrases. Commonly heard around a gaming table, this phrase is often associated with Tabletop Role-Playing Games (TTRPG). As an avid gamer, bringing game-like elements to the classroom is an exciting yet daunting task. Certain agricultural education lessons lend themselves to Game-Based Learning (GBL) techniques; however, the up-front time and effort may first appear insurmountable. In actuality, many of the lessons being taught in SBAE classrooms are already utilizing active learning techniques like role-playing or simulations. During a lesson overviewing ecosystems, TTRPG elements could be added where players act as a camping party and the instructor provides scenarios of an impending natural disaster, flash flood or tornado, to introduce both survival and natural husbandry skills. Lessons covering livestock or crop production also have opportunities to add GBL elements. For example, role-playing game elements have been applied virtually to livestock production topics leading to Oklahoma State University's Paker-Feeder Market Simulator. Across agricultural education, these active learning techniques are often used to explore careers and hands-on activities. While these lessons are successful in these formats, the addition of a set of rules or timely objectives to engage students with the material on a friendly competitive level is all that is needed to explore the world of GBL. Agricultural educators are already doing most of the legwork for Game-Based Learning lessons, maybe it is time to stop and ask ourselves "Would we like to do this?"

For more information:

- https://rpgclassroom.com/2019/12/24/national-curriculum-skills-met-by-role-playing-games/
- https://extension.okstate.edu/fact-sheets/upgraded-packer-feeder-marker-simulator.html
- https://www.youtube.com/watch?v=-X1m7tf9cRQ&feature=youtu.be

Garrett Hancock – Ph.D. Student, Auburn University

Seeds of Change: Effective Practices in Elementary Agricultural Education

by Maria "Len" Helm

Dive into the heart of elementary agricultural education (EAE) with our groundbreaking study, "Effective Teaching Practices According to Elementary Agriculture Educators: A Modified Delphi Approach." With a pulse on the vibrant classrooms of Georgia, this research unlocks the secrets of successful EAE teaching.

Picture this: a panel of seasoned EAE teachers huddles together, trading insights and ideas. Using the Delphi method, a consensus emerges from the spirited discussions, revealing the golden triad of effective teaching: experiential learning, reflective teaching, and a touch of affective personality. Now, imagine these principles coming alive in your classroom. Watch your students' faces light up as they connect with the agricultural content through immersive, hands-on experiences. Listen to the hum of animated conversations as discussions and collaboration weave a rich tapestry of learning. Feel the sense of achievement as your students apply their knowledge to real-world situations, their minds buzzing with critical thinking and problem-solving skills.

But wait, there's more! This study goes beyond mere techniques, exploring the profound impact teachers can have on students' lives. From promoting community awareness to creating connections between agriculture and other subjects, the role of the educator emerges as pivotal.

So, are you ready to revolutionize your teaching practice?

Dig into this study for an in-depth exploration. Let's sow the seeds of change together!

For more information:

- https://sway.office.com/K4czQK3d3aYFpzHT?ref=Link

Maria "Len" Helm is a Doctoral Candidate at the University of Georgia in the Department of Agricultural Leadership, Education & Communication. She has a teaching career spanning from preschool to college. She taught Chemistry and Biology at North Point High School in Maryland, and also taught Botany and Science and Society at the College of Southern Maryland. Originating from the Philippines, Len currently leads a service-learning course that integrates science students into the community, aiding teachers and inspiring students to engage in STEM fields. Her varied research explores elementary agriculture education, holistic teaching, and the neurobiological aspects of learning, intending to connect holistic teaching with neurotransmitters and hormones in future work.

Maria "Len" Helm – Doctoral Candidate in Agricultural Leadership, Education, and Communication, University of Georgia

Making Entrepreneurship Relevant Using a Board Game

by Dr. Neil A. Knobloch

Agriculture teachers engage students in experiential learning to help their students apply concepts learned in the classroom to real-world settings. Agriculture teachers face challenges to motivate their students to engage in Supervised Agricultural Experiences (SAE) and keep financial records. Bringing a board game into the classroom and having students play a business management simulation is one way to make learning authentic (Knobloch, 2003) and motivate students to learn how to keep financial records using double-entry accounting.

Different sections of eighth grade students in an exploratory agriculture course played The Farming Game®, but were assigned to keep records using two different methods—a check-book style entry with one account balance vs. double-entry accounting using a transaction register worksheet (Brown & Knobloch, 2022). Students completed a knowledge test before and after the unit, and a motivation assessment after the unit. Students' business management knowledge was higher for both groups and entrepreneurship intent was similar between the control and treatment groups after the two-week unit. However, students who previously completed a 4-H animal science project had higher entrepreneurship intent than their peers who did not complete a 4-H animal science project.

This study supports the premise that board games and educational simulations can effectively teach business management skills (Knobloch, 2005) and offers educators an enhanced understanding of how to capitalize on the value of SAEs and 4-H animal science projects when building entrepreneurial skills in youth. Students with SAE and 4-H project experiences can help them see the relevance of learning agricultural concepts in the classroom.

For more information:

Brown, A. H., & Knobloch, N. A. (2022). Effects of a simulation on eighth grade students' business management knowledge and entrepreneurial intent in an exploratory agriculture course. Journal of Agricultural Education, 63(2), 88-101. https://doi.org/10.5032/jae.2022.02088

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Dr. Neil Knobloch – Professor of Agricultural Sciences Education and Communication, Purdue University

Empowering Teachers to Transform Youth Safety Education

by Dr. Michael Pate, Dr. Scott Smalley, Dr. Dustin Perry, & Dr. Becki Lawver

A remarkable transformation in SBAE youth safety has occurred, conceived initially as a study aimed at collecting evidence regarding teachers' understanding of hazards, safety protocols, training experiences, and awareness of student injuries associated with supervised agricultural experiences (SAEs). This undertaking evolved into a train-the-trainer program spanning multiple years and states, specifically designed for SBAE teachers. The objective of this research-to-practice initiative was to equip teachers with the necessary tools to effectively deliver curriculum on a range of topics, including SAE risk assessment, tractor and machinery rollovers, ROPS (rollover protection system), PTO safety, ATV safety, agricultural implement operation safety, backing, and hitching techniques, as well as roadway safety for agricultural equipment. The program not only provided teachers with comprehensive curriculum materials and modeled hands-on activities but also afforded them the opportunity to educate their own students on agricultural safety. The impact was significant, as the program successfully reached over 1,400 SBAE students, resulting in a notable increase in their knowledge of agricultural safety practices. For educators seeking to enrich their pedagogical approach to agricultural safety education, and for those aiming to equip their students with essential knowledge and resources, free curriculum modules are readily accessible through the SAY National Clearinghouse. Additionally, the collaboration with The AET opens doors to further curriculum resources. This partnership facilitates SAE safety tracking, risk assessments, and the testing of agricultural safety knowledge for both teachers and students alike.

For more information:

– https:/doi.org/10.13031/jash.13113

Pate, M. L, Lawver, R. G., Smalley, S., & Perry, D. (2019). Agricultural Safety Education: Formative Assessment of a curriculum integration strategy. Journal of Agricultural Safety and Health. 25(2). 63–76, https://doi.org/10.13031/jash.13113 and https://pubmed.ncbi.nlm.nih.gov/32425478/

Dr. Michael Pate – Professor of Agricultural Systems Technology, Utah State University

Dr. Scott Smalley – Associate Professor of Agricultural Education and Studies, Iowa State University

Dr. Dustin Perry – Associate Professor of Agricultural and Technology Education, Montana State University

Dr. Becki Lawver – Department Head and Professor of CTE, Ag Education, Leadership Education, Utah State University

Effective Strategies for Participating in the National Chapter Award Program

by Emily Manuel

We recently consulted an expert panel of FFA advisors representing FFA chapters in NAAE Region II that attained a three-star ranking at the national level at least two of the five years from 2017-2021. The purpose of the study was to identify the strategies used by chapters to receive a three-star ranking. As a result, a list was compiled of 37 strategies that could be utilized by SBAE teachers to reach a three-star ranking in the NCA Program. Strategies were categorized into four themes: (1) Planning & Resources, (2) Implementing Activities, (3) Application Writing, and (4) Reflecting. These strategies have the potential to serve as a resource for FFA chapters competing in the NCA program. In the Planning & Resources theme, it was agreed upon by panelists that a Program of Activities should be used to systematically plan major activities throughout the school year. It was recommended from the Implementing Activities theme that FFA officers should be invested in the chapter activities and as many students as possible should have ownership of the activities. The Application Writing theme included strategies that suggest following the NCA rubric, integrating proper grammar, and selecting a uniform writing format for the application are critical to NCA success. Performing your own teacher reflection throughout the process while guiding students in reflection is also important to the success of a chapter in the NCA program shown by the Reflecting theme. It was also concluded from this study that teachers prefer to learn new information from peers; therefore, these resources should be easily accessible and disseminated through more teacher-led professional development opportunities when possible.

For more information:

- http://argo.library.okstate.edu/login?url=https://www.proquest.com/dissertations-theses/identifying-effective-strategies-participating/docview/2770954540/se-2

Materials:

- https://drive.google.com/file/d/1zkzSS0Fhqe3jNI-jf-3PyV1c-t082pUQF/view?usp=sharing

Since conducting this research, I have presented various workshops and lectures sharing these strategies. I will also attach a handout with the list of strategies and themes from this research that I have shared in those presentations. Please let me know if you need any additional information.

Emily Manuel – Ph.D Candidate in Agricultural Education, Communications & Leadership, Oklahoma State University

Increasing Accessibility through the SAE for All Dichotomous Key

by Kayla N. Marsh & Dr. K. Dale Layfield

Supervised agricultural experience (SAE) is an essential component of the comprehensive school-based agricultural education (SBAE) program, which provides opportunities for the practical application of work-based skills (Camp et al., 2000; Phipps et al., 2008). Despite the significant impact that SAEs can have on students' growth, SAEs continue to be a challenge for agriculture teachers (Dyer & Osborne, 1995; Rubenstein & Thoron, 2013; Rubenstein et al., 2014). Tools, resources, and curricula for agriculture teachers differ greatly between programs based on accessibility to time, funds, and support. However, teachers with an implementation plan report success and increased student motivation (Marsh, 2022). Rubenstein et al. (2022) developed and revised the SAE dichotomous key to align with SAE for All. They updated the SAE for ALL Dichotomous Key as a practical tool for SBAE teachers, reducing the time and challenge of idea generation and development from foundational to immersion SAEs. In 2022, we moved the SAE for ALL Dichotomous Key from a print-based medium to a digital format to increase its usability as an interactive tool in the 21st century classroom. The digital SAE for All Dichotomous Key was created as a PowerPoint show (.ppsx), allowing teachers and students access to complete the dichotomous key on any device as PowerPoint software is not required to view the interactive tool. These changes increase student access and provide teachers with a tool that is easy to implement in the planning phases of a student's SAE program.

For more information:

- Updating the Essentials: SAE for All Through a Dichotomous Key, p. 106 https://aaea.wildapricot.org/resources/Documents/Southern%20Region/2022SouthernConference/2022SRAAAE_PosterProceedings.pdf

Download a zipped version of this tool:

- https://tinyurl.com/2srtdv3f

Kayla N. Marsh – Graduate teaching and research associate, Oklahoma State University

Dr. K. Dale Layfield – Associate Professor of Agricultural Education, Clemson University

Using Research to Support Teaching

by Dr. Sallie McHugh & Dr. Farish Mulkey

Team teaching has been shown to improve both learning and teaching. From the student's perspective, team teaching allows for more active learning, contributing to greater student interest and engagement (Zadra, 1998). Team teaching is an ever-present trend in K-12 education as the disparity in the student-to-teacher ratio continues to rise across all levels (Winn & Messenbeimer-Young, 1995). Team teaching can encompass an interactive model where two or more teachers teach during instructional time. It aims to improve how the material is presented to the students, and collaboration has been recognized as a foundation for professional growth (Darling-Hammond & McLaughlin, 1995; Lieberman,1995; Roth et al., 2002).

The Abraham Baldwin Agricultural College (ABAC) agricultural education teacher preparation program utilizes this concept in two classes to model team teaching in the postsecondary classroom. Two professors co-teach two senior-level cohort courses, with both being present in the classroom during instructional time. Four cohorts were taught using the team-teaching method, and each was surveyed to evaluate student opinions on this teaching model's effectiveness. Overall, the respondents (n = 108) believed that team teaching was effective. Respondents indicated they received more insight from multiple perspectives on the same topic, and classes were always more enjoyable due to variations in teaching styles. This feedback was critical in maximizing an opportunity to better our practice. The students are our customers, and our teacher preparation program must intentionally seek feedback to better prepare them for their teaching role in the ever-evolving agriculture industry.

References

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Development in an Era of Reform. Phi Delta Kappan, 92(6), 81–92. https://doi.org/10.1177/003172171109200622

Winn, J. A., Messenbeimer-Young, T. (1995). Team teaching at the university level: What we have learned. Teacher Education and Special Education, 18(4), 223-229. https://eric.ed.gov/?id=EJ530774

Zadra, N., "Team teaching: A study of collaboration" (1998). Graduate Student Theses, Dissertations, & Professional Papers. 10539. https://scholarworks.umt.edu/etd/10539

Dr. Sallie McHugh – Associate Professor, Abraham Baldwin Agricultural College

Dr. Farish Mulkey – Assistant Professor of Agricultural Education, Abraham Baldwin Agricultural College

Using Interactive Virtual Tours of Agriculture and Food Science Facilities in the Classroom

by Kylie Harlan & Dr. Courtney Meyers

Field trips are a common experiential learning tool for students of all ages, but they are often difficult to execute due to various obstacles. Virtual tours can provide similar experiences and learning outcomes as traditional field trips while helping to alleviate most logistical challenges.

During a series of focus groups, we evaluated post-secondary students' perspectives of using an interactive virtual tour (IVT) of a cotton gin as a learning tool. After exploring the IVT individually for 15 minutes, students discussed their opinions of the tour and provided suggestions for improvement. While they noted nothing could replace a traditional field trip, they said IVTs can be a good alternative and supplement. Some students appreciated the autonomy the IVT experience provided them to explore at their own pace, while others wanted more structure. The IVT had a total of 22 "tour stops," with various content such as photos and short videos (30 to 50 seconds each) to text-only descriptions. Overwhelmingly, students said they preferred the video content to the photos and text, as they provided a lot of information in a short amount of time. These recommendations helped improve this IVT and other IVTs for the USDA grant-funded project. We have created tours of additional locations including a greenhouse, dairy plant, beef stocker unit, flour mill, and an aquatic and invasive plant research center. IVTs offer instructors an innovative way to connect more students with agriculture and food science facilities.

To view available IVTs and learn more, visit

– www.theivisitproject.com

Additional Resource:

– If you're interested in using these tours in your classroom, scan the QR code to complete a brief interest form.

Kylie Harlan – Lecturer in Agricultural Communications, Texas Tech University

Dr. Courtney Meyers – Professor of Agricultural Communications, Texas Tech University

Supporting Global Learning in Domestic Settings

by Dr. Melanie Miller Foster

Assumptions are occasionally made when it comes to global learning and should be challenged. For example, "culture" is often equated with "nationality"; therefore, to have an intercultural experience you must travel internationally. For many years, study abroad has been touted as the way to engage with people who are different from us. This assumption may have led some to believe global learning opportunities are out of reach for most of our students.

When these assumptions are challenged, new global learning opportunities for our students can emerge in our local communities. As Anu Taranath (2019) says in her wonderful new book, Beyond Guilt Trips: Mindful Travel in an Unequal World, "Racial, economic, and cultural differences are often much closer at hand; one need not travel twelve thousand miles...sometimes, a mere twelve miles will do just fine." Intentional facilitation of intercultural experiences makes a much bigger difference than how far we can travel.

One favorite in-class intercultural activity is something I call "Rapid Exchanges." Working with a local community organization that offers English language tutoring to adult learners, I invite students and their language teachers into class for a speed-dating style conversation. The reflections from the participants that come out of this brief encounter evidence that these rapid yet positive encounters with difference have sparked student curiosity and show that it is possible to meaningfully engage with difference right in our home classroom. What assets and resources are available in your learning environment that could be leveraged for intentional, intercultural experiences?

For more information:

Taranath, Anu. (2019). Beyond Guilt Trips: Mindful Travel in an Unequal World. Lutsen, MN: Between the Lines Publishing. 208 pages.

Dr. Melanie Miller Foster – Associate Teaching Professor, Penn State University

Cooperating Teacher Preparation and Support

by Heather Nesbitt & Dr. Debra Barry

Cooperating teachers, also known as mentor teachers, play a significant role in the student teaching experience (Clarke et al., 2014). The decision to enter the profession and the student teacher's self-efficacy can be greatly influenced by the cooperating teacher (Edgar et al., 2011; Kasperbauer & Roberts, 2007; Roberts, 2006; Rocca, 2005). Student teachers who have a positive student teaching experience and develop a higher self-efficacy are more likely to enter and remain in the classroom (Swan et al., 2011).

The University of Florida implemented a cooperating teacher preparation and support program in 2018, which now includes onboarding meetings, a pre-internship workshop with their student teacher, biweekly emails with infographics, monthly zoom meetings, a cooperating teacher manual, and a cooperating teacher website. This program has anecdotally allowed for greater mentorship efforts by cooperating teachers to dive deeper into pedagogy and program management with their student teacher. Additionally, university supervisors have been able to focus their conversations on greater teacher development.

Through this research, we have been able to identify best practices in the areas of social support, professional support, and role modeling, as well as investigate how they are implemented (Alemdag & Simsek, 2017; Barry, 2019; Russell & Russel, 2011). Cooperating teachers recognize that they are demonstrating the day-to-day aspects of their roles as an agriculture teacher. However, they feel the pressures of their fast-paced classrooms and acknowledge that they need to slow-down and spend more time on explaining their philosophies and methodologies of their roles (Nesbitt et al., 2022).

For more information:

- https://doi.org/10.37433/aad.v3i4.261

For resources and additional information, visit

- https://www.ufcooperatingteacherssupport.com/

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Swan, B. G., Wolf, K. J., & Cano, J. (2011). Changes in teacher self–efficacy from the student teaching experience through the third year of teaching. Journal of Agricultural Education, 52(2), 128-139. https://doi.org/10.5032/jae.2011.02128

Heather Nesbitt – Doctoral Candidate in the Department of Agricultural Education and Communication, University of Florida.

Dr. Debra Barry – Assistant Professor in the Department of Agricultural Education and Communication, University of Florida

Why Are Some Eggs Brown?

by Makeda Nurradin

"Why are some eggs brown?"Agricultural literacy is a pressing concern as the general population becomes increasingly disconnected from agriculture. Research conducted with food pantry recipients revealed a lack of agricultural knowledge, particularly regarding food labeling and nomenclature. Through observations and informal interviews conducted at a food pantry, it was evident that participants had numerous questions about labeling and nomenclature, such as GMO, organic, and local. This study identified an opportunity to address these knowledge gaps by implementing educational initiatives in community centers and food pantries. By leveraging existing resources and engaging with the public through workshops and personalized interactions, we can promote agricultural literacy and enable individuals to better understand and appreciate the intricacies of food production and sourcing.

Teachers can incorporate lessons and activities focused on agricultural literacy to deepen students' understanding of food production, labeling, and nomenclature. Engaging discussions, interactive exercises, and real-world examples can connect classroom learning to the broader agricultural context. Additionally, experiential learning opportunities such as farm visits and community gardens can provide students with firsthand exposure to agricultural practices, fostering a deeper appreciation for agriculture and potential career paths.

By incorporating research-informed teaching practices and resources, educators can enhance students' agricultural literacy, equipping them with the knowledge and skills needed to make informed decisions about food and sustainable agricultural practices. Addressing the agricultural knowledge gap in the classroom contributes to building a more agriculturally literate society that values and supports the agriculture industry.

Makeda Nurradin – Ph.D. Candidate in Agriculture Education, Auburn University

Gender Perspectives Related to Agricultural Mechanics Instructors

by Dr. Don Edgar & Dr. Michael L. Pate

Careers in agricultural mechanics have traditionally been perceived to be reserved for males. However, the number of agricultural education instructors identifying as female has increased yet the courses involving agricultural mechanization have not typically been taught by females. Many high school programs continue to emphasize STEM based courses such as agricultural technology and mechanics. With higher enrollment trends of secondary students identifying as female, it is paramount to increase the number of female agricultural education teachers for agricultural technology and mechanics courses. Research studies conducted in post-secondary welding courses examined the differences in students' preferences of instructor gender. A female instructor taught one section of the course while a male instructor taught a different section. At midterm, these instructors switched sections to teach the remaining course content. Notably, a higher proportion of female students indicated a preference for having a female instruct the course. Prior to the instructor switch, male students preferred a male instructor, but this changed after the female instructor taught their section. Anecdotal evidence showed that female students seemed to value having a female instructor and it was further displayed that they reached out to the female instructor more often even when the class was turned over to the male instructor. This research begins to identify valuable positive experiences for female students who may enroll in agricultural mechanization courses. This has the potential to encourage female students to enroll, learn, and gain competency in career fields such as agricultural and biological engineering.

For more information:

- https://doi.org/10.26076/6311-f7d6

Dr. Don Edgar – Professor of Agricultural Education, New Mexico State University

Dr. Michael Pate – Professor of Agricultural Systems Technology, Utah State University

2023 FFA Advisor Needs Assessment

by SeeTrail N. Mackey, Abigail Girardot, & Olivia Power

In spring 2023, the National FFA Organization conducted an online survey to identify and assess the current needs of FFA advisors and agriculture. Teachers can use this research to support their endeavors with fellow teachers, including understanding the changing makeup of individuals in the agricultural educator profession, sharing resources to address student needs, and planning professional development opportunities. Respondents identified themselves into one of three categories: licensed educators (83%, N=1,985), alternatively certified educators (14%, N=343), or special grant/permission or emergency certified educators (3%, N=63). Responding teachers answered questions about their students who are ESL/ELL or have IEPs; our findings indicate that less than half feel they have enough resources to address these students' needs. Teachers were also asked about professional development opportunities and factors influencing their participation. The top five professional development topic areas advisors want to engage in were SAE for All, Implementation of FFA as intracurricular, cross-curricular projects, game-based learning, and self-care for teachers. Almost 90% said they would participate in a teacher mentorship opportunity if there were no barriers. This study has identified the current needs of agriculture teachers across the nation, and directs those looking to support teachers to areas of concern across the country.

For more information:

– https://ffa.box.com/s/po3yca-201l5y65ieaxh7go5dk3a8hz93

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Emotional Exhaustion and COVID-19

by Dr. Colby Gregg, Dr. Katrina Swinehart-Held, & Dr. Justin Pulley

Our research focused on teacher perceptions of administrative actions during COVID-19 and its impact on emotional exhaustion. We found teachers experienced a neutral overall reaction from their administrators' actions (SAA), had high levels of self-efficacy (TSE), moderate levels technological pedagogical content knowledge (TPCK), and moderate levels of emotional exhaustion (EE) before and after the beginning of the pandemic. Teachers reported a significantly higher level of emotional exhaustion approximately 8 months after the beginning of the pandemic. We found administrators' actions had a significant relationship on teachers TPCK and EE, and teachers TPCK had a significant relationship on TSE. This research has been used to create professional development opportunities to help teachers reflect on what worked, what didn't work, and what they would change or keep. The resource below was used with teachers to identify what they tried for the first time, if they would like to do it again, what they will never do again, and what they would like to change for next year.

– https://drive.google.com/file/d/1Jh6XZClKLuxE5__d1EaaGKq0E4cP7C0Z/view?usp=sharing

They then brainstormed in groups to determine what were SAE, FFA, and Classroom concepts and activities to remember that other teachers had discussed. Teachers then had the opportunity to reflect on strategies they used to de-stress and come up with self-care strategies to reduce emotional exhaustion in the upcoming year. Take a moment to identify what did and didn't work for you and develop some strategies for the upcoming year!

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Dr. Katrina Swinehart-Held – Assistant Professor of Agricultural Education, Central State University

Dr. Justin Pulley – Assistant Professor of Agricultural Mechanics, Tarleton State University

Georgia High School Counselors' Perspectives on Agricultural Education

by Jacob "Cole" Lowery & Dr. Andrew Thoron

Counselors have a positive perception of agriculture being taught in their schools and are supportive of all students (regardless of academic ability) enrolling in SBAE classes. Counselors believe that college bound students and academically challenged students benefit from high school agriculture courses. They also perceive parents of college bound students are reluctant to have their child enroll in SBAE courses. Based on this, it's important to share career opportunities in agriculture with parents who intend their child to attend college. It's equally important to outline how SBAE can help their child develop career aspirations, and learn life and agricultural skills that prepare them for their next steps. Further, it was found that counselors were less aware of scholarship opportunities through FFA and agricultural organizations (local, state, and national). Teachers can use these opportunities to help educate parents of the positive implications of enrolling in and considering agriculture as a major in college.

In Georgia, the state DOE staff has started to hold annual events to educate counselors through special programing and tours to agricultural college campuses to learn more about job opportunities and careers for BS degree graduates. Further, they have expanded that to include scholarship bulletins and awareness. The key is to reach parents of potential students. Positive impacts include social media by local FFA chapters, Agricultural programs to highlight past graduates and make scholarship announcements so that the general public can see the opportunities.

For more information:

– [2022SRAAAE_PosterProceedings.pdf (aaaeonline.org)]

Jacob "Cole" Lowery – Agriscience Teacher, Northwest Whitfield High School, Tunnel Hill, GA

Dr. Andrew Thoron – Department Head Agricultural Education and Communication, Abraham Baldwin Agricultural College

Supporting Welding Students with Developmental Disabilities: An Instructional Aid and Teaching Methods to Assist Students in Operating Oxy Acetylene Cutting Equipment

by Dr. Maureen Victoria, Dr. Timothy Murphy, Dr. Holli Leggette, Dr. Gary Briers, & Dr. Marcia Montague

Training high school students to be skilled and credentialed in welding and metal fabrication fills a gap in the skilled-trades workforce. Exposure to equipment and operational instructions is intimidating for students, especially for students with developmental disabilities (DDs). Students with DDs (i.e., attention deficit hyperactivity disorder, autism, dyslexia) find overstimulation in the welding laboratory to be overwhelming. Therefore, we investigated the effectiveness of a systematically designed visual teaching aid and we investigated the teaching methods that best promote student self-determination and skill acquisition. We assessed the skill of operating the oxyacetylene cutting torch. Texas high school students were engaged in one of three teaching methods while using the visual teaching aid. Students in peer-to-peer learning groups and in teacher-to-small-group learning groups were compared to students in a traditional teacher-led whole group. Students who used the teaching aid in peer-to-peer instructional groups scored higher in both the skills performance and self-determination assessments. Teachers may see benefit from creating their own teaching aids using: 1) concise text, 2) specific imagery, and 3) a sequential format using task analysis to illustrate each specific behavior. Providing accommodations, such as peer-to-peer teaching and visual teaching aids, throughout the curriculum will help students learn complex tasks. Because the welding and metal fabrication laboratory can provide overwhelming stimulation, the teacher's management of students' pace of learning is critical for minimizing overstimulation and maximizing skill acquisition. We recommend a deliberately paced, positive, and supportive environment for students with DDs exposed to the stimuli of the laboratory.

For more information and resources please e-mail

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Dr. Marcia Montague – Clinical Assistant Professor of Educational Psychology, Texas A&M University

Action Research to Improve Student Learning in the Classroom

by Dr. Hui Hui Wang & Dr. Neil Knobloch

Action research is an effective way for teachers to tackle educational problems in their classrooms by applying systematic research approaches while teaching to improve their own practice. In this brief, we share: (1) an example of action research in practice; and (2) how action research supports our own teaching.

The action research was conducted in a semester-long teaching methods course—

Teaching Science, Technology, Engineering, and Mathematics (STEM) through Agriculture, Food, and Natural Resources (AFNR). The course instructors decided to conduct an action research study because the students had various interpretations of integrated STEM learning, and they had difficulties to develop high quality integrated STEM through AFNR lessons. The goal of the action research was to better understand the students' interpretations, and to develop a rubric that helps students conduct self-reflection to improve the level of STEM integration through AFNR for their lessons.

As instructors, we spent a year observing and reflecting on the initial teaching experience and delineated criteria, levels, and evidence of integration. In 2018, we published a rubric with three levels and six features to help students better understand integrated STEM in developing their lessons (Wang & Knobloch, 2018). After that, we continued to collect data from students based on their reflections and feedback. In 2022, based on students' comments, we revised and published version two to improve the usage and the language of the rubric (Wang & Knobloch, 2022). The article is an example to support agricultural teachers to conduct action research in their classrooms.

For more information:

Knobloch, N. A., & Wang, H. H. (2023). Boiler STEAM website. Retrieved at: https://ag.purdue.edu/department/asec/boilersteam/index.html

Wang, H. H., & Knobloch, N. A. (2022). Preservice educators' interpretations and pedagogical benefits of a STEM integration through agriculture, food and natural resources rubric. Journal of Pedagogical Research, 6(2), 4-28. https://doi.org/10.33902/JPR.202213513,

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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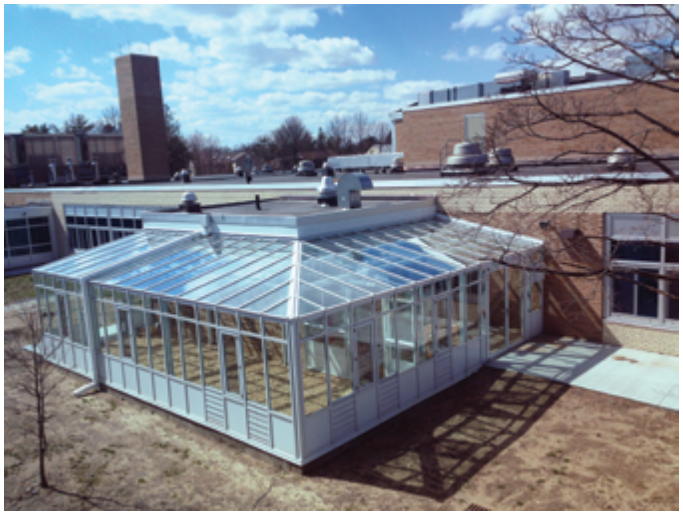

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