

Integrating Inquiry-Based Learning into Agricultural Education

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Introduction

The United States education system strives to improve to meet the needs of students. For this reason, the United States participates in the Program for International Student Assessment (PISA). The latest PISA results in 2015 rank the United States at 24th out of the 72 countries analyzed for science (Organization for Economic Cooperation, 2015). This ranking places the United States far behind the top science performers of Singapore, Hong Kong, and China, as well as below the Organization for Economic Cooperation and Development average for all countries tested (Organization for Economic Cooperation, 2015). The science performance of United States students needs to be increased to compete globally with science students in other countries.

One of the ways science can be incorporated into United States education is through agricultural education. Phipps, Osborne, Dyer, and Ball (2008) state that agricultural education may be a way to increase student learning in Science, Technology, Engineering, and Mathematics. Another article stated that pre-service teachers viewed incorporating science as a possibility in the agricultural education curriculum (Balschweid, Thompson, & Cole, 2000). Haynes, Robinson, Edwards, and Key (2012) suggest that teaching science within agriculture may improve student achievement. Science can naturally be taught through agricultural education. Agricultural education utilizes many hands-on methods to teach science. The investigative, laboratory method of learning science was suggested as more effective, according to Myers and Dyer (2006), which may include portions of inquiry in the lesson. Agricultural education can

incorporate science and may, as a result of increased student learning, improve the United States education rankings in science worldwide.

Agriculture teachers often include hands-on and experiential learning in their classrooms. Inquiry-based instruction is a way to incorporate hands-on activities in classes. One of the core components of agricultural education is a contextual, inquiry-based classroom. Even so, many agriculture teachers have not yet adopted inquiry-based learning in their teaching. I will review literature pertaining to incorporating inquiry-based instruction in agricultural education. The literature review will be used to understand how teachers currently use inquiry-based instruction, the benefits students gain from inquiry, and the difficulties agriculture teachers face in inquiry-based instruction. Then, I will explain the process of creating a lesson resource database for inquiry-based lessons in agricultural education.

Review of the Literature

Defining Inquiry-Based Learning

John Dewey began the movement to include inquiry in science curriculum at his laboratory school. He believed that what students learned needed to be applied (Kliebard, 2004). Many educational reformers continue to look to Dewey's curriculum for guidance in developing inquiry-based learning. Many educational methodologies may have influenced inquiry-based learning, making inquiry difficult to define.

Full inquiry involves the student leading the entire process of learning. Bybee (2011) regards full inquiry as students shaping the question under inquiry, developing the methods, materials, and data, and producing a report based on results. The Institute for Inquiry defines inquiry as "an approach to learning that involves a process of exploring

the natural or material world, and that leads to asking questions, making discoveries, and testing those discoveries in the search for new understanding” (Institute, 2017). This may not always be possible in every classroom with every subject. For the purpose of this project in agricultural education, inquiry-based learning will include lessons that incorporate at least partial inquiry with active engagement.

Inquiry-based learning may be likened to problem-based learning for use in agricultural education. Parr and Edwards (2004) studied the similarities between each instructional strategy to determine if problem-based learning can be called inquiry. Both approaches maintain the student-centered approach and engage students. Additionally, the researchers state that inquiry-based instruction and problem-based learning are very similar in “intent, process, and anticipated learning outcomes” (Parr & Edwards, 2004, p. 110). Engagement, exploration, explanation, elaboration, and evaluation are the five steps in the 5E learning cycle, used in both inquiry-based learning and problem-based learning (Parr & Edwards, 2004). The 5E model was developed by Rodger Bybee. He states that it is “intended to help teachers approach instruction in a meaningful way, one that enhance[s] student learning (Bybee, 2014). Based off of this intent and the use of the 5E learning cycle in multiple learning methodologies, it should be considered as a method to use for inquiry.

Clark, Ewing, and Foster (2011) agree that implementation of inquiry and problem-based learning may look similar in an agricultural education classroom. However, the researchers also mentioned that a teacher will give students the problem in problem-based learning, while students will develop their own question in inquiry-based learning. Even with this slight difference, teachers may be able to extend their inquiry-

based instruction into the realms of problem-based learning. Since problem-based learning is a common teaching method in agricultural education, more teachers may be using inquiry than we can account for based on the definition of inquiry-based learning.

There are many similarities between inquiry-based learning and problem-based learning. Additionally, utilizing the 5E model may create effective student learning when used with inquiry. Any instruction that uses partial inquiry with active engagement will be considered inquiry-based learning for this project.

Current Use of Inquiry-Based Learning in Agricultural Education

Agricultural education teachers use hands-on learning and laboratory activities to engage students. Inquiry may be incorporated into lessons. Washburn and Myers (2010) surveyed Florida agriculture teachers to discover how often they use inquiry in their classrooms. The Teacher Inquiry Scale used indicated that teachers use inquiry almost three times per week. This includes asking open-ended questions, encouraging further investigation by students, and probing students to defend their findings. The Student Inquiry Scale focused on how often students are asked to engage in inquiry. Respondents indicated that students engaged in inquiry-type activities nearly once per month. While teachers believe they are using inquiry in their teaching multiple times each week, students may not actually participate in inquiry more than once per month. This study shows that inquiry can be used regularly in classes.

National groups of agricultural teachers have developed programs to instruct other teachers on using inquiry-based instruction to engage students. One of these programs is the National Agriscience Teacher Ambassadors. These teachers engage in professional development to learn and implement inquiry in their classrooms. Thoron, Myers, and

Abrams (2011) studied the perceptions of inquiry implementation by teachers, inquiry-based classrooms to the school environment, and assessment through inquiry. Focus groups of teachers in the program were asked about these areas. Teachers discussed transforming their role from the source of knowledge to a facilitator and the difficulty of encouraging students to think critically. However, they viewed inquiry as more rewarding at the end of the lesson. Participants stated that other teachers in their schools became curious about inquiry because of their lessons. Finally, assessment became about the process of learning, not the final answer. These teachers' perceptions show that teachers see inquiry in their classrooms as valuable, yet challenging. The National Agriscience Teacher Ambassadors program continues to train teachers for inquiry-based instruction.

Another method to increase the number of teachers using inquiry-based instruction is to provide curriculum. The Curriculum for Agricultural Science Education (CASE) incorporates inquiry-based learning into all lessons. Teachers must attend a one-to-two week training on the curriculum before receiving access for classroom implementation. CASE has been shown as effective in engaging students through inquiry-based learning. Witt, Ulmer, Burriss, Brashears, and Burley (2013) showed that student active engaged time increased with CASE curriculum compared to teacher-selected lessons. CASE curriculum, which uses inquiry-based instruction, is a viable source for engaging students in learning that some agriculture teachers are using.

Agricultural educators currently use inquiry-based learning from once per month up to multiple times each week. While this is a wide range, the true use of inquiry in the classroom may not be able to be identified. However, there are programs working to increase the use of inquiry. The National Agriscience Teacher Ambassadors program is

working to train teachers in the creation, use, and implementation of inquiry-based learning. In addition, the Curriculum for Agricultural Science Education trains teachers and gives them the curriculum needed to teach inquiry on a regular basis. These programs continue to foster the development of inquiry within agricultural education.

Student Aptitude Benefits through Inquiry-Based Learning

Instructional methods are typically chosen for the effectiveness in teaching material. However, inquiry-based learning may increase student aptitude in several ways. Thoron and Myers (2012a) compared agricultural education students' scientific reasoning abilities when instructed through the subject matter approach and inquiry-based learning. Students who received inquiry-based instruction had a statistically significantly higher ability to reason scientifically. Those taught through inquiry-based instruction also understood the content matter better than those taught through the subject matter approach. A similar study was conducted by Thoron and Myers (2012b) to evaluate agricultural education students' argumentation abilities through Schen's 2007 rubric. Students taught through inquiry-based instruction had a higher argumentation skill score than those taught through the subject matter approach. This finding stayed true across gender, ethnicity, grade, and socioeconomic status. Both research studies conducted by Thoron and Myers suggest that inquiry-based learning leads to greater cognitive skills, particularly in scientific reasoning, argumentation abilities, and content matter knowledge.

Other researchers have found gains in student aptitude. Kim (2011) studied a group of thirty-five eighth-grade girls attending a weeklong science camp. Throughout the camp, teachers used inquiry-based instruction to teach about the greenhouse effect, air

and water quality, and alternative energies. At the end of the camp, there was a statistically significant difference in content knowledge compared to the beginning of the camp. Kim attributes this difference to inquiry-based learning. Blythe, DiBenedetto, and Myers (2015) conducted focus groups of agriculture teachers who use inquiry-based instruction. The teachers believed that students understood content material better through inquiry-based instruction than through prior teaching methods. Research conducted by Grover and Stovall (2015) required students to investigate a mystery plant throughout the semester. The students reported that they engaged in deeper research because of the inquiry-based method used in the project. Additionally, students stated that they gained teamwork abilities and developed their personal communication due to working in groups. The inquiry-based learning method may provide growth in content knowledge and cognitive abilities. Students may also further develop interpersonal skills, since inquiry-based learning often requires students to work together.

Student Interest

Students' interest in content may be increased when taught through inquiry-based instruction. Thoron and Burlison (2014) conducted research in an agricultural education classroom on student interest levels in agriculture and in inquiry-based learning. Over seventy percent of students agreed or strongly agreed that agriscience is useful for solving everyday problems and they have a real desire to learn agriculture. Over half of the students said they would like other classes to use inquiry. Eighty percent of students reported that they enjoyed doing lab activities in class. The results of the study indicate that inquiry-based instruction is effective for increasing students' interest in agriculture and inquiry. Grover and Stovall's (2015) mystery plant project also increased student

interest in agriculture. Inquiry-based learning may be a way to increase interest in agriculture.

Outside of agricultural education, researchers have shown to increase student motivation and change students' attitudes. Research conducted in a middle school science class was done with inquiry-based learning. Students felt like they came up with the questions and were real scientists, since they developed the experimentation processes used. Discovery fueled students' experiments and led to their enjoyment of the inquiry process. One student started with science as his least favorite subject; his mindset was changed due to scientific inquiry. The questions that students developed themselves provided motivation, discovery, and learning (Rivera Maulucci, Brown, Grey & Sullivan, 2014). Kim's (2011) study with inquiry-based instruction at a middle school science camp showed changes in participants' attitudes towards science, scientists, and careers in science. Inquiry allowed the students to see themselves with careers in science. Attitudes towards the content area changed in both of these studies through inquiry.

Love, Hodge, Corritore, and Ernst (2015) researched inquiry through two flipped college classes. Scheduled class time was used for group-focused inquiry activities that deepened students' learning. The professors actively engaged with students. When students asked questions or encountered difficulties, the professors guided them through a problem-solving sequence rather than giving them the answer. Surveys resulted in ninety-four percent of students in one class stated that they would recommend the course to another student. Inquiry may encourage students to pursue additional inquiry courses, change students' attitudes, and increase student interest.

Success for All Students

Agricultural education classes often have a wide range of ability levels within the student population. For this reason, inquiry-based learning must be considered in the context of low achieving students and special needs students. Kogan and Laursen (2014) studied the long-term effects of inquiry-based learning. Their research is especially important for understanding how low achieving students perform in inquiry-based learning classes. Lower achievers improved their grades in later, more difficult inquiry-based learning courses compared to their first inquiry-based course. This finding was opposite that of high achievers, whose grades usually fell as they took higher-level courses. Blythe, DiBenedetto, and Myers (2015) reported similar findings for agricultural education. Many success stories were shared by the participants, in which low achieving or average students gained confidence and ability through inquiry-based instruction. Low achieving students may find great success when taught through inquiry.

Students with special needs may benefit from inquiry-based learning. In a study by Camenzuli and Buhagier (2014), students with social, emotional, and behavior difficulties (SEBD) were taught math through inquiry-based instruction. Students revealed that they enjoyed the active learning that inquiry-based learning afforded them, such as real-world examples. Teachers stated that student behavior improved in class, and multiple students confirmed that their behavior was less aggressive and attention was highly focused. Students revealed in journals that they believed they were learning more through inquiry than through traditional classes. Their teacher agreed that they were learning math and developing an appreciation for mathematical concepts. Students with SEBD in the inquiry-based learning program raised their test scores over the second semester over thirteen percent, while students with SEBD in the regular classes raised

their scores just over two percent, showing higher achievement through inquiry-based learning.

Easterly and Myers (2011) conducted a study to compare the content knowledge learned through inquiry-based instruction for students with an Individualized Education Plan (IEP) and students without an IEP. There was no significant difference between the two groups, showing that students with an IEP may learn as effectively as other students through inquiry-based learning. Inquiry may be an effective learning tool to curb behaviors, engage low achievers, and teach all students effectively.

Teacher Difficulties

While many research studies show benefits of inquiry-based learning, teacher difficulties are also mentioned. Blythe, DiBenedetto, and Myers (2015) discussed the transition in teacher role. Many teachers believe it takes several years to become consistent and confident with inquiry-based instruction. The teachers stated that they struggled to allow students to create their own learning in the classroom. Clark, Ewing, and Foster (2011) mention the teacher transferring ownership of the learning to students. The teacher transitions to a role of support and guide, rather than the holder of knowledge. Instructors must ensure that learning objectives are met, as well as assist students in understanding how to use inquiry-based learning. Teachers may experience difficulties in transitioning the teacher role for inquiry-based instruction.

Other issues may arise as teachers implement inquiry-based instruction. Teachers in Olagoke, Mobolaji, and A's (2014) study and a study by Washburn and Myers (2010) cite insufficient knowledge as a reason not to use inquiry-based instruction. These teachers believe that more training would make them more prepared to teach using

inquiry. Both studies also include the necessity of more resources. Teachers believe that they do not have the funding or equipment to provide for inquiry-based instruction.

Blythe, DiBenedetto, and Myers (2015) include teacher concerns regarding the additional time inquiry-based instruction requires to prepare for and conduct (Olagoke, Mobolaji, & A, 2014; Shoulders & Myers, 2011). All of these apprehensions may be contributing factors to those who currently or would like to teach using inquiry.

Interpretation

The research presented in the literature review section suggests that inquiry-based learning may be a beneficial instructional method for all learners. Research done with high school agricultural education students and adult learners proposes that inquiry-based learning can be used with a diverse range of learners.

Inquiry-based learning should be implemented in an agricultural education classroom for many reasons. Research states that students benefit by learning through inquiry-based learning in both increased cognitive abilities and content interest. Additionally, a wide range of students can be served by inquiry-based learning. Students who are typically low achieving or have an Individualized Education Plan have benefitted from inquiry. Although inquiry is used in some agricultural education classrooms currently, there is room for a more widespread use of inquiry-based instruction. A resource database that includes inquiry-based lessons in each of the eight agriculture, food, and natural resources pathways could assist teachers. Teachers state that there are difficulties involved in implementing inquiry-based learning. A resource database may alleviate some of those difficulties and allow teachers to interact with other teachers implementing inquiry-based learning. Inquiry-based learning can be beneficial for

agricultural education students, and a resource database may help teachers to implement inquiry lessons.

Inquiry-Based Learning Lesson Resource Database

Inquiry-based learning is used in some agricultural education classrooms on an irregular basis. However, inquiry may increase students' cognitive abilities and development and engage students in the content. Additionally, students who have an Individualized Education Plan or are low achievers may benefit from inquiry-based learning. Teachers may experience difficulties in implementing inquiry-based instruction, particularly in time and knowledge. With justification for the benefits of inquiry-based learning paired with teacher difficulties in implementing inquiry, I worked to create a lesson resource database for inquiry-based learning in agricultural education.

Project Beginnings

As a student teacher, I taught under a teacher who used inquiry on a regular basis in her classroom. She did not use a specific curriculum for inquiry; however, she created and modified many lessons that incorporated inquiry into each of the courses she taught. While using these lessons and creating some of my own, I experienced the engagement of students through inquiry-based learning. In fact, there were students who took an agriculture chemistry course instead of the traditional chemistry class, because they liked the style of learning better. It became obvious to me that inquiry engaged students and made them more interested in the content.

When I began my first year of teaching, I knew that I wanted to incorporate inquiry into my classroom. I was fortunate to attend the Curriculum for Agricultural Science Education Introduction to Agriculture, Food, and Natural Resources training

prior to my first year of teaching. I used portions of this curriculum, and ideas sprung from it, in many of my classes. However, there were still needs for more inquiry-based lessons in my courses. I spent time creating some lessons, modifying lessons from other teachers, and searching online to find engaging, effective lessons. Many of my peers in their first year of teaching spent hours each week scrolling online for lessons they could use in their own classrooms. Additionally, school districts want to know what standards are being met in each lesson. Once a lesson is found or created, it takes time to closely examine the 2015 National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards and find the appropriate standards met by the lesson. I saw the need for an easy-to-access online resource that included inquiry-based lessons, which are already aligned to the National AFNR Standards.

The idea for an online lesson resource database came closer to reality through approval of University of Wyoming's Institutional Review Board in March 2017. I created a release form to inform lesson submitters of their rights as a research participant. Teachers who submitted lessons also had the option of maintaining confidentiality on this form. Whenever a lesson was submitted, this signed release form was also required before I could begin any additional work on the lesson.

In order to publish the completed lesson database online, I needed to find a host. I contacted the National Association of Agricultural Educators (NAAE) and the Wyoming Scholars Repository (WySR) to ask about hosting options. A representative from NAAE suggested that I create a group under NAAE Communities of Practice. This site provides a place for agricultural educators to post and find lesson plans, ask questions, and find resources. The WySR representative stated that they could host my finalized project with

a permanent link. I determined that WySR and a group on NAAE Communities of Practice would host the final lesson resource database.

Lesson Solicitation

My first step in the lesson portion of the project required me to solicit lessons from agriculture teachers. I began by sending out emails to teachers I personally know in Minnesota in April 2017. In addition, contacts in other states provided me with names and contact information for agriculture teachers they believed would provide lesson plans. Throughout the summer and fall of 2017, I continued to send out emails to attempt to gain additional lesson plans. In all, over fifty emails were sent to agriculture teachers. Another method of solicitation I tried was social media. I posted a request for lessons in two Facebook groups: Ag Education Discussion Lab and Ag Teacher Buddies. I also used Facebook to contact agriculture teachers that I did not have emails for. Throughout the April to October 2017 time period, I made personal connections through texts, phone calls, and in-person requests to many agriculture teachers. Finally, I sent out a request over listserv emails to agriculture teachers in fourteen different states, all in geographically varying locations. While the proposed baseline for the project was one hundred lessons, my solicitation efforts resulted in thirty-one lessons by November 2017.

Aligning Submissions with Standards

Once lessons were submitted with a signed Institutional Review Board Release Form, I organized them into a spreadsheet. This spreadsheet included the lesson title, lesson content, career pathway, author, and date of submission. Since there were not any teachers who requested confidentiality, I wanted to ensure that all teachers received proper credit for their lessons.

The intent of the project was to align all lessons with National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards. The National Council for Agricultural Education (The Council) published these standards in 2015. The Council includes many organizations for agricultural education and represents youth organizations in agricultural education. The National AFNR Standards were aligned to the Common Career Technical Core Standards for Career Ready Practices. Other content standards were also taken into consideration, including the Next Generation Science Standards, Common Core Standards for English Language Arts and Mathematics, and the National Standards for Financial Literacy (The National Council, 2015). The standards begin with Career Ready Practices and Cluster Skills, which are general employability skills. Then, the standards are broken into eight different career pathways: agribusiness systems, animal systems, biotechnology systems, environmental service systems, food products and processing, natural resource systems, plant systems, and power, structural and technical systems. Under each pathway, standards are narrowed down three times. First, the broad standard is the Common Career Technical Core Standard. Each of these standards is narrowed further through Performance Indicators. Performance Indicators state the knowledge and skills a student should have by completion of the particular pathway. The last component of each standard is the sample measurements. The sample measurements are given in three levels – awareness, intermediate, and advanced. Sample measurements are meant to give an idea of the knowledge and skills a student may attain, but they are not all encompassing (The National Council, 2015). The National AFNR Standards are a guide to use in developing new lessons and aligning existing lessons with a system of standards.

When submissions were received, I began by reading through the lesson to identify the learning goals. Oftentimes, the learning goals lead to standards that should be used. I began by identifying the Career Ready Practices and Cluster Skills that each lesson aligned with. Since these are focused on employability skills, nearly every lesson has several of these standards included. Then, I identified which career pathway the lesson fell under. In some cases, lessons fit into multiple career pathways. With a quick skim of Common Career Technical Core Standards, I narrowed in on the standards that are met. I read through the sample measurements provided under each Performance Indicator to determine which specific Performance Indicators should be used as standards in the lesson. Each lesson begins with a cover page that includes the title of the lesson, the submitter, and the National AFNR Standards it aligns with.

Seed to Eating HACCP Plan

Submitted by Erin Christensen

National AFNR Standards:

CRP.06.01 Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

CRP.07.01 Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

CRP.12.01 Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.

PS.01.01 Determine the influence of environmental factors on plant growth.

PS.02.01 Classify plants according to taxonomic systems.

PS.03.02 Develop and implement a management plan for plant production.

FPP.01.01 Analyze and manage operational and safety procedures in food products and processing facilities.

FPP.01.02 Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03 Apply food safety procedures when storing food products to ensure food quality.

FPP.03.01 Implement selection, evaluation and inspection techniques to ensure safe and quality food products.

FPP.03.02 Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

FPP.03.03 Create food distribution plans and procedures to ensure safe delivery of food products.

Example of a lesson cover page.

Publication

Upon completion of aligning lessons to National AFNR Standards, I created a group on NAAE Communities of Practice. The group is named “Inquiry-Based Learning Lessons.” NAAE Communities of Practice allows for tags to be included when creating a page or uploading any lesson, so that searches for a specific word result in the page or lesson appearing. Whenever “inquiry” is searched, this group is one of the results. On the group page, all lessons have been uploaded and categorized into career pathway. Once a user finds the group, they can see all lessons available on the home page. The page is available at <https://communities.naae.org/groups/inquiry-based-learning-lessons>.

The screenshot displays a list of lesson plans organized into five categories, each with a header and a list of documents. Each document is represented by a blue icon of a document with lines of text.

- GENERAL INQUIRY**
 - Oreo Inquiry Lesson Plan.docx
 - Agriscience & Science Research Rubric.docx
 - Top 10 Commodity Project.docx
 - Born in USA Lesson Plan.docx
- AGRIBUSINESS SYSTEMS**
 - ABS Product Development Project
- ANIMAL SYSTEMS**
 - AS Who am I Disease.docx
 - AS Facility Tour & Animal Handling.docx
 - AS Animal Behavior Lab.docx
 - AS Animal Terminology.docx
 - AS - Cattle Reproduction.docx
 - AS The Great Debate.docx
 - AS Facilities Design.docx
 - AS Primal Meat Cuts.docx
- FOOD PRODUCTS AND PROCESSING SYSTEMS**
 - FPP - Ice Cream Milk Fat Lab.docx
 - FPP - Beef Jerky Lab.docx
 - FPP - Food Processing Final.docx
 - FPP - Sugar Sugar.docx
 - FPP - Salt and Milk Lab.docx
 - FPP - Combining Tastes Lab.docx
 - FPP - Product Development Project.docx
 - FPP - Honey & Sugar.docx
 - FPP - Primal Meat Cuts.docx
 - FPP - Seed to Eating HACCP Plan.docx
- NATURAL RESOURCE SYSTEMS**
 - NRS - HoliDebate.docx
 - NRS - Soil Intro Activity.docx
 - NRS - Water Introduction.docx

Examples of lessons categorized on <https://communities.naae.org/groups/inquiry-based-learning-lessons>.

A permanent link will also be created for this project on the Wyoming Scholars Repository. The published lesson resource database has been promoted on Facebook through the Ag Education Discussion Lab and Ag Teacher Buddies.

Future Implications and Recommendations

The nature of this project allows it to continue beyond the finalization of this paper. If teachers submit additional lessons, I will align them with standards and upload the lessons to NAAE Communities of Practice. Furthermore, if modifications need to be made to lessons currently included, this can easily happen through the group format of NAAE Communities of Practice. Teachers may also collaborate and comment on lessons in the Inquiry-Based Learning Lessons group.

The Inquiry-Based Learning Lesson Resource Database could prove useful to any teacher of agricultural education. I foresee student teachers and beginning teachers using the resources most often, because of their potential lack of lesson resources. However, more experienced teachers, particularly those with inquiry experience, will allow this database to flourish through their additional submissions, comments, and critiques of lessons. It is my hope that this resource will encourage more teachers to include inquiry in their classrooms, since many studies have documented the benefits inquiry affords to students.

If this project is expanded or another similar project takes place in the future, I would recommend changes to how solicitation of lessons occurs. Even though I sent out a multitude of emails, phone calls, texts, personal connections, and social media posts, I did not meet my baseline of one hundred lessons. Instead, I would recommend starting with a few people who are very well connected in agricultural education, such as education

consultants in National FFA or NAAE. They will have a greater ability to direct the researcher to teachers who are reputable in inquiry-based learning and likely have effective lessons. This change could result in many more lessons being included in the lesson resource database.

Conclusion

Agriculture teachers often include hands-on and experiential learning in their classrooms. Inquiry-based instruction is a way to incorporate hands-on activities in classes. While many agriculture teachers may desire to implement inquiry-based learning, they may not have the financial resources to attend conferences or know where to find inquiry-based learning lessons. A resource database of inquiry-based learning lessons for agricultural education may allow agricultural education instructors to implement inquiry-based instruction in their classrooms to positively benefit their students.

Inquiry-based instruction may be an instructional strategy agriculture teachers are adding to their teaching for increased student engagement. Increased student active engaged time was seen when comparing inquiry-based instruction to a traditional agriculture class (Witt, Ulmer, Burris, Brashears, & Burley, 2013). Agriculture classes often have a diverse range of ability levels, and inquiry-based instruction could increase academic growth for all learner levels. Inquiry-based instruction resulted in improvement of academic scores through several classes for low achievers and students with social, emotional, and behavioral disorders (Kogan & Laursen, 2014; Camenzuli & Buhagiar, 2014). Scientific reasoning in agriculture classes was also increased through inquiry-based instruction (Thoron & Myers, 2012).

Other researchers have studied agriculture teachers and inquiry-based instruction. Washburn and Myers (2010) identified that Florida agriculture teachers only use inquiry once each month, on average. Blythe, DiBenedetto, and Myers (2015) studied agriculture teachers' perceptions about inquiry-based instruction. Inquiry-based instruction could be useful to implement in agricultural education to increase student engagement and academic growth. A lesson resource database may help agriculture teachers realize these benefits to students.

The Inquiry-Based Learning Lesson Resource Database includes thirty-one inquiry-based lessons. Each of these lessons is aligned to National Agriculture, Food, and Natural Resources (AFNR) Standards. Lessons are available in all eight pathways within the National AFNR Standards. The lesson resource database may prove beneficial to any teacher of agricultural education, particularly those teachers who are less experienced or lack the resources to undergo further training in inquiry-based instruction. The Inquiry-Based Learning Lesson Resource Database will provide a resource for teachers to incorporate inquiry into the classrooms, providing the potential for increased benefits for students.

The United States' education rankings in science are a cause for action. One of the ways that science can be incorporated into curriculum is through agricultural education. Learning science through an agriculture context may increase student achievement in science. With the potential for increases in student aptitude through inquiry-based learning paired with learning science through agriculture, the science scores of United States students may improve. Inquiry-based learning through

agricultural education may be a part of the solution to increase our science rankings worldwide.

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