CREATING AWARENESS OF THE TURKEY INDUSTRY THROUGH STEM-BASED CURRICULUM

by

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A Thesis

Submitted to the Faculty of Purdue University

In Partial Fulfillment of the Requirements for the degree of

Master of Science

Department of Animal Sciences

West Lafayette, Indiana

May 2022

THE PURDUE UNIVERSITY GRADUATE SCHOOL
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Dedicated to the Indiana poultry industry.

ACKNOWLEDGMENTS

Thank you to my friends and family who supported me during my educational journey over the last six years at Purdue. Thank you to my lab mates and friends, Bri and Elizabeth, for the advice and friendship. Thank you Dr. Elizabeth Karcher, Dr. Sarah LaRose, and Dr. Greg Fraley for guiding me the last two years of my master's program. Thank you to the Indiana State Poultry Association and Indiana poultry producers for providing me the opportunity to learn more about the industry and its impact on the Hoosier state. Thank you to the elementary students and teachers who participated in my project. Lastly, thank you to the Indiana State Department of Agriculture and the Indiana Turkey Market Development Council for funding my project and making it possible.

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ABSTRACT

Agriculture is a growing industry, as it supplies food for the increasing world population. Additionally, career opportunities within the industry are also increasing. In Indiana agriculture in particular, the poultry industry is expanding at a high rate as poultry products are an affordable and healthy protein option for consumers. However, the industry is left with the challenge of fulfilling open job positions in order to produce more food. Due to the demographic shift from rural to urban areas, a gap between the understanding of farm to fork exists among consumers. This adds to the challenge, as interest in agriculture decreases. One way to increase consumer knowledge and interest in agriculture is through education. Limited agricultural-related curriculum exists for K-12 teachers to implement in their classrooms. By creating awareness of the agriculture industry, confidence can be instilled in students and they are more likely to find the content interesting. This interest can impact their future career choice. Chapter two of this thesis reviews the literature in regards to the relevance of the agriculture industry, agricultural-related curriculum, learning development, and teacher impact on learning.

Chapters three and four of the thesis discuss two studies conducted during the implementation of an agricultural-related curriculum for elementary students. The POULT Program was created to provide elementary students with an accurate and relevant online STEM-based curriculum focused on the turkey industry. The program took place over six consecutive school days in 23 4th and 5th grade Indiana classrooms during the fall of 2021. Seventeen teachers and 482 students participated in the study. Students completed five online modules, an interactive notebook, turkey digestion simulation game, and a class project.

Chapter three analyzes how students' previous experience and knowledge, the POULT Program, and the taxonomy of assessment questions impacted students' interest in the turkey industry and agricultural literacy. Results from the study showed that students' agricultural literacy increased from pre to post program completion, individual interest was predicted by previous knowledge, and individual interest had a positive impact on students' situational interest. Students' agriculture knowledge, turkey knowledge, and agriculture experience also impacted situational interest. With these results, we can conclude that agricultural-related curriculum can have an impact on students' agriculture literacy and their interest in agriculture.

Chapter four analyzes how teacher self-efficacy, previous experience, and previous knowledge impacted students' interest in agriculture. We found that teachers reported high engagement self-efficacy and low poultry science content knowledge self-efficacy. We also found that teachers with more agriculture experience had greater motivational self-efficacy, and teachers with greater agriculture knowledge had lower motivational self-efficacy. Teachers' instructional self-efficacy also had a positive impact on students' challenge. Teachers reported that they liked the program content and class project. Overall, teachers reported that technology issues and time constraints were limiting factors of the program.

In conclusion, the POULT Program was successful in increasing students' agricultural literacy. We learned that previous knowledge and experience, teacher self-efficacy, and agricultural-related curriculum can impact students' interest in agriculture. From these findings, we can create and effectively implement more agricultural-related curriculum that will benefit students by making them more aware of the industry and potentially impacting their future career choices.

CHAPTER 1. INTRODUCTION

The world population is increasing, resulting in a need for more food production (Peppers, 2015). In order to produce more food, the industry needs additional employers to fulfill population demand. In Indiana in particular, the poultry industry is thriving, as the state is currently ranked number one in duck production, number two in eggs, and number five in turkey production nationally. However, there is a lack of students interested in pursuing a career in the agriculture and poultry industries. One reason for this could be due to the shift in demographics of the American population from rural to urban locations (Dimitri et al., 2005).

As the population shifts, so does the agriculture literacy of consumers (Roberts et al., 2016). Agriculture literacy can be defined as the knowledge and understanding of the history and production process of food (Frick & Kahler, 1990). Not only can agricultural-related curriculum increase agriculture literacy, but they can also impact students' future career choices. For example, the Social Cognitive Career Theory states that students pursue careers based on their interests (Lent et al., 1994). If a student feels confident in their abilities and finds the outcome to be rewarding, they are more likely to pursue the task again (Nugent et al., 2015). When students reengage in tasks and their interest is maintained, they are likely to develop individual interest in the task, which has a positive impact on their motivation and academic performance (Dev, 1997). Through agricultural-related curriculum, teachers can instill interest in their students by providing challenging, engaging, and relevant activities for students (Harackiewicz et al., 2016). Additionally, agricultural-related curriculum can provide students with critical thinking exercises that allow them to solve real world problems and prepare them for the future workforce (Koh et al., 2015).

One limitation of agricultural-related curriculum is the teacher's willingness to implement the programs in their classrooms. Teachers may feel unprepared to teach these subjects, and ultimately, it is up to the teacher to determine what and how they teach their students (Menon & Sadler, 2018). By increasing teachers' self-efficacy, or their beliefs in how they can achieve the goal, in teaching agriculture content, they are more likely to actively search out agricultural-related curriculum for their students (Roberts et al., 2001). One way to increase teachers' self-efficacy is through professional development and training. This not only prepares the teacher for teaching the content, but also provides students with a more positive learning experience (Dutton, 2016).

The POULT Program was designed to create awareness of the turkey industry through an online STEM-based curriculum for elementary students. The program consisted of five online modules, an interactive student notebook, an online simulation game, and a class project. It was designed to be completed over six consecutive days for 30 to 45 minutes each day. The program was piloted across 23 4th and 5th grade Indiana classrooms during the fall of 2021. Seventeen teachers and 482 students participated. Questionnaires were given throughout the program in order to address the following research questions:

1. Does the taxonomy of notebook assessment questions have an impact on students' interest in poultry science-based activities?
2. Does prior experience, prior knowledge, and participation in the POULT program have an impact on students' interest?
3. Does the POULT program increase agricultural literacy?
4. Does the level of teacher agriculture knowledge and self-efficacy in the subject area have an impact on students' interest?
5. What are teachers' perceptions of implementing the POULT program in their classroom?

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CHAPTER 2. LITERATURE REVIEW

2.1 Relevance of the Agriculture Industry

Agriculture is a relevant and necessary industry around the world as it provides the nutrition needed to support all forms of life. The agricultural industries are responsible for cultivating land, growing crops, and raising animals for food production (Axelos & Van, 2017). By 2050, the expected world population is over 9 billion people, leaving agriculturalists with a big challenge: feeding the world (Peppers, 2015). In addition, agriculturalists must keep in mind how to achieve this goal in a sustainable matter that minimizes the environmental footprint and preserves natural resources (Thornton, et. al., 2018). This leaves the agriculture industry in high demand for careers such as farmers, engineers, environmental scientists, veterinarians, nutritionists, economists, and the list goes on.

A report by the USDA concluded that between the years 2020 and 2025, the United States can expect approximately 59,400 career openings each year for new college graduates with an interest in food, agriculture, renewable resources, and the environment (Fernandez et al., 2020). This is a 2.6% increase from previous years. These students will compete for jobs with other college graduates who receive degrees in biological science, engineering, health science, business, etc. (Fernandez et al., 2020). Out of these 59,400 job openings, 24,700 will be management and business careers, 18,400 will be in science and engineering fields, 7,900 will be in food and biomaterials production, and 8,400 will be in education, communication, and government fields (Fernandez et al., 2020). Despite the job availability, there will not be enough college graduates to fulfill the openings (Peppers, 2015). In order to meet the demand, universities and colleges of Agriculture across the United States are working to recruit students to their agriculture programs (Espey & Boys, 2015).

There are a few factors that contribute to the lack of agricultural students ready to fill the available job opportunities. The demographics of America have changed over the last several decades. Rural populations and the number of farms have decreased throughout the years. In fact, between 1900 and 2000, the number of farms decreased by 63% (Dimitri et al., 2005). Additionally, more and more students are entering college with urban backgrounds and limited animal agriculture experience. This leads to a larger interest in companion animals, horses, and exotics

(Buchanan, 2008). Wildman and Torres (2001) concluded that students' prior experiences were the most influential at determining which major they selected in college. As demographics shift, students are not exposed to agriculture as frequently prior to college, potentially leading to less interest in pursuing agricultural careers. Wickenhauser et al. (2021) found that in order to increase interest in agriculture careers, students must be exposed to possible career opportunities at an early age.

2.1.1 *Indiana Agriculture*

Indiana is a top-producing agricultural state with approximately 56,000 farms (Reynolds, 2020). Ranked number 5 in the United States for both field corn and soybeans, Indiana is home to over 45,000 laying hens, 20,000,000 turkeys, 4,450,000 hogs, and a number of other livestock such as cattle, ducks, and sheep (Reynolds, 2020).

Poultry, or domesticated birds such as chickens, turkeys, and ducks, provide a nutritious and accessible protein source for cultures and communities around the world (Yegani, 2009). Compared to other species, producing poultry leaves little environmental impact and has an efficient feed to food product conversion rate (Daghir et al., 2021). This has caused an increased demand for poultry as the agriculture industry has been challenged with feeding a growing population in a sustainable way (Yegani, 2009). In turn, the poultry industry grown at a fast rate of 5% per year since the 1960s (Daghir et al., 2021). The turkey industry in Indiana is no exception.

According to the Indiana State Poultry Association, in 2020, there were 471 commercial turkey farms in Indiana with 110 being in Dubois County and 67 in Jay County (Indiana State Poultry Association, personal communication). Many of these commercial farms are considered contract farms who contract with a larger corporation that provides resources and guidelines for the producers to follow (Mugwagwa et al., 2020). Turkey farming is popular in the southern part of the the state due to the hilly terrain. With a lack of flat land for growing crops, farmers took advantage of the land that was available and raised turkeys instead (Brennan, 2020). With a large amount of corn and soybean production nearby, Hoosiers have easy access to provide their birds with a healthy diet (Lawrence & Bortz, 2008). In addition to live turkey production and grain production, Indiana benefits in numerous ways by the creation of career opportunities in the turkey industry. For example, the manufacturing, transportation, and processing components of the turkey industry generate a demand for qualified employees to enter the agriculture industry (Lawrence & Bortz, 2008).

2.2 Agricultural Education

2.2.1 *Agriculture Literacy*

The use of the term agriculture literacy became prevalent beginning in the 1970s. While a variety of definitions exist, Roberts et al. (2016) defined "agriculture literacy" as one's knowledge about the food and fiber system, including its past and its present contributions to society (Roberts et al., 2016). Someone who is agriculturally literate understands the history and production process behind where their food comes from (Frick & Kahler, 1990). Technological advances have helped food production become more efficient and production has shifted to larger facilities (Balschweid et al., 1998). As mentioned previously, rural populations are decreasing as people move to more urbanized locations (Dimitri et al., 2005). Unfortunately, this leads to a disconnect to agriculture and a decrease in agriculture literacy (Roberts et al., 2016).

However, over the last couple decades, new consumer concerns have risen. A few of these include buying local, organically produced products, climate change, and genetically modified organisms (Kovar & Ball, 2013). While agriculturally literate consumers are more likely to support the changes and advancements in agriculture, consumers with less knowledge of the agricultural industries are quicker to question the product or production practices (Kovar & Ball, 2013). By increasing agriculture literacy, members of society can have a better understanding of where their food comes from, how it is produced, and make more informed decisions (Roberts et al., 2016).

Agricultural-related curriculum, whether through formal or non-formal learning, is a good place to begin educating the general public. The National Agriculture in the Classroom Organization created a set of National Agriculture Literacy Outcomes that provide K-12 educators with learning outcomes integrating agriculture themes with science, social studies, and health content areas (Spielmaker & Leising, 2013). These five themes include *Agriculture and the Environment, Plants and Animals for Food, Fiber & Energy, Food, Health, and Lifestyle, Science, Technology, Engineering & Math,* and *Culture, Society, Economy & Geography.* One example of a National Agriculture Literacy Outcome for upper elementary students in the *Agriculture and Environment* theme that can be integrated with social studies content is "Identify the major ecosystems and agro-ecosystems in their community or region (e.g., hardwood forests, conifers, grasslands, deserts) with agroecosystems (e.g., grazing areas and crop growing regions).” By integrating these outcomes in their lessons, teachers are able to provide students with the opportunity to solve real-world problems while also increasing their agriculture literacy (Spielmaker & Leising, 2013).

The American Farm Bureau Foundation for Agriculture’s Pillars of Agriculture Literacy model also provides a planning tool for increasing agriculture literacy in formal and non-formal agricultural-related curriculum. Through mastering the five outcomes of the model, students can increase their agriculture literacy by understanding the relationship between the agriculture industry and the environment, animals, lifestyle, technology, the economy, food, fiber, and energy. The first outcome is to be able to define agriculture and other key vocabulary words such as livestock, production, and sustainability. Then students can expand on their vocabulary by becoming more literate in terms such as *cattle*, and then classifying a cow, heifer, bull, or steer. Students then learn the history of agriculture such as domestication of livestock and important events throughout history that led to today’s agriculture industry. Next, students can connect products that they see in their everyday life and explain the use of the products. Lastly, students will be able to fully describe the farm to fork process, or food production. Educators can take into consideration the Pillars of Agricultural Literacy to increase their students’ awareness of the industry as well as help them to become more informed consumers (American Farm Bureau Foundation for Agriculture, 2013).

2.2.2 *Agricultural-related Curriculum*

One way to integrate agriculture into the classroom is through agriculture-related curriculum programs, which provide K-12 teachers with curriculum to implement in their classroom. This curriculum is oftentimes tested and reviewed to support teachers’ needs and satisfy state and national learning standards (National Research Council, 2009). A number of programs are available to educate youth on food production. Teachers have access to curriculum that they can implement in their classrooms. Integrating agriculture into everyday lessons is one way to include agriculture in schools (Peake et al., 2020). In addition, teachers agree that through the integration of agriculture in everyday course work, students are more likely to increase their agriculture literacy (Knobloch et al., 2007). One example of this is the USDA’s Agriculture in the

Classroom program, which provides teachers with curriculum that relates content to agriculture for their K-12 classes. This program is successful in increasing students' agriculture knowledge in grades K-6 (Pense et al., 2005). Another program, Farm to School, provided 42,587 schools across the United States with programming on food production and nutrition education in the 2018-2019 school year (National Farm to School Network). The FoodCorps is another nutrition-based education program that provided 167,000 students in 2021 with hands-on gardening and cooking lessons (FoodCorps, 2022). Students that participated in the program were even shown to eat three times more vegetables than other students (FoodCorps, 2022).

School-based agricultural education courses and opportunities offered through the National FFA Organization are other popular forms of formalized agricultural-related curriculum found in public high schools and middle schools. In addition to education in and about agriculture, these programs provide students with career, technical, and leadership exploration opportunities (Roberts et al., 2016). Non-formal programing through the Cooperative Extension Service, such as 4-H, provides youth with more opportunities to explore agriculture. Unfortunately, only 2 to 12% of youth in grades K-12 are participating in these types of agricultural-related curriculum programs (Roberts et al., 2016). Therefore, more opportunities need to be available to reach the rest of the large student population with limited awareness of the agriculture industry that will provide students with the skills they need for entering the agriculture workforce as well as knowledge they need for becoming agriculturally literate citizens (Roberts & Ball, 2009).

2.2.3 *Poultry-related Curriculum*

As mentioned previously, the demand for poultry products has increased, leading to an increase in demand for employees in the industry. The industry relies on universities, government funding, and private industries to conduct research and improve the industry for both the animal's welfare and consumer convenience. Unfortunately, there has been a decline in the number of poultry departments at the college level. In fact, in the 1940s there were 45 poultry science departments but today, there are only about six in the United States (Thaxton et al., 2003). This could be due to the lack of interest in poultry science and lack of interest in the improvement of the industry (Yegani, 2009). In order to increase interest in youth, agricultural-programming can be implemented in K-12 schools.

Educational materials are available for educators to implement in their classrooms or non-formal programs. The US Poultry and Egg Association created a virtual game, An Egg-citing Poultry Adventure, that integrates poultry-related curriculum with mathematics (US Poultry and Egg Association, 2021). In addition, the American Egg Board provides poultry-related curriculum for K-12 educators to incorporate in their classroom activities (The Incredible Egg, 2021). One popular experiential learning opportunity seen in elementary classrooms is the chick embryology project, which is often implemented by a Cooperative Extension Educator from the state's land grant university. Students learn about the development of a chick during incubation and have the opportunity to incubate chicks in their classroom. A study showed that participation in the chick embryology program increased student interest, motivation, and knowledge comprehension (Morehouse & Knobloch, 2005). Online curriculum presents another opportunity to reach a greater audience. The use of integrated STEM-based poultry curriculum in K-12 programs has been shown to increase student industry awareness, interest, and knowledge of poultry concepts (Erickson et al., 2019; Marks et al., 2021).

2.2.4 *STEM Education*

Science, technology, engineering, and math are four disciplines that continue to grow in demand across the country but lack the student interest to fulfill the need (Zilberman & Ice, 2021). Since 1990, the concept of STEM has been an important one for educators to implement in their classrooms. When individual disciplines are taught alone, students often don't see the relevance or importance of learning the material, leading to a decrease in interest and motivation. By integrating these disciplines with other subjects, students are able to make connections to their own lives as they seek to solve real world problems (Kelley & Knowles, 2016). Wang and Knobloch (2018) suggest that AFNR (agriculture, food, and natural resources) challenges provide complex and real world problems that students can work to solve through the integration of STEM skills. By incorporating STEM in agriculture curriculum, educators can promote interest and prepare their students for the future workforce.

2.2.5 *Social Cognitive Career Theory*

A 1999 study reported that students that participated in high school agriculture courses and participated in FFA or 4-H were more likely to pursue a degree in agriculture compared to those without these characteristics (Dyer et al., 1999). This is consistent with Lent, Brown, and Hackett's (1994) Social Cognitive Career Theory which describes how students select careers based on their interests (Drymiotou et al., 2021). This is based off of Bandura's (1986) Social Cognitive Theory which describes how self-efficacy and outcome expectancy play a role in students' actions. For example, a student is more likely to pursue a task if they feel that they can achieve the goal successfully and the outcome is appealing to them. By increasing students' self-efficacy and outcome expectancy through agricultural-related curriculum, students will be more comfortable pursuing these career fields in the future (Nugent et al., 2015). Gorter and Swan's study of high school and college students attending an agriculture mechanics camp experience supported this concept (2018). Students' self-efficacy increased and was additionally linked to a positive relationship with students' consideration in a career in teaching agriculture mechanics.

Lent, Brown, and Hackett's (1994) Social Cognitive Career Theory states that career decisions are based on three interlocking models: interest development, choice, and performance. First, over time, people are exposed to career opportunities and activities. They are exposed to opinions and viewpoints that may persuade their likelihood of pursuing these tasks. They set standards and expectations for themselves. If they perform well and meet these expectations, they are more likely to pursue them again. When they have high self-efficacy and believe they can succeed, they are more likely to find an interest in the task. Additionally, interest in an activity is also based on the outcome of participation, whether it is an intrinsic or extrinsic motivator. Students may or may not continue to participate depending on how valuable the outcome is to them. In conclusion, career choice can be decided based on the individual's self-efficacy in how they will perform, their interest in the field, and the outcome of the career (Lent et al., 1994). Therefore, introducing students to agriculture by providing them with engaging opportunities is one way to increase their likelihood of pursuing a career in industry.

2.3 Learning Development

2.3.1 *Interest and Motivation*

Interest can be defined as the psychological state in which one's attention is fully concentrated on one particular task (Ainley, 2010). In education, student interest is an important concept that applies to all subject areas and can change over time. Prior to partaking in a task, students already have some level of individual interest in the subject based on prior experience and engagement. In contrast, situational interest is created through temporary, external stimulus that causes a reaction (Rotgans & Schmidt, 2017). Over time, situational interest is transformed into individual interest through four stages outlined in Figure 2.1 (Hidi & Renninger, 2006).

The first stage of interest development is when situational interest is triggered by an external factor. The second stage occurs when situational interest is maintained and and persists over time or reoccurs. Individual interest begins to emerge in stage three of interest development. Students begin to develop a meaningful connection to and value to the subject. Stage four of interest development describes well developed individual interest. Students in this stage have developed a positive attitude toward the subject and value the opportunity to continue learning and being involved in related tasks (Hidi & Renninger, 2006). Continuing engagement preserves individual interest, and likewise, without continued engagement, individual interest may become dormant (Hidi & Renninger, 2006).

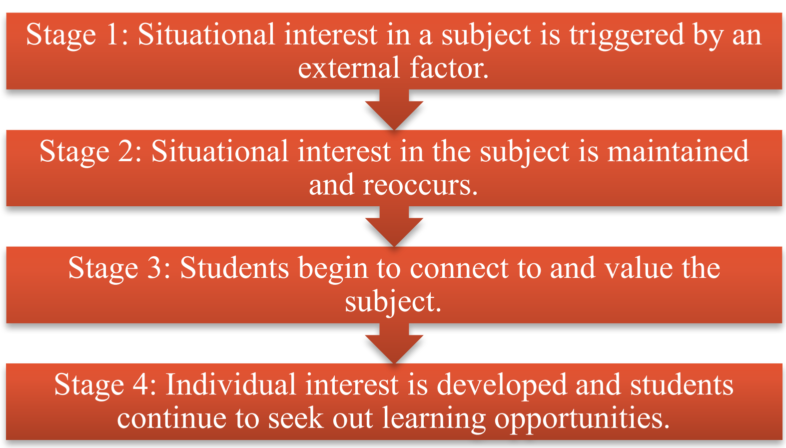

Figure 2.1. Four stages of interest development

Figure adapted from Hiddi & Renninger, 2006

Interest is an important motivational variable in education (Hidi, 2006). As displayed in Figure 2.2, when situational interest is sparked in a subject and it recurs over time, individual interest is developed. From this, students will become intrinsically motivated to continue to learn and seek out information, ultimately leading to a positive outcome in academic performance (Dev, 1997). If a student is unmotivated and not inspired to achieve a goal, this is referred to as ammotivation (Ryan & Deci, 2000). In contrast, if a student is intrinsically motivated, students choose to follow through with a task because they enjoy it, not just because it is required (Csikszentmihalyi, 1990). When a student is extrinsically motivated, they complete a task to achieve a specific outcome (Ryan & Deci, 2000). Through interest and motivation, students can create an experience that results in high quality learning and achievement (Ryan & Deci, 2000).

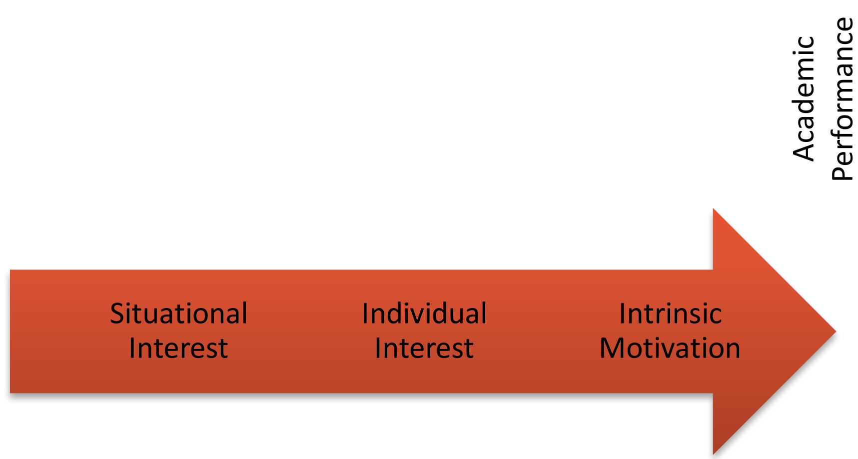

Figure 2.2. Interest and motivation impact academic performance

Harackiewicz et al. (2016) describes two intervention approaches to interest. The first is to create and maintain situational interest by providing activities that challenge and engage students. The second intervention is to expand on students' individual interest by connecting ideas of a new topic with topics that are already of interest (Harackiewicz et al., 2016). In order to create situational interest, educators should provide students with a variety of unique hands-on activities that allow students to make choices and work with others (Palmer, 2009). Walkington (2013) reported that high school students who received story problems related to their interests in a math class performed better academically than those who received standard, non-personalized story problems. This illustrates that adapting lessons to focus on students' individual interests may increase their motivation to learn and perform better academically. Problem based learning is another way to create situational interest in the classroom. For example, students are given a real-world problem to solve and are motivated to continue seeking answers as the problem intensifies and relates to their own life (Harackiewicz et al., 2016). A fourth way of interest intervention is through encouraging students to find value in the subject. A study by Rozek et al. (2017) consisted of teachers communicating with parents of high school students about the importance of math and science. In turn, the parents communicated this with their children, leading to take an additional science or math course compared to other students. Additionally, these students were also more likely to purse STEM course in college and plan to pursue STEM careers. Lastly, as with any educational activity, not all interest interventions will be successful for all courses or students (Harackiewicz et al., 2016). To promote interest through hands-on, problem based learning activities, educators can challenge and motivate students through the promotion of critical thinking.

2.3.2 *Skills in the Workforce*

In addition to creating interest in agriculture and STEM careers, educators can promote the development of soft skills in their students. When hiring new employees, employers look for candidates who possess skills such as communication, decision-making/problem solving, teamwork, self-management, and professionalism (Wickenhauser et al., 2021). In addition, these "21st Century Skills" provide students with the ability to live in a changing world and adapt to new circumstances (Stehle & Peters-Burton, 2019). Through problem-based learning, reflection, and group work, students can practice these skills (Stehle & Peters-Burton, 2019). Koh et al. (2015) suggested that educators should integrate design thinking in their curriculum that challenges students to create, evaluate, and improve a product rather than just demonstrate their knowledge.

2.3.3 *Bloom's Taxonomy*

Active learning allows the learner to critique and challenge content and provides them with engaging opportunities rather than simply recalling information (Tabrizi & Rideout, 2017).

Providing students with effective questions will promote a positive learning environment (Tofade et al., 2013). This can be achieved through the use of Bloom's Taxonomy (Bloom, 1956; Anderson & Krathwohl, 2001), which guides educators on creating learning objectives for their students. Bloom's Taxonomy consists of six categories that increase in complexity of cognitive skills as seen in figure 2.3 (Adams, 2015). Questions that fall under the higher-order critical thinking skills (*Analysis, Evaluate, Create*) require students to think deeper and transfer their knowledge of the subject to something new (Adams, 2015). In addition, these questions increase students' curiosity in the subject and promote engagement (Remark & Ewing, 2015). In a study by Miri et al. (2007), students' critical thinking skills increased when teachers promoted high-order thinking in their classrooms. Through higher-order questions and active learning, educators can provide their students with a positive learning environment where they are encouraged to practice critical thinking.

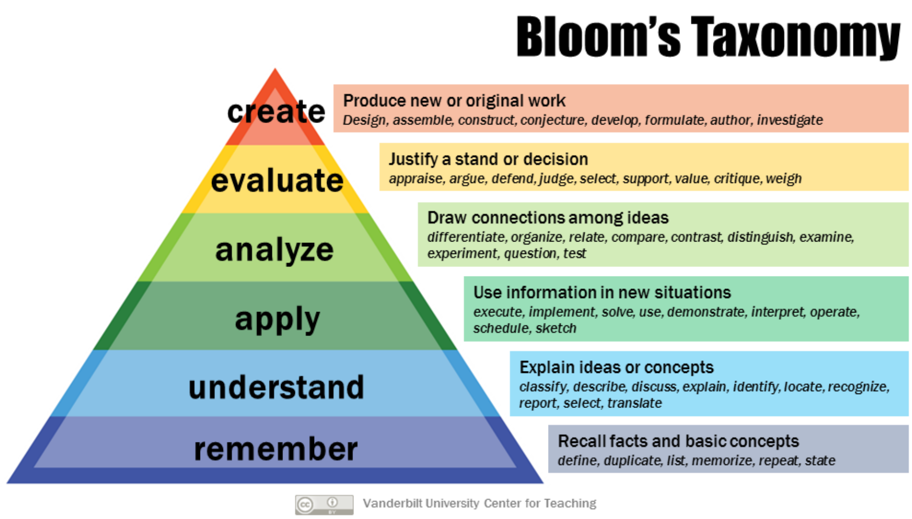

Figure 2.3. Bloom's Taxonomy

Figure courtesy of Vanderbilt University Center for Teaching (Armstrong, 2010)

2.3.4 *Teaching Formats*

While elementary agricultural-related curriculum is limited, opportunities for online learning continues to grow, leading to more options for K-12 teachers to implement. Online learning is defined as using the internet, technology tools, and learning strategies to educate students from a distance (Colorado & Eberle, 2010). One method utilized is asynchronous modules, where students can access material at anytime and anywhere and work through materials at their own pace (Ally, 2004). Through a blended learning approach, teachers present students with the opportunity to learn both asynchronously online as well as through in person synchronous learning (Moorhouse & Wong, 2021). While little research has been done in this area, in order for blended and online learning to be effective, professional development needs to be in place to ensure teachers can provide students with proper support (Borup et al., 2021). Online material must be sequenced in an order that makes sense for students and can be summarized at the conclusion of the lesson so that students can see the big picture and reflect on what they learned (Ally, 2004). In addition, students should be provided with a variety of relevant and exciting activities that can be beneficial to all students and motivate them to learn (Ally, 2004).

One way that students are able to reflect on what they have learned is through the completion of an interactive notebook. Through the use of interactive notebooks, students can process what they learned online and create meaningful connections to their own life (Jaladanki & Bhattacharyya, 2014). Students can use an interactive notebook to take notes and answer questions that they can then utilize when reviewing and studying the material (Wist, 2015). When teachers write questions for the notebook, Bloom's Taxonomy can be utilized in order to stretch student's knowledge and transfer it to other subjects (Jaladanki & Bhattacharyya, 2014). A study by Marks et al. (2021) suggests that elementary students who utilized a physical, interactive notebook in addition to an online program increased content knowledge in an engaging and meaningful way.

Another way that students are able to reflect on what they have learned is through a collaborative group project. Collaborative learning can be defined as students interacting and using each other's knowledge and skills to solve a problem (Hammar, 2014). When implemented correctly, collaborative learning can increase student success by motivating students to achieve their goals (Slavin, 1996). For example, a study by Baines et al. (2007) looked at how a collaborative group project impacted students' knowledge levels. An experimental group consisted of classrooms that were part of an intervention program that trained teachers how to implement group work. While the experimental group utilized group work, the control group consisted of classrooms that utilized primarily individual learning and the teachers did not partake in an intervention. The results showed that students who utilized group work increased knowledge levels over the course of the year. In order to achieve the goal, all group members had to work together and collaborate to solve the problem (Slavin, 1996). In addition, students strengthen communication skills, share and observe others' viewpoints, and work through differences or misunderstandings which can be beneficial as they move forward in life and eventually into the workforce (Hammar, 2014).

2.4 Teacher Impact on Learning

2.4.1 *Teacher Self-Efficacy*

According to a year national survey, 67% of surveyed US elementary teachers felt unprepared to teach science, which in turn had the potential to impact how they teach their students (Menon & Sadler, 2018). Bandura's (1977) self-efficacy theory states that one's belief in their ability to achieve a goal reflects their behavior and actions. In addition, people with high self-efficacy tend to show higher levels of more continuous effort (Roberts et al., 2001). Elementary teachers generally have a low self-efficacy in teaching science because of negative perceptions of science, lack of materials to teach science, and the reliance on videos to teach science (Avery & Meyer, 2012). By providing teachers with professional development programs, their self-efficacy can increase. For example, a study by Knaggs and Sondergeld (2015) showed that with proper science education and proper science teaching education, teachers can increase their science self-efficacy. Dutton (2016) showed that, especially in agriculture, topics can change over time and lead to educators' need for additional training programs to effectively teach students. Their study showed that teachers' self-efficacy in teaching about greenhouse crop production increased after participating in a greenhouse management workshop. Through professional development trainings and workshops, teachers can increase their self-efficacy and provide students with a positive learning experience (Dutton, 2016).

2.5 Conclusion

The agriculture industry, especially Indiana's turkey industry, is continuing to expand opportunities for employment. However, students entering college and the workforce lack interest and skills to fulfill these career openings. Through agricultural-related curriculum, teachers can provide students with the resources and support they need to increase their agriculture literacy and interest in the industry. In addition, students can apply curriculum to real-world problems through STEM integration and higher order thinking skill development. By creating programs that are engaging and appealing to students, agricultural-related curriculum can be a successful way to create awareness of the industry and introduce students to career opportunities.

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CHAPTER 3. CREATING AWARENESS OF THE TURKEY INDUSTRY THOUGH AN ONLINE STEM-BASED CURRICULUM

3.1 Abstract

Elementary students have minimal exposure and understanding of the farm to fork process. Exposure to agriculture curriculum is critical to increasing agricultural literacy and awareness of where food comes from. The objective of this study is to investigate student interest, awareness, and literacy gains after completing an online STEM-based turkey curriculum. In Fall 2021, the POULT program was implemented in 23 4th and 5th grade classrooms across Indiana with a total of 472 student enrolled and a 53.81% response rate. Students completed 5 online modules, an interactive notebook, and class project over six consecutive school days. Demographic information, individual interest, agriculture content questions, and situational interest were measured at various time points throughout the program. Results indicated that student content scores increased at the end compared with beginning scores (6.94 vs 9.70, $P < .001$). Additionally, students' individual interest, prior agriculture knowledge, and agriculture experience impacted their situational interest. Situational interest subscales novelty and attention demand were both high throughout completion of the POULT Program. Students enjoyed completing the online digestion simulation game and learning about the farm to fork process. In conclusion, online STEM-based agriculture programs can be a positive way to increase students' interest and knowledge in agriculture.

Keywords: agricultural literacy, curriculum, elementary, interest

3.2 Introduction

Over time, the gap between the understanding of the farm to fork process has increased. Urban populations continue to grow and consumers are more removed from food production (Satterthwaite et al., 2010). However, this does not lessen the consumer's desire to know how their food was produced and choose healthy food (Gundala & Singh, 2021). Additionally, the world population is increasing and expected to reach 9.7 billion by 2050 (United Nations, 2019), and with this increase will come a greater need for increased food production. Therefore, the demand for skilled employees in the agriculture industry continues to increase. Approximately 59,400 career openings for college graduates in fields such as food science, renewable resources, and environmental science will become available each year between 2020 and 2025 (Fernandez et al., 2020). An increase in interest and knowledge in agriculture will be vital to fulfilling these career openings. However, this comes at a time when fewer students are showing an interest in agriculture careers (Jean and Christian, 2018). The demand for poultry products will continue to increase because it is a sustainable, nutritious and affordable protein source (Yegani, 2009). In fact, between 2023 and 2031, global poultry consumption is predicted to increase by 16.7% (USDA Agricultural Projections to 2031, 2022). However, the number of students interested in the industry has declined. For example, since the 1940s, university poultry science departments decreased from 45 to just six today (Thaxton et al., 2003). This creates a challenge for the agriculture industry on how to increase student interest and fulfill career demands.

Not only is interest in agriculture decreasing, but so is consumer knowledge on the history and understanding of food production, also known as agricultural literacy (Frick & Kahler, 1991). As populations become increasingly urbanized, a disconnect from farm to fork exists (Roberts et al., 2016). One way to increase student interest in agriculture and agricultural literacy is the integration of agriculture content in K-12 classrooms (Peake et al., 2020). There is limited agriculture curriculum available for teachers to utilize in their classrooms. The Agriculture in the Classroom program, sponsored by the USDA, provides lesson plans related to agriculture content (Pense et al., 2005). Traditional agriculture courses are also available in some middle and high schools along with the National FFA Organization, which provides youth with hands on career and technical opportunities (Roberts et al., 2016). In regard to poultry-related curriculum, various associations such as the US Poultry and Egg Association provide curriculum and resources for teachers to implement in their classrooms (US Poultry and Egg Association, 2021). Despite these examples, there are still not enough programs that cover all aspects of production agriculture from farm to fork for K-12 students.

In addition to agriculture, there is an increase interest in integrating STEM (science, technology, engineering, and math) skills with other subjects will help students to see the relevance and importance of learning these subjects. Additionally, when STEM is integrated with agriculture content, such as food and natural resources, students develop skills needed to solve real world problems (Wang & Knobloch, 2018). For example, STEM skills prepare students for a future career in solving global issues such as food insecurity (Kelley & Knowles, 2016). As students practice these skills and develop positive relationships with learning, they are more likely to pursue a future career in the field (Nugent et al., 2015). The Social Cognitive Career Theory describes students' career choices based on their interests (Lent et al., 1994). Situational interest is created by interactions with external stimuli in the environment (Rotgans & Schmidt, 2017). Over time, as students reengage in the task, they begin to make connections and value the subject. This sustained situational interest can lead to development of individual interest, where students actively participate and seek out learning opportunities (Hidi & Renninger, 2006).

In order to promote interest, educators can challenge students (Harackiewicz, 2016). For example, by utilizing higher-order thinking skills, students are challenged to practice critical thinking, which promotes deeper thinking and the transfer of knowledge to new ideas (Adams, 2015). Several formats are available for teachers to integrate higher-order thinking in their lessons. Online learning is utilized using both synchronous (in real-time) and asynchronous (materials accessible at any time) methods (Ally, 2004). Interactive notebooks are often utilized for students to reflect on what they have learned. This allows students to process and review information in a meaningful way (Jaladanki & Bhattacharyya, 2014). Through collaborative learning, students are able to work with one another in order to solve problems (Hammar, 2014). Additionally, students are more likely to be motivated to learn when working with peers (Slavin, 1996). By implementing agricultural-related curriculum, students' interest may increase and close the gap between the understanding of farm to fork process.

The purpose of our study is to examine the impact of an online STEM-based agricultural-related curriculum on elementary students' interest and agricultural literacy. The POULT Program was created to provide 4th and 5th grade teachers with agricultural-related curriculum on the turkey industry. By better understanding the impact of agriculture curriculum, like the POULT Program, on interest and literacy, we can create programs that have potential to impact students' career interests. Our study was guided by the following three questions:

1. Does the taxonomy of notebook assessment questions have an impact on students' interest in poultry science-based activities?
2. Does prior experience, prior knowledge, and participation in the POULT program have an impact on students' interest?
3. Does the POULT program increase agricultural literacy?

3.3 Methods

3.3.1 *Context and Participants*

Elementary school teachers across the state of Indiana were recruited to participate in the POULT Program. Various recruitment efforts were utilized including emails and information sessions. Examples include an information poster at the virtual Indiana STEM Education Conference in January 2021 and emails about the program through the Indiana Association of School Principals list serves. Registration was a first-come basis until we reached our desired number of 500 student participants by the July 15, 2021 deadline. Overall, 17 teachers registered for the program, representing 23 classrooms (482 students; 20.83 ± 4.63 students/classroom). The 23 classrooms were distributed by the following grades: ten fourth grade (43.48%), 12 fifth grade (52.17%), and one $4^{th}/5^{th}$ grade (4.35%).

In early August, we mailed each teacher POULT program materials for the POULT program (teacher guide, consent forms, interactive student notebooks, materials for the class project including the career cards and worksheets). Each teacher signed up to attend one of four virtual informational meetings that took place in mid-August. In these meetings, teachers learned about expectations of the POULT Program, program materials, online program navigation, and research objectives for the program. Teachers were instructed to complete all aspects of the POULT Program between September 1 and November 15, 2021.

3.3.2 *Program Development*

The POULT Program was designed to engage students in STEM, increase awareness of the turkey industry, increase overall agricultural literacy, and provide fun, free activities to meet Indiana Academic Standards. This program specifically targeted 4^{th} and 5^{th} graders because of their developmental process. During these elementary years, students begin to create values, are open and perceptive to new ideas, and begin building interest (van Tuijl & van der Molen, 2016). The program consisted of five online modules, an interactive student notebook, simulation game, and class project (Table 3.1). Teachers were expected to implement the program across six consecutive school days, spending 30 to 40 minutes each day on the program. During the first five days, students asynchronously completed material in their interactive student notebooks as they worked through the online module material. In addition to the online module on day three, students completed an online turkey digestion simulation game. On the sixth day, teachers guided the class through a synchronous class project. During program development, an advisory committee consisting of two Indiana $4^{th}/5^{th}$ grade teachers and three turkey industry representatives were present to review the curriculum for accuracy and appropriateness.

Table 3-1. POULT Program daily schedule for student participants

Day	**Topic**	**Activities**
1	Introduction to the Turkey Industry	Interactive Student Notebook Online Module
2	Turkey Production: From Farm to Fork	Interactive Student Notebook Online Module
3	Turkey Anatomy and Physiology	Interactive Student Notebook Online Module Turkey Digestion Simulation
4	Animal Welfare: Healthy and Happy Turkeys	Interactive Student Notebook Online Module
5	Why Eat Turkey?	Interactive Student Notebook Online Module
6	Careers in the Turkey Industry	Class Project

Note. Students completed the POULT Program over six consecutive school days. On the first five days, students completed an interactive notebook as they worked through an online module. On the third day, students also completed an online turkey digestion simulation game. On the sixth day, students completed a class project led by their teacher.

3.3.3 *Learning Objectives and State Standards*

Each of the POULT program's five modules included a list of learning outcomes that were mapped to Indiana Academic Standards for 4^{th} and 5^{th} grade students (Table 3.2). In addition, National Agriculture Learning Outcomes and STEM skills were also considered when designing curriculum. National Agriculture Learning Outcomes provide students with the skills they need to solve real world problems while integrating science, social studies, and health with other content areas (Spielmaker & Leising, 2013).

Table 3-2. POULT Program learning objectives

Module Title	Learning Outcomes
1: Introduction to the Turkey Industry	1. Define agriculture and explain the concept to others. 2. Classify everyday products as agricultural or non-agricultural and defend why they fall into the two categories. 3. Discuss the importance of the turkey industry to Indiana's economy. 4. Identify and discuss important agriculture events in US history. 5. Explain the general history of turkey farming and describe how it has progressed over time.
2: Turkey Production: From Farm to Fork	6. Formulate a basic diet for turkeys and describe how the feedstuffs are grown. 7. Organize the steps involved in the turkey industry from breeding to processing. 8. Differentiate the different stages of growing and producing turkeys. 9. Define what sustainability is and develop ways that turkey farmers can practice.
3: Turkey Anatomy and Physiology	10. Differentiate male and female turkey characteristics and identify basic parts. 11. Describe the parts and functions of the turkey digestive tract. 12. Describe the egg laying cycle and embryo development.
4: Animal Welfare: Healthy and Happy Turkeys	13. Demonstrate an understanding of the five freedoms. 14. Explain the role Temple Grandin has played in animal welfare and the turkey industry. 15. Define biosecurity and develop proper practices to keep humans as well as animals safe and free of disease.
5: Why Eat Turkey?	16. Differentiate different nutrient classes and explain their role in health. 17. Categorize common food items by their nutrient class. 18. Examine the nutrients turkey provides and describe the health benefits. 19. Students are able to select turkey products and understand what their labels mean. 20. Develop simple and nutritious turkey recipes that can be made later at their homes.

Note. Each online module in the POULT Program was based on learning objectives that were based on the Indiana Academic Standards for 4^{th} and 5^{th} grade students.

3.3.4 *Online Modules*

For the first five days of the POULT Program, students completed a series of online modules accessed through D2L Brightspace (D2L Corporation, Canada), a learning management system. Modules were created via Story Line 360 software (Articulate, New York, NY). Each module included short videos, readings, and interactive activities that were aligned to the learning outcomes (Table 3.1). At the end of each module, students completed questions to reflect on the module's content. Figure 3.1 includes example screenshots from the online modules.

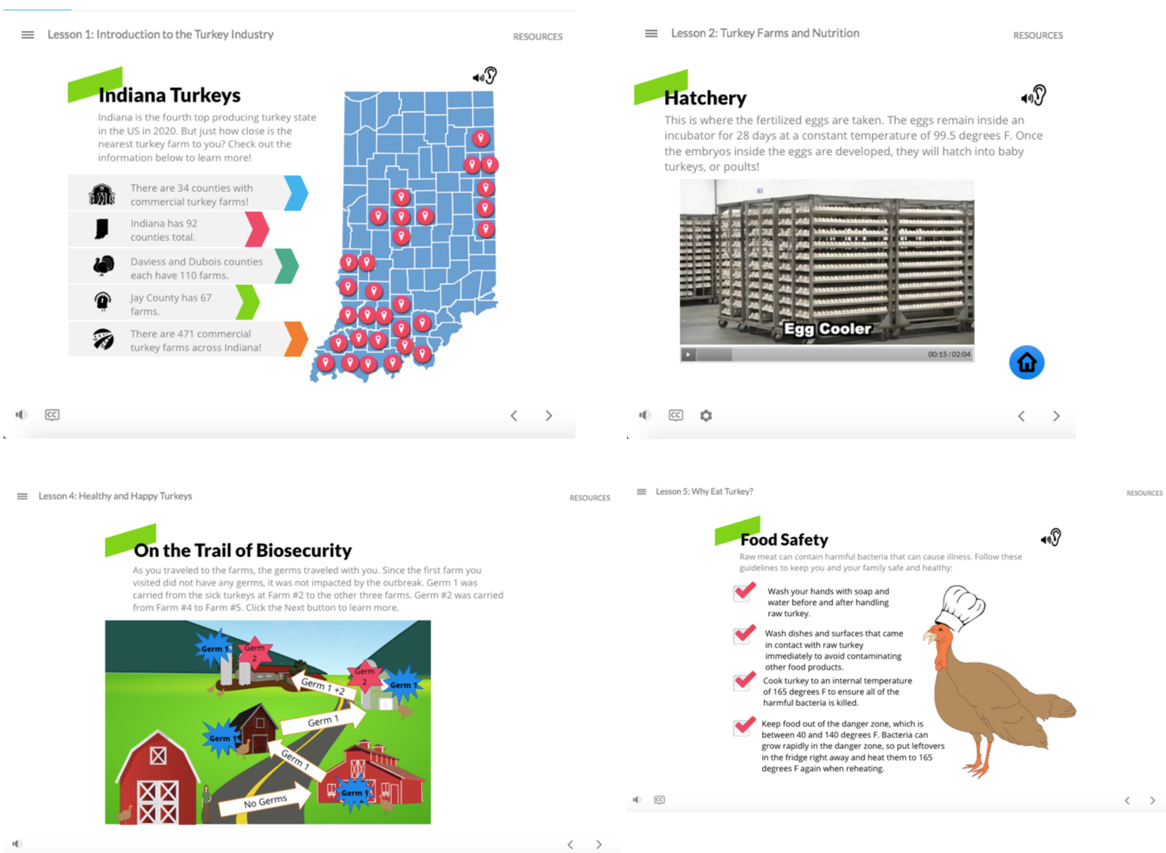

Figure 3.1. POULT PROGRAM screenshots from online modules

The structure of the online modules for the POULT Program was based off previous online poultry-related curriculum (Marks et al., 2021 and Erickson et al., 2019) and the ARCS (Attention, Relevance, Confident, Satisfaction) model (Keller, 1987). The ARCS model is a method of instructional design that incorporates motivational theory into creating effective and meaningful learning activities for students. According to this theory, instruction needs to hold and sustain students' attention, be relevant to students, build confidence in students, and satisfy students' needs for a sense of accomplishment (Keller, 1987). By incorporating this model into the design of the POULT Program online modules, students were more likely to be stay engaged through the curriculum. Students' attention was held and sustained through a variety of short and interactive activities that required reading, listening, making decisions, and solving problems. All of the material was made relevant to students by demonstrating how the turkey industry played a role in their lives. The online modules were designed to build students' confidence and provide them with a sense of accomplishment because activities and questions all had goals for students and could not be continued until they achieved the goal. For instance, students were asked questions throughout the modules. Hints were provided for students until they selected the correct answer.

3.3.5 *Interactive Student Notebooks*

As students completed each online module, they had a physical, interactive notebook to complete. The use of an interactive student notebook allows students to reflect on their learning and make connections between the new material and their own life (Jaladanki & Bhattacharyya, 2014). The notebook consisted of five chapters that corresponded with each online learning module as well as a section at the end for class project notes and a final reflection. We created two versions of the notebook. Both versions included the same questions at the beginning of each module that allowed students to think about the module's content. Both versions also included reflection questions at the end of each chapter so students could reflect on what they learned and what questions they still had over the material for the day.

The primary difference between the two versions of the notebooks was the primary type of questions asked in each section. In version 1, students were asked lower-order thinking questions and answered questions that required them to recall information they learned in the online module (Nappi, 2017). Questions required students to *remember, understand,* and *apply* their knowledge as described in Bloom's Taxonomy (Bloom, 1956; Anderson & Krathwohl, 2001). In contrast, notebook version 2 included higher-order thinking questions that allowed students to become more independent thinkers (Nappi, 2017). These questions challenged students to *analyze, evaluate,* and *create* in order to demonstrate their knowledge (Bloom, 1956; Anderson & Krathwohl, 2001). An example of the two types of questions can be seen in Figure 3.2.

Notebook Version	Question Type	Example Question
1	Lower-order thinking recall question	Identify three agriculture and three non-agriculture products in addition to the ones listed.
2	Higher-order thinking transfer question	There are many products that can be made from either agriculture or non-agriculture products. One example of this is paint. Today's paint is a non-agriculture product because it is made from synthetic chemicals. However, many years ago, paint was made from agriculture products such as berries. Develop a product that could be made from either agriculture or non-agriculture products. Draw and describe your product below.

Figure 3.2. POULT Program interactive student notebook question examples

3.3.6 *Simulation Game*

An online simulation game was embedded in online module 3 (Figure 3.3). This game aligned with the module's topic of Turkey Anatomy and Physiology. Similar to the online modules, the simulation game was also based on the ARCS model (Keller, 1987). Students chose a "character" and worked their way through the digestive tract of a turkey. Student attention was encouraged through "pointing and clicking" their way through the digestive tract while answering questions. Additionally, the content was relevant and related back to students own digestive systems. Before moving to the next screen, the student had to correctly identify anatomical parts, describe functions, and identify the location of the feed product's energy in relation to the digestive system. This encouraged students to build confidence by ensuring they correctly answered the questions before moving on. The simulation was designed to leave students with a feeling of satisfaction and achievement once all parts of the digestive tract were "unlocked" and they made it through the digestive tract.

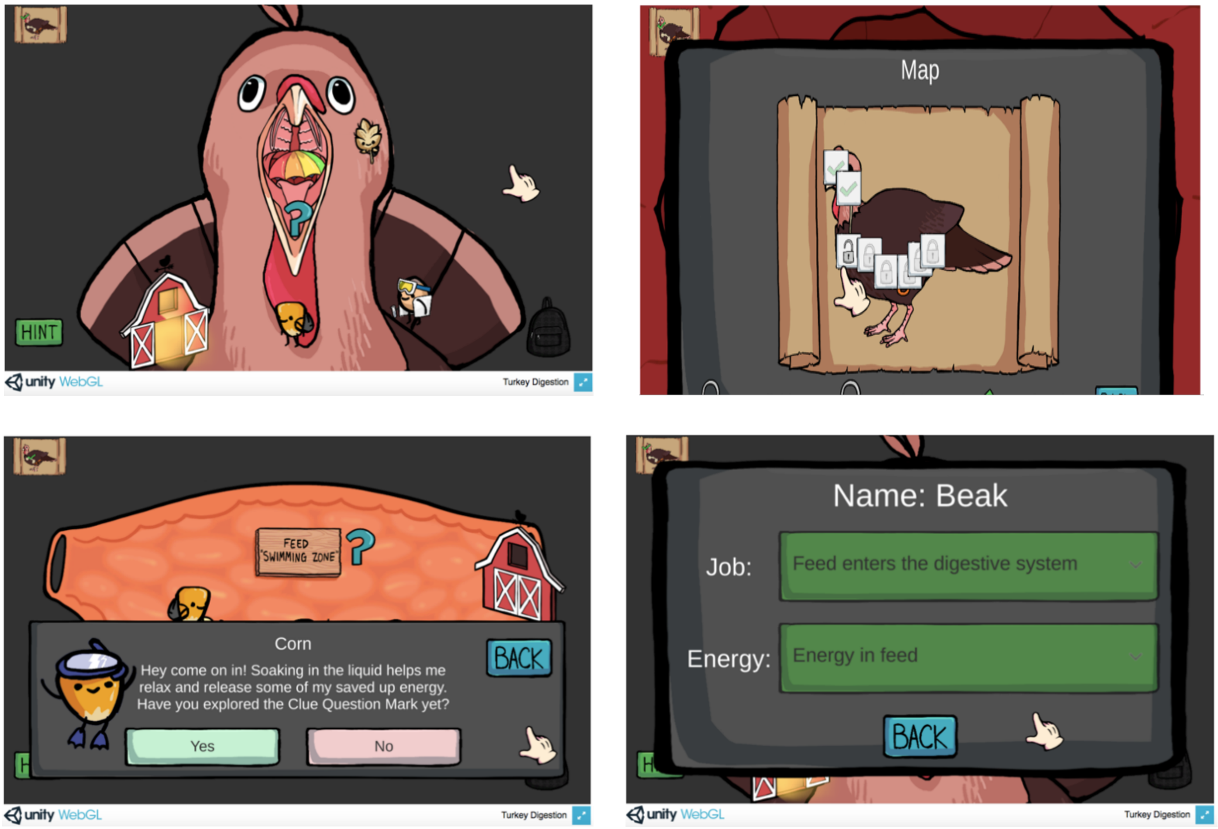

Figure 3.3. POULT Program turkey digestion simulation game

3.3.7 *Class Project*

On the sixth day of the POULT Program, students completed a class project that was led by their teacher and included group work and discussion. Incorporating group work allows students to collaborate with one another and share ideas. In addition, group work provides students with skill development such as communication and teamwork. Students can share their ideas with one another and build upon their learning (Wilson et al., 2018). Students were divided into small groups of three and each student using the Process of Oriented Guided Learning Inquiry and were assigned a role as a recorder, manager, or speaker (The POGIL Project, 2021). The group project combined information presented in the online modules on career opportunities to emphasize the importance of the careers in the farm to fork process. Each group received “career cards” (Figure 3.4) and worked together to discuss and determine at what stage of the farm to fork process each career belonged. After answers were shared with the class, the teacher led a class discussion on the importance of the farm to fork process and potential careers in the turkey industry. Group discussion allows for students to hear others' viewpoints and make connections with their own lives (Buchanan, 2011). Immediately following the class project, students completed final reflection questions in the interactive notebooks.

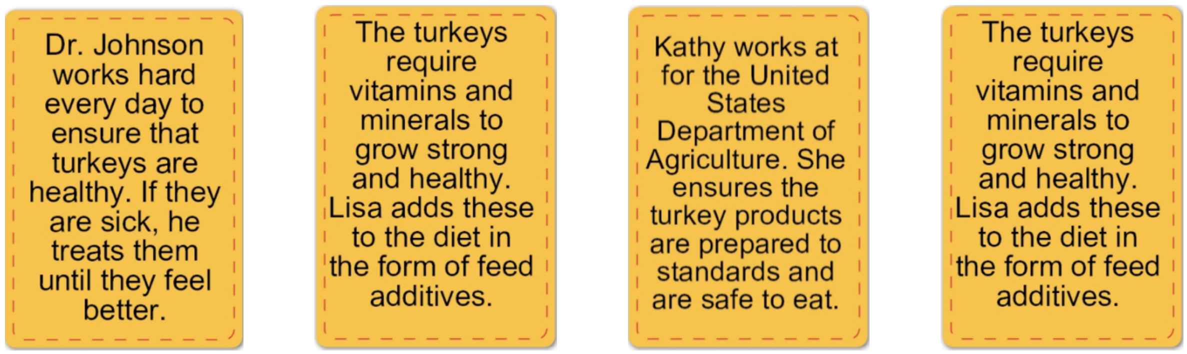

Figure 3.4. POULT Program class project career cards

3.3.8 *Study Design*

A mixed methods approach was used to evaluate the POULT Program's effectiveness in creating awareness of the turkey industry. Questionnaires were administered to assess student demographics, prior experience with animal agriculture, individual interest prior to the program, situational interest at various time points, and change in agriculture literacy. Prior to beginning the program, teachers sent consent forms home with students. Students and their parents had to give consent to participate in the research aspect of the program. If consent was not given, questionnaire data for that student was deleted and not used in this study. Two hundred fifty-four students (52.70%) provided consent and were included in the study. Two of the classes dropped out or did not complete the program requirements, therefore were not included in the study. The study and its components were approved by Purdue University's Institutional Review Board.

3.3.9 *Instrumentation*

To collect quantitative data, students completed three questionnaires throughout the POULT Program prior to module 1 on day one (T1), after module 5 on day five (T2), and after the class project on day six (T3; Table 3.3). Students completed all questionnaires via Brightspace's (D2L Corporation, Canada) survey feature. Prior to beginning the program (T1), students (n=244; 50.62% response rate) answered seven multiple-choice questions about their demographics and prior experience with agriculture. These included specific questions about hometown (n=1), experience with various species of animals (n=1), participation in various agricultural activities (n=3), and whether or not they have knowledge in agriculture and turkey production (n=2). Students' hometown was classified as farm, rural non-farm (<10,000 citizens), town (10,000-50,000 citizens), suburb (<50,000 citizens), or central city (>50,000 citizens).

Table 3-3. POULT Program student questionnaires

Day	**Questionnaire**	**Content**
Day 1 prior to module 1	1	Individual interest, ag literacy, demographics, prior experience
Day 5 after module 5	2	Situational interest, ag literacy
Day 6 after class project	3	Situational interest

Note. Students were given questionnaires on day 1, 5, and 6 of the POULT Program to measure their individual interest, agricultural literacy, demographics, prior experience, and situational interest.

Individual interest was assessed with the Individual Interest Questionnaire (IIQ) (Linnenbrink-Garcia et al., 2010) to determine student interest in the turkey industry at the start of the program. Five statements were provided that analyzed students' feelings and attitudes towards the turkey industry: the turkey industry is useful for me to know about; the turkey industry helps me in my daily life outside of school; I enjoy learning about the turkey industry; I like the turkey industry; the turkey industry is exciting to me. Students ranked each statement using a 5-point self-report scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Students' situational interest was measured after completing the fifth online module (T2, n=153; 31.74% response rate) and after completing the class project (T3, n=139; 28.84% response rate) using the Situational Interest Scale (SIS; Sun et al., 2008). The scale consisted of 15 questions that analyzed 5 subscales: attention demand, challenge, novelty, exploration intention, and instant enjoyment. Students answered questions on a 4-point Likert scale based on questions from Sun et al. (2008) study. Both situational interest and individual interest scales utilized questions based off a study by Marks et al. (2021) that were validated with a similar group of students.

Student agriculture literacy was assessed through questions in questionnaire 1 (T1, n=244) and in questionnaire 2 (T2, n=153) to evaluate the change in agricultural literacy from the start of the program to after completion of the online modules. Students were given the same 15 content questions at each time point to measure the change in the number of questions correctly answered. The questions were all multiple choice with four answer choices. The answers could be found in the POULT Program online modules and were aligned to meet National Agriculture Learning Outcomes (Spielmaker & Leising, 2013) and Indiana State Academic Standards.

All students, regardless of which notebook version they received, answered questions about their experience with the POULT Program. Four reflective, open-ended questions were asked about students' favorite part of the online module, favorite part of the class project, most important information learned in the program, and what they still want to learn more about. These questions were based off of questions created for a similar group of students in Marks et al. study (2021). The interactive notebooks were collected after the class project (T3) to determine common themes among the answers that students provided (n=208; 43.15% response rates).

3.3.10 *Statistical Analysis*

Quantitative data was analyzed using IBM SPSS software (2020, Armonk, NY). Cronbach's alphas were analyzed to determine the consistency of the individual interest and situational interest questionnaires. For the SIS, Cronbach's alpha varied between the subscales: instant enjoyment (0.81), novelty (0.64), challenge (0.61), attention demand (0.68), and exploration intention (0.54). Multiple linear regressions were run to identify the relationship between students' demographics, prior experience, individual interest, and situational interest. A paired sample t-test was completed to show the change in agricultural literacy from T1 to T2. Interactive student notebook types were compared by utilizing mean comparisons of students' situational interest. Additionally, means of situational interest were compared between T2 and T3 for each notebook type. Students' reflective, open ended questions regarding their experience with the POULT Program were qualitatively analyzed utilizing inductive coding. Responses were grouped together in common themes (Skjott Linneberg & Korsgaard, 2019).

3.4 Results

3.4.1 *Demographics*

The majority of students (n=127, 52.05%) reported living in town. Sixty-two students (25.41%) reported living in a rural, non-farm location. Twenty-seven students (11.07%) lived in the suburbs and 22 students (9.02%) reported that they lived on a farm. Only six students (2.46%) reported that they lived in a central city.

3.4.2 *Individual Interest*

The mean individual interest at the start of the program was 3.24 ± 1.06 on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). This indicates that individual interest was relatively neutral at the start of the program. Students' agriculture knowledge ($p=0.03$) and knowledge on turkey production ($p<0.001$), at the start of the program, positively impacted individual interest at T1.

3.4.3 *Situational Interest*

The SIS includes five subscales: instant enjoyment, novelty, challenge, attention demand, and exploration intention. Students' individual interest at T1, positively impacted their attention demand (T2=3.14; T3=3.06), challenge (T2=2.62; T3=2.56), exploration intention (T2=3.01; T3=2.71), novelty (T2=3.14; T3=3.16), and instant enjoyment (T2=2.86; T3=2.84) in both T2 and T3 ($p<0.05$). In T2, students' agriculture knowledge negatively impacted their attention demand ($p=0.002$), exploration intention ($p=0.02$), and novelty ($p=0.03$). Exploration intention can be described as the desire to continue exploring the task, attention demand is experienced when the student engages in the activity and develops an enjoyment for continuing in the task, and novelty is comprised of unique, original components that cause students to explore the task (Chen et al., 1999). Students' agriculture experience positively impacted their challenge (p=0.04) and exploration intention (p=0.02). These students found the activity difficult but still within their means to "solve" the problem (Chen et al., 1999). In T3, students' agriculture knowledge negatively impacted their instant enjoyment (p=0.002), which means they were not emotionally engaged in the task (Chen et al., 1999). Students' knowledge on turkey production negatively impacted novelty (p=0.04).

Attention demand (recall=3.08; transfer=3.19), challenge (recall=2.58; transfer=2.65), novelty (recall=3.08; transfer=3.19), exploration intention (recall=3.07; transfer=2.96), and instant enjoyment (recall=2.87; transfer=2.85) at T2 did not significantly differ between notebook types from attention demand (recall=3.01; transfer=3.10), challenge (recall=2.48; transfer=2.62), novelty (recall=3.12; transfer=3.19), exploration intention (recall=2.69; transfer=2.74), and instant enjoyment (recall=2.85; transfer=2.82) at T3 (table 4). When comparing the situational interest for each notebook type between time points (table 5), exploration intention was significantly higher in T2 for both the recall (p=0.002) and transfer (p=0.044) notebooks.

Table 3-4.Mean comparison of situational interest subscales between notebook types at T2 and T3

	Attention Demand	**Challenge**	**Novelty**	**Exploration Intention**	**Instant Enjoyment**
Time Point 2					
Recall (n=71)	3.08	2.58	3.08	3.07	2.87
Transfer (n=89)	3.19	2.65	3.19	2.96	2.85
Time Point 3					
Recall (n=67)	3.01	2.48	3.12	2.69	2.85
Transfer (n=78)	3.10	2.62	3.19	2.74	2.82

Note. Students completed one of two notebook types. Situational interest was measured at T2 (after online module completion) and T3 (after class project completion) and compared between notebook types. Asterisk indicates significance (p<0.05).

Table 3-5. Mean comparison of situational interest within notebook types between T2 and T3

	Attention Demand	Challenge	Novelty	Exploration Intention	Instant Enjoyment
Recall					
Time Point 2 (n=71)	3.08	2.58	3.08	3.07*	2.87
Time Point 3 (n=67)	3.01	2.48	3.12	2.69	2.85
Transfer					
Time Point 2 (n=89)	3.19	2.65	3.19	2.96*	2.85
Time Point 3 (n=78)	3.10	2.62	3.19	2.74	2.82

Note. Students completed one of two notebook types. Situational interest was measured at T2 (after online module completion) and T3 (after class project completion) and compared at each time point. Exploration intention was significantly higher in T2 for both recall and transfer notebooks. Asterisk indicates significance ($p<0.05$).

3.4.4 *Agricultural Literacy*

There was a significant increase in correct agriculture content questions from T1 (6.94 ± 2.14) to T2 (9.70 ± 2.89) ($p < 0.001$). This indicated that student understanding of the turkey industry increased from pre to post program implementation.

3.4.5 ***Student Feedback***

Students answers four questions in the final reflection of their interactive student notebook and responses were grouped together to form common themes for each question (Table 6). First, students (n=208) were asked to complete the following sentence: "My favorite part of the online modules was…" Three common themes were identified as the students' favorite part of the online modules: the farm to fork process, the feed mill, and the turkey digestion simulation game. Overall, 18 students (8.65%) enjoyed learning about the farm to fork process of turkey production. One student reported their favorite part was “learning about the different stages and farms the turkeys go through.” Sixteen students’ (7.69%) favorite part was learning about the feed mill and turkey’s diet. Another common theme was the turkey digestion simulation game that was embedded in module 3, as 53 students (25.48%) said that was their favorite part. One student said “it was fun going through the body.”

Next, students (n=208) were asked what their favorite part of the class project was and two common themes were identified: group work and decision making. Forty-eight students (23.08%) enjoyed working with groups and 47 students (22.60%) enjoyed deciding on where their “career card” fell within the farm to fork process. Students said they enjoyed “working in a group to get the job done! I honestly like working in groups so much” and “deciding which stage the cards went to.”

The third question asked students (n=211) what the most important information they learned in the program was. Thirty students (14.22%) found learning about the farm to fork process to be most important, and 32 students (15.17%) found the feed mill to be of most importance. One student learned that “a grain farm ties in with turkeys.” Several students (n=32; 15.17%) felt that learning about animal welfare and how turkeys are raised was also important. One student commented “how people support and help turkeys grow and live a happy life.”

The last question asked students (n=205) what they still want to learn about. Students were curious to learn more about the farm to fork process (n=22; 10.73%), turkey behavior (n=24; 11.71%), and anatomy and physiology (n=23; 11.22%). Specifically, a few students stated they wanted to learn more about “how to take care of them,” “how turkeys communicate,” “turkey circulatory system.”

Table 3-6. Student feedback on the POULT Program

Question	Common Themes	Examples
"My favorite part of the online modules was…"	Turkey Digestion Simulation Game Farm to Fork Process Feed Mill	*"turkey simulation because it was fun going through the body."* *"learning about the different stages and farms the turkeys go through."* *"when we learned what they eat and what's in their food."*
"My favorite part of the class project was…"	Group work Decision making	*"working in a group to get the job done! I honestly like working in groups so much!"* *"deciding which stage the cards went to."*
"The most important information that I learned in the program was…"	Welfare Farm to Fork Process Feed Mill	*"how people support and help turkeys grow and live a happy life."* *"how turkeys go to the store and their life cycle."* *"a grain farm ties in with turkeys."*
"I still want to learn more about…"	Farm to Fork Process Behavior Anatomy and Physiology	*"how to take care of them."* *"how turkeys communicate."* *"turkey circulatory system."*

Note. After completion of the POULT Program, students answered questions in their interactive student notebook in order to analyze their experience with the POULT Program. Responses (n=208) were grouped in common themes using inductive coding.

3.5 Discussion

This study was completed to better understand how students' previous experience, knowledge, and agriculture curriculum can impact students' interest and create exposure to future agriculture careers. We saw a neutral individual interest related to turkey production prior to program implementation, similar to a previous study that found elementary students' individual interest in laying hens to also be neutral prior to the start of the program (Marks et al., 2021). A larger gap exists between farm to fork and fewer students have exposure to the agriculture industry (Dimitri et al, 2005). Therefore, we expected to see less individual interest in agriculture, which is based on prior experience and exposure (Rotgans & Schmidt, 2017). Additionally, prior agriculture knowledge was positively correlated with individual interest. Individual interest is developed over time and students reengage in tasks that they have high individual interest in (Rotgans & Schmidt, 2017). This is consistent with another study that found students' prior agriculture knowledge was a strong indicator of interest in fifth and sixth grade students (Bickel, 2015). Individual interest also predicted situational interest, which is similar to a study where students' individual interest prior to beginning a series of lessons would predict their situational interest while completing the lessons (Tsai et al., 2008). Over time and engagement in similar tasks, situational interest may develop into individual interest, creating a need to re-evaluate individual interest (Hidi & Renninger, 2006). However, we did not measure individual interest after the POULT Program was completed because the time frame of the program (6 days) was too short to differentiate between situational and individual interest.

In T2, after completion of the online modules, students that had greater agriculture knowledge had lower attention demand, exploration intention, and novelty. This could indicate that students with prior agriculture knowledge did not find the online modules to be engaging, unique, or increase their curiosity (Chen et al., 1999). In T3, after the class project, students with more agriculture knowledge had low instant enjoyment and students with more knowledge on turkey production had low novelty. Questionnaires measuring students' agriculture and turkey production knowledge were self-report scales. This could have caused an inaccurate representation of students' actual, objective knowledge (Han, 2019). Agriculture is a large field that encompasses a variety of topics and disciplines outside of animal science. Students may have knowledge in agriculture but it may not necessarily be the content that was covered in the POULT Program. At the same time, students may have known all the material covered in the program, but may lack knowledge in other areas such as aquaculture or vegetable production. Additionally, this negative relationship between knowledge and situational interest could be due to repetitive information that students already knew. Knowledge is a significant indicator of situational interest. However, interest is lost once a threshold of knowledge is reached, indicating that novelty and uniqueness no longer present (Fastrich & Murayama, 2020).

Agriculture experience also had a positive relationship with challenge, which indicates that these students found the thinking they did in the tasks to be complex, demanding, and hard (Sun et al., 2008). In our study, immediately after module completion, students who reported greater agricultural experiences had lower exploration intention. These students may have taken the modules more seriously because they already found relevance to what they were learning and connected the information to their own experiences. Individual interest is created through repeated experiences over time and is a predictor of situational interest (Hidi & Renninger, 2006). This could explain why students who have had these agriculture experiences in the past are more likely to develop situational interest and continue to seek learning about the topic.

Students may have shown higher exploration intention after completing the online modules than after completing the class project because the class project was a review of what students had learned throughout the online modules, making the content repetitive. Additionally, the class project may have exhausted students on the topic because interest begins to decline as delivery of the same information increases (Fastrich & Murayama, 2020).

Higher-order thinking questions positively impacted students' interest and motivation (Caram and Davis, 2005), and there is a positive correlation between higher-order thinking skills and academic achievement (Sholihah et al., 2021). However, our study did not show differences in students' interest between notebook types. Yen and Halili (2015) discuss a few of the challenges with higher-order thinking in education. First, higher-order thinking requires more time than lower-order thinking skills. In the study, students were allotted 30 to 45 minutes to complete the online module and interactive student notebook, regardless of which notebook they were given. Students may have needed more time to fully practice these higher-order thinking skills. Additionally, students may not be as familiar with answering questions that require higher-order thinking. They may take the "easy way out" as well since the notebooks were not graded. Students may not take non-graded work as seriously as graded and their responses do not always reflect their true learning (Napoli and Raymond, 2004). Lastly, students completed the notebooks in their classrooms with their teachers' supervision. Not all teachers practice promoting higher-order thinking and may not have been able to support students when they needed help with a question.

3.6 Summary

By understanding how agriculture programs, prior experience, and prior knowledge impact students' interest, we can create more effective curriculum to increase agricultural literacy and create awareness of the industry. Our study demonstrated that students' prior knowledge and experience influences their situational and individual interest, and the POULT Program increased students' agricultural literacy and created situational interest, in particularly exploration intention. Several limitations existed that may have impacted the results of this study. Our study targeted 4th and 5th grade classrooms across Indiana, a state where turkey production is ranked number five nationally. Student knowledge, experience, and interest in agriculture might be different in other states where agriculture may be more prevalent or even more disconnected from students. While the study included schools across the state, many classrooms were from the same school district, which could also impact results. A wider variety of school districts could be included in the study to get a better representation of the Indiana elementary population.

Secondly, students had difficulties navigating the BrightSpace learning platform and logging into their unique profile. Future iterations of the program could focus on other modes of administration that will promote ease of use for elementary students. Additionally, this study was conducted during the fall of 2021 during a global pandemic. With students and teachers out of school in quarantine, schools unexpectedly shutting down and going remote, and increased stress levels in the school setting, results could be impacted. For instance, students may be able to focus more on the content of the program, leading to increased interest levels. Future studies should analyze the impact of agriculture curriculum during a time when distractions and abnormal classroom experiences are limited.

In conclusion, students' agricultural literacy increased from pre to post program completion. Students' individual interest was predicted by previous knowledge and had a positive impact on students' situational interest throughout the program. Students' agriculture knowledge, turkey knowledge, and agriculture experience impacted their situational interest at various subscales. The results of our study support the need to increase agricultural curriculum available to teachers. Utilization of these curricula can result in increased students interest and awareness of the farm to fork process.

3.7 Acknowledgements

This study was funded and possible through the support of Indiana's Turkey Market Development Council and the Indiana State Department of Agriculture.

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CHAPTER 4. IMPACT OF TEACHER SELF-EFFICACY ON ELEMENTARY CURRICULUM

4.1 Abstract

Teachers may be hesitant to implement STEM-based agriculture programs due to their perceived low self-efficacy in the subject area. More deliberate professional development resources for educators can be refined by understanding how their beliefs impact students' learning and interest. The objective of this study is to determine how teachers' previous knowledge and self-efficacy in agriculture impacts student interest in the turkey industry. Four hundred eighty-two students enrolled in the POULT program across 23 Indiana classrooms (17 teachers) in the fall of 2021. Students completed the program (online modules, interactive notebook, and class project) over 6 consecutive school days. Student situational interest was measured two times throughout the program. Teacher self-efficacy, previous agricultural experience, and knowledge of turkey industry were assessed at the start of the program (70.59% response rate). Teachers showed low self-efficacy in poultry content knowledge and high self-efficacy in engagement. Their agriculture experience positively increased their self-efficacy to motivate students to learn about turkey production. Additionally, teachers' instructional self-efficacy impacted students' situational interest. Overall, teachers found the program to be a positive way to engage students in agriculture. However, time commitments and technology issues may prevent them from implementing the program again in the future.

Keywords: self-efficacy, agriculture, curriculum

4.2 Introduction

As the world population increases, so does the need for employees in the agriculture industry. In fact, the world population is expected to reach 9.7 billion by 2050 (United Nations, 2019). Additionally, each year between 2020 and 2025, 59,400 new jobs open for college graduates in fields of agriculture (Fernandez et al., 2020). In order to fulfill these career opportunities, interest in agricultural industries needs to be present. Students are more likely to pursue a career in a field that interests them (Drymiotou et al., 2021). As the demographics of the American population shift from rural to urban areas, so does the public's connection with agriculture. In addition to interest, consumers' agriculture literacy, or their understanding of food and fiber production, also has decreased (Roberts et al., 2016). However, this does not change consumer concerns with how their food is produced (Kovar & Ball, 2013). Educating students about agriculture in more formal classroom settings, may be one strategy to increase student awareness of agricultural industries and job opportunities as well as agricultural literacy.

However, limited agriculture curriculum is available for teachers to implement in their classroom. According to the National Institute of Food and Agriculture, the National Agriculture in the Classroom program reaches five million students each year through their various agriculture activities (2022). For example, the program has lesson plans available for teachers that integrate agriculture with other subjects such as math and science and has been shown to increase agriculture literacy (Pense et al., 2005). In regards to the poultry industries, the US Poultry and Egg Association and American Egg Board have curriculum available that educates youth on poultry production (US Poultry and Egg Association, 2021; The Incredible Egg, 2021). Even with agriculture curriculum available, it is up to K-12 teachers to decide whether or not they implement these lessons in their classroom (Knobloch et al., 2007). Additionally, teachers' beliefs and past experiences play a role in what they teach their students (Knobloch et al., 2007). This is reflected through Bandura's (1977) self-efficacy theory, which states that behavior and actions are oftentimes dictated by one's belief in their ability to achieve a goal. The self-efficacy theory is applicable to agriculture and science as well. Elementary teachers in particular have a low self-efficacy in teaching science topics (Avery & Meyer, 2012). However, through proper teacher education trainings, teacher self-efficacy can increase and lead to better learning experiences for students (Dutton, 2016).

The purpose of our study was to examine teacher impact on students' interest and change in agricultural literacy. By examining teachers' demographics, previous experience, and self-efficacy in teaching agriculture, we can learn more about how students' interest and knowledge in agriculture is impacted. Our study examined how teachers and students responded to a STEM-based online agricultural-related curriculum for elementary students. Our study was guided by the following two questions:

1. Does the level of teacher agriculture knowledge and self-efficacy in the subject area have an impact on students' interest?
2. What are teachers' perceptions of implementing the POULT program in their classroom?

4.3 Methods

4.3.1 *Context and Participants*

The POULT Program was designed for elementary students in grades 4 and 5, as this age group is more perceptive to try new things and begin to build interest (van Tuijl & van der Molen, 2016). The desired number of student participants were 500, and recruiting efforts started at the beginning of 2021. An informational poster was presented at the virtual Indiana STEM Education Conference in January, where K-12 teachers attended to learn about possible STEM opportunities that could be implemented in their classrooms. In June, the Indiana Association of School Principals contacted Indiana elementary principals via their list serve. Information about the POULT Program and a recorded webinar was shared with teachers. Teachers registered via email and were then provided more details on program implementation. Registration ended on July 15, 2021; however, when the desired number of participants was reached, registration ended. Teachers could join a waitlist in the event that space became available.

After recruitment, there were 482 students registered for the POULT program across 23 Indiana classrooms. Class size ranged from 12 to 31 (mean=20.83±4.63). Grade distribution consisted of 47.83% 4th grade, 56.52% 5th grade, and 4.35% combined 4th and 5th grades. Seventeen teachers participated with four teachers teaching two classrooms and one teacher teaching three classrooms.

After registration ended, we mailed packages of POULT program materials to teachers in early August. Each teacher attended one of four virtual teacher meetings that took place in mid-August. The meeting provided an in-depth review of the POULT program requirements and expectations. Additionally, the meeting included time for teachers to ask questions or voice concerns. Teachers could start the POULT program anytime between September 1, 2021 and November 15, 2021, but once started, the program needed to be completed in six consecutive school days.

4.3.2 *Program Development*

The POULT Program was designed to increase awareness of the turkey industry and increase agricultural literacy by engaging students in STEM through free, fun activities. An advisory board consisting of two 4th and 5th grade teachers and three turkey industry representatives reviewed all aspects of the program and provided feedback during the program development.

The POULT Program consisted of five online modules, an interactive student notebook, an online simulation game, and a class project. During the first five days of the program, students completed one online module each day and answered corresponding questions in their interactive notebook. This work was completed asynchronously during a 30 to 40-minute period. Additionally, on day 3 of the online portion of the program, students completed the online simulation game that was embedded in the learning module. The collaborative class project occurred on the last day of the program (day 6).

4.3.3 *Learning Objectives and State Standards*

The curriculum and learning outcomes of the POULT Program were designed to meet 4th and 5th grade Indiana Academic Standards (Table 4.1). In addition, National Agricultural Learning Outcomes and STEM skills were also considered. National Agricultural Learning Outcomes are based on five themes including Agriculture and the Environment; Plants and Animals for Food, Fiber & Energy; Food, Health, and Lifestyle; Science, Technology, Engineering & Math; Culture, Society, Economy & Geography (Spielmaker & Leising, 2013). By integrating curriculum with these five themes, educators can provide students with skills to become more agriculturally literate and solve real world problems (Spielmaker & Leising, 2013). Additionally, by integrating science, technology, engineering, and mathematics skills in the POULT Program, students can understand how their school work is connected to real-world problems and sharpen problem solving skills (Estapa & Tank, 2017). Skills learned can then be applied to future class work and lead to career opportunities.

Table 4-1. POULT Program learning outcomes

Module	Title	Learning Outcomes
1	Introduction to the Turkey Industry	1. Define agriculture and explain the concept to others. 2. Classify everyday products as agricultural or non-agricultural and defend why they fall into the two categories. 3. Discuss the importance of the turkey industry to Indiana's economy. 4. Identify and discuss important agriculture events in US history. 5. Explain the general history of turkey farming and describe how it has progressed over time.
2	Turkey Production: From Farm to Fork	1. Formulate a basic diet for turkeys and describe how the feedstuffs are grown. 2. Organize the steps involved in the turkey industry from breeding to processing. 3. Differentiate the different stages of growing and producing turkeys. 4. Define what sustainability is and develop ways that turkey farmers can practice.
3	Turkey Anatomy and Physiology	1. Differentiate male and female turkey characteristics and identify basic parts. 2. Describe the parts and functions of the turkey digestive tract. 3. Describe the egg laying cycle and embryo development.
4	Animal Welfare: Healthy and Happy Turkeys	1. Demonstrate an understanding of the five freedoms. 2. Explain the role Temple Grandin has played in animal welfare and the turkey industry. 3. Define biosecurity and develop proper practices to keep humans as well as animals safe and free of disease.
5	Why Eat Turkey?	1. Differentiate different nutrient classes and explain their role in health. 2. Categorize common food items by their nutrient class. 3. Examine the nutrients turkey provides and describe the health benefits. 4. Students are able to select turkey products and understand what their labels mean. 5. Develop simple and nutritious turkey recipes that can be made later at their homes.

Note. POULT Program learning outcomes are aligned to Indiana Academic Standards, National Agriculture Learning Outcomes, and STEM skills for 4^{th} and 5^{th} grade students.

4.3.4 *Online Modules*

The POULT program's five online modules were created using Story Line 360 software (Articulate, New York, NY). Each student was given an individual login to access the program in D2L Brightspace (D2L Corporation, Canada), a learning management system. The modules were designed utilizing Keller's ARCS model. This model emphasizes that in order to motivate students to learn, the curriculum must be *attentive, relevant, confidence building*, and *satisfying* (Keller, 1987). The modules consisted of various activities including short videos and readings designed to increase students' attention and provide relevance to their own life. Additionally, the modules included click-and-interact activities designed to be satisfying for students. Content questions were created to make students feel confident in their abilities to learn agriculture content. By providing students with hands-on activities, they could make decisions and apply the new knowledge to other new and relevant contexts (Liao et al., 2021). Similar to Marks et al. (2021) and Erickson et al. (2019) studies, the POULT Program curriculum was designed to promote awareness of the turkey industry as well as provide students with interesting knowledge on the agriculture industry and its relevance to their own lives.

4.3.5 *Interactive Student Notebook*

As students worked through the online module, they also completed activities in their interactive student notebook. The use of the interactive student notebook allowed students to engage with the material from the online modules in a meaningful way (Marks et al., 2021). Notebook activities included questions that aligned to the online module learning outcomes and could be answered by completing the online modules.

4.3.6 *Simulation Game*

As students completed online module 3, Turkey Anatomy and Physiology, they also completed an online simulation game. Students played as a "feed ingredient" character and traveled through the turkey digestion system. Students learned about each part of the digestive tract and where energy from their feed was at within the turkey's body. Similar to the online modules, students made decisions and had to answer questions correctly before moving on. This encouraged students to stay focused and work until they learned the material correctly.

Additionally, students navigated through the turkey digestive tract with the use of a feed character of their choice.

4.3.7 *Class Project*

There are many benefits to teamwork in the classroom, including collaboration of information and ideas, stimulation of creativity, higher satisfaction with decision making problems, more effective learning, and essential life skills (Burke, 2011). On the last day of the POULT Program, students completed a class project that was led by the teacher. Students were divided into groups of 3 (or 3 to 4 depending on the size of the class) and assigned roles. By assigning roles to students, they are given a defined, important responsibility. The roles assigned in the POULT Program were recorder, manager, and speaker, that was based on the Process Oriented Guided Inquiry Learning method (The POGIL Project, 2021).

Groups were provided one to three "career cards," depending on the size of the class. Each card described a career profile of someone in the turkey industry. Students in small groups had to work together to determine which stage of the farm to fork process their "career card" belonged to based on the profile's responsibilities. Posters identifying the different farm to fork stages were set up at the front of the classroom. After small group discussions, the class regathered as a whole. The teacher had each small group share their answers with the rest of the class. Then a class discussion was implemented to reiterate the importance of each stage of the farm to fork process and potential careers in the turkey industry. Lastly, students completed final reflection questions at the end of their interactive student notebook.

4.3.8 *Study Design*

A mixed methods approach was used to evaluate the teacher impact on creating awareness of the turkey industry in elementary classrooms. Questionnaires were administered to teachers to assess their demographics, prior experience with agriculture, and self-efficacy in regards to teaching about the turkey industry, and determine their perceptions of the program. Questionnaires were administered to students to assess their demographics, prior experience with agriculture, individual interest, situational interest, and agricultural literacy. In total, 14 teachers (82.35%) and

254 students (52.70%) provided consent and were included in the study. Purdue University's Institutional Review Board approved this study and its components.

4.3.9 *Instrumentation*

Prior to program implementation, teachers (n=11; 64.71% response rate) completed a questionnaire via Qualtrics® Survey Software (Qualtrics Inc, Provo, UT) that sought to determine their self-efficacy in teaching about poultry science. Additionally, they responded to questions about their hometown, agriculture experience (4-H participation, visits to the county/state fair, visits to animal production farms), experience with poultry, and if they have knowledge on agriculture or turkey production.

Teachers responded to 32 questions measuring their self-efficacy on teaching curriculum about the turkey industry using Likert-scale ranging from 1 (strongly disagree) to 6 (strongly agree). Questions were based on the Teaching Engineering Self-Efficacy Scale and were broken down into five subscales – poultry science content knowledge self-efficacy, motivational self-efficacy, instructional self-efficacy, engagement self-efficacy, and outcome self-efficacy (Yoon Yoon et al., 2014). Teacher's self-efficacy, or their belief in their ability to achieve a goal, can impact how they teach (Menon & Sadler, 2018).

After students completed the POULT program, teachers were administered a feedback survey that included five quantitative and three qualitative questions to determine their experience with implementing the POULT Program in their classroom (n=11; 64.71% response rate). Teachers were asked to rank the following questions on a Likert scale ranging from 1 (easy) to 10 (difficult): 1) their difficulty in implementing the program; and 2) difficulty of program completion for students. They were also asked the following multiple choice questions: 1) whether or not they would implement the program again; 2) if they would recommend the program to other teachers; and 3) the average time spent each day on program implementation. Teachers were also asked open-ended questions related to their favorite aspect of the POULT Program, what they would change about the program, and their overall feedback on the program.

In order to determine student change in interest, students completed three questionnaires via Brightspace (D2L Corporation, Canada) throughout the POULT program. In questionnaire 1, students' (T1; n=244) demographics and prior experience with agriculture and turkey production was measured. Students' (T1; n=244) individual interest was also measured in questionnaire 1 based on questions from the Individual Interest Questionnaire (IIQ) (Linnenbrink-Garcia et al., 2010). Students answered five questions based on their attitude and feelings towards the turkey industry prior to beginning the program using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Validity and reliability of the questionnaire was established through a prior study with a similar group of students (Marks et al., 2021).

While individual interest is developed over time, situational interest is determined by external factors in the environment at a given time (Sun et al., 2008). Situational interested was measured after students completed the last online module in questionnaire 2 (T2; n=146) and then again after completion of the class project in questionnaire 3 (T3; n=132) using questions based on the Situational Interest Scale, modified by Sun et al. (2008) for elementary students. Questions included five subscales – attention demand, challenge, exploration intention, instant enjoyment, and novelty. Fifteen questions were asked using a four point Likert scale. Questions analyzed how students felt towards the online modules/class project in regards to the turkey industry (Sun et al., 2008). Marks et al. (2021) utilized the same questionnaire with a similar group of students, validating the instrument.

4.3.10 *Statistical Analysis*

We completed quantitative analyses utilizing IBM SPSS software (2020, Armonk, NY). Internal consistencies of scales were analyzed through Cronbach's alphas. Multiple linear regressions were run to identify the relationship between teachers' demographics and prior experience to their self-efficacy and the impact of teachers' self-efficacy on students' situational interest. Quantitative data from the feedback surveys were analyzed using mean comparisons. Responses collected as qualitative data were inductively coded into common themes (Skjott Linneberg & Korsgaard, 2019).

4.4 Results and Discussion

4.4.1 *Teacher Demographics and Prior Experience*

Teachers self-reported their demographics and prior experience. The majority of teachers (n=6; 54.55%) reported living in a rural, non-farm location. Remaining teachers reported living in town (n=3; 27.27%) or suburbs (n=2; 18.18%). Regarding experience, the majority of teachers (n=8; 72.73%) indicated that they did not have any previous poultry experience. Most teachers enrolled in the program had some agricultural experience (n=10; 90.91%). This varied from visiting a county or state fair to visiting an agriculture production farm. Additionally, 54.54% of teachers (n=6) reported they had a little agriculture knowledge and only 27.27% (n=3) reported that they had definite agriculture knowledge. No teachers were confident in their turkey knowledge, but four (36.36%) reported they did have some knowledge.

4.4.2 *Teacher Self-Efficacy*

Cronbach's alphas for the teacher self-efficacy subscales ranged from 0.80 to 1.00, which supports that the questions used to measure self-efficacy were reliable (Tavakol & Dennick, 2011). Table 2 includes the results for each of the five subscales: poultry science content knowledge self-efficacy, motivational self-efficacy, instructional self-efficacy, engagement self-efficacy, and outcome self-efficacy. Teachers in our study reported high engagement self-efficacy (5.36 ± 1.03). This means that teachers were confident in their ability to engage students when teaching about poultry science (Yoon Yoon et al., 2014). A positive relationship also exists between elementary teachers' self-efficacy in teaching science and their engagement with teaching (Membiela et al., 2021).

Table 4-2. Teacher self-efficacy means on teaching about poultry science

	Poultry science content knowledge self-efficacy	Motivational self-efficacy	Instructional self-efficacy	Engagement self-efficacy	Outcome self-efficacy
Mean	2.65	4.58	4.22	5.36	4.86
Min, Max	1, 5	3, 6	2, 6	3, 6	3, 6
Standard Deviation	1.32	1.05	1.06	1.04	1.01

Note. Teachers' (n=11) self-efficacy on teaching about poultry science was measured using a questionnaire based on Ohio State Teacher Efficacy Scale (OSTES). Questions were broken down into subscales and analyzed using a Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree).

In contrast, teachers had lower poultry science content knowledge self-efficacy. This is consistent with the global decrease in agriculture literacy levels and the change in rural to urban demographics, meaning the public is becoming more separated from agriculture (Roberts et al., 2016). Our population reflected this in regards to poultry science, as teachers reported low levels of turkey knowledge and experience. Teachers with more agriculture experience had greater motivational self-efficacy ($p=0.01$). These teachers who had more experience with agriculture may have been able to motivate students to become more interested in the lesson. This could be because these teachers had prior experiences that they could share with students and make the material more relevant. However, in contrast, teachers that self-reported that they have agriculture knowledge ($p=0.03$) had lower motivational self-efficacy. According to a study by Ghaith and Yaghi, the more years a teacher spent in the profession, the lower their teaching self-efficacy was (1997). Teachers were more likely to believe that they have little impact on student learning (Ghaith &Yaghi, 1997). In our study, teachers with more agriculture knowledge may believe that they won't be able to motivate students due to students' preconceived notions towards agriculture. Additionally, teachers' level of agriculture knowledge was self-reported and based on subjective knowledge, which could differ from actual objective knowledge. Teachers' knowledge and previous experiences had no significant impact on their instructional (4.22 ± 1.06) or outcome (4.86 ± 1.01) self-efficacy in teaching poultry science.

4.4.3 *Teacher Self-Efficacy Impact on Student Situational Interest*

The class project was the last component of the POULT program. Classrooms led by teachers with greater instructional self-efficacy, resulted in students reporting a higher challenge ($p \leq 0.05$). Challenge can be defined as the level of difficulty of the task that attracts a student to engage in the activity (Sun et al., 2008). When teachers had a high belief in their ability to teach poultry science, it translated to the students who felt more challenged and engaged in the project. This is because teachers can play a direct role in students' interest, and teachers with more self-efficacy in instruction may have challenged students to think more when completing the task (Sun et al., 2008).

The other subscales of teacher self-efficacy (content knowledge self-efficacy, motivation self-efficacy, engagement self-efficacy, and outcome self-efficacy) did impact students' situational interest. Teacher content knowledge self-efficacy in our study did not impact situational interest. This is supported with by others who reported while teachers' content knowledge does not directly impact students' situational interest, it still plays a role. When a teacher is more confident in the content they are teaching, they are better able to support students, leading to an increase in students' interest in the activity (Rotgans & Schmidt, 2011). By increasing teachers' agricultural literacy, they may feel more confident in supporting students, therefore increasing student situational interest. When a student finds interest in a topic, they are more motivated to continue learning, which in turn leads to higher academic achievement (Dev, 1997). Teachers' self-efficacy positively impacts students' achievement (Shahzad & Naureen, 2017). Through professional development programs, teachers can be better prepared to implement agricultural-related curriculum in their classrooms, thus increasing students' interest and positively impacting their learning and achievement.

4.4.4 *Teacher Feedback*

Teachers ranked the difficulty of the program implementation and completion slightly higher than neutral (Table 4.3). When administrating the program, teachers reported technology issues. Students were provided individual login information to access the modules. Teachers reported back to the program administrators when students could not log in, requiring passwords to be reset. Five teachers (45.45%) reported that Brightspace was not user friendly for elementary students, and it was hard to navigate. One teacher commented that *"The online modules were somewhat difficult for my students to navigate through. With the technological difficulties, it was hard to tell which modules were completed and which students still needed to finish."* Another teacher suggested to *"make the modules more user friendly."* This could be one factor influencing the difficulty of the program. Although, teachers' confidence in utilizing technology in the classroom has increased over the course of the pandemic (Beardsley et al., 2021), teachers are more likely to use technology in their classrooms if they had a positive experience with it in the past (Bruce & Chiu, 2015). Teachers may be less likely to implement the POULT Program again in the future if they experienced technology issues.

Table 4-3 Mean comparison of difficulty of program implementation and completion

Statement	**Mean Agreement Score**	**Min, max**
Ease of program implementation in the classroom.	6.09	1, 8
Difficulty of program completion for students.	6.91	3, 10

Note. Teachers (n=11) completed a feedback survey after program completion. On a scale of 1 (easy) to 10 (difficult), teachers ranked the difficulty of program implementation and completion slightly above neutral.

Additionally, teachers were also asked whether or not they would recommend the program to other teachers (Table 4.4). Four teachers (36.36%) indicated they were likely or very likely to recommend the program to other teachers. Three teachers (27.27%) indicated that they were unlikely to recommend. When asked how likely they were to implement the program again in the future, 45.45% (n=5) were unsure and 27.27% (n=3) indicated that they probably would again. Technology issues could be one deterrent of implementing or recommending the program.

Another possibility could be the time commitment that the program required. The majority of teachers (n=9; 81.82%) reported that they spent 45 to 60 minutes per day on each module. The amount of instructional time to complete a module may be a limitation for some teachers. The program was advertised as 30 to 45 minutes each day, and teachers may not have had enough time for the program in their schedule. Several teachers (n=4; 36.36%) commented on the length as something they would change about the program. Teachers suggested that the modules should be broken up to allow for more time to be spent on materials. One teacher commented *"these modules take much longer than one class period. Breaking them down a little more would help."* Students' attention spans differ by grade, with elementary students' average sustained attention being 10 to 15 minutes (Mathis, 2020). Even when following the ARCS model and keeping content relevant and engaging for students, the modules overall could have been too long. For example, the short videos students watched were less than 4 minutes long. However, students may have had a difficult time staying engaged through the whole module, which included multiple activities. Additionally, teachers may not have allotted enough time for the program in their schedule if it took longer to implement than advertised.

The majority of teachers (n=5; 54.55%) generally agreed that their favorite aspect of the POULT Program was the opportunity to provide students with agricultural-related curriculum. For example, one teacher said their favorite aspect of the POULT Program was the *"connection to Indiana and turkeys."* Another teacher stated *"I liked how it walked through the farm to fork process."* Three teachers (27.27%) also liked the class project that was implemented on the last day of the program. One teacher commented *"I loved the group project! The students enjoyed collaborating, and I thought the students did an excellent job finding the correct step in the farm to fork process. I also appreciate the clear instructions and project guidelines."* Other than technology and time commitment changes, two teachers suggested that the POULT Program included more interactive activities such as a *"include a STEM activity"* or attend a *"real life field trip."* Incorporating more hands-on activities in the POULT Program may be beneficial on impacting students' motivation (Holstermann et al., 2010). Additionally, hands-on learning is a successful way to increase students' interest and motivation because it allows students to connect with what they are doing and higher-order thinking skills are fostered (Oje et al., 2021).

Table 4-4. Feedback survey results

Statement	Option	Agreement	Percentage (n=11)
How likely are you to recommend the POULT Program to other teachers?	Very unlikely	0	0%
	Unlikely	3	27.27%
	Neutral	4	36.36%
	Likely	3	27.27%
	Very likely	1	9.09%
Do you plan to implement the POULT Program in the future?	Definitely not	0	0%
	Probably not	3	27.27%
	Might or might not	5	45.45%
	Probably yes	3	27.27%
	Definitely yes	0	0%
On average, how much time did students spend on each module?	10-20 minutes	0	0%
	20-30 minutes	0	0%
	30-45 minutes	2	18.18%
	45-60 minutes	9	81.82%

Note. After program completion, teachers (n=11) completed a feedback survey that included three quantitative questions reported in this table.

4.5 Summary

Our study was conducted during a global pandemic where classrooms across the United States were working under abnormal circumstances. Teachers exhibited a high average level of burnout stress due to the pandemic (Pressley, 2021). Teachers may have been frustrated and distracted more than normal due to the pandemic. This could have caused teachers to abandon or neglect the program, preventing them from fully engaging and investing themselves and their students in the content. Future studies could also analyze self-efficacy in implementing online programs since the teachers were implementing the pre-designed program, not necessarily teaching the students about turkey production. In our program, only teachers' self-efficacy for teaching poultry science content was measured. However, teachers reported technology issues and time constraints, which may have had a larger impact on the study than teachers' self-efficacy in teaching poultry science content. We may have seen a different relationship between teachers' self-efficacy in implementing online programs and students' interest in the content. For instance, if a teacher felt confident in implementing online programs, students may have found the content more interesting because the teacher was able to limit technology issues and distractions for students. On the other hand, teachers' self-efficacy in teaching poultry science content may impact students' interest more if the teacher is directly teaching students about turkey production. Another recommendation for future studies is to implement a professional development training for teachers enrolled in the program. A short training session occurred prior to the program that consisted of an overview of the components of the POULT Program, how to navigate the online learning platform, and expectations of implementing the program. However, a more in-depth training on poultry science content may have been beneficial to increase their self-efficacy in teaching students. Additional training may allow teachers to relate to the content more and excite students about learning about turkey production.

In conclusion, educators can benefit by understanding how their self-efficacy has a positive impact on students' interest and achievement (Mojavezi & Tamiz, 2012). Teachers in our study reported high engagement self-efficacy and low poultry science content knowledge self-efficacy. Teachers' previous agriculture experience and knowledge impacted their motivational self-efficacy. As teachers' instructional self-efficacy increased, so did their students' desire to continue the task because they found it challenging. By creating awareness and interest in agriculture, specifically poultry science, career opportunities in the industry will be appealing to students entering college or the workforce.

4.6 Acknowledgements

Thank you to the Indiana State Department of Agriculture and the Indiana Turkey Market Development Council for funding this project.

4.7 References

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CHAPTER 5. CONCLUSION

As the world population increases, the agriculture industry is challenged with providing enough food to feed consumers. However, interest in the industry is decreasing, leaving another challenge of fulfilling the increasing number of career opportunities. The POULT program was designed to create awareness and understanding of the turkey industry for elementary students. Students completed five online modules, an interactive student notebook, an online simulation game, and a class project. During Fall 2021, 482 students completed the program across 23 Indiana classrooms (17 teachers). Before, during, and after program completion, teachers and students completed questionnaires that provided data to analyze how agricultural-related curriculum and teacher self-efficacy impact student interest and knowledge of the turkey industry.

In Chapter 3, the study analyzed the impact of prior experience, prior knowledge, the POULT program, and the taxonomy of assessment questions on students' interest and knowledge of the turkey industry. First, students' previous agriculture and turkey knowledge positively impacted their individual interest in turkey production, indicating that students are more likely to find an interest in a topic they are knowledgeable on. Second, students' previous knowledge had a negative impact on their attention demand, exploration intention, novelty, and instant enjoyment, and students with previous experience had a positive relationship with challenge and exploration intention. These findings indicate that students may find the content boring or repetitive if they are already knowledgeable on the subject. However, if they have previous experience, they might be curious to learn more, new information. Exploration intention was higher after students completed the online modules compared to after completing the class project. This could be because the online modules presented new information, whereas the class project reviewed the material already covered. Third, the level of thinking skills required to answer questions did not impact students' situational interest. Lastly, participation in the POULT Program increased students' agricultural literacy.

In Chapter 4, the study reported the impact of elementary teachers' experience and knowledge on their self-efficacy in teaching poultry science content, and the impact their self-efficacy has on students' interest. First, teachers' agriculture experience positively impacted their motivational self-efficacy, whereas their previous agriculture knowledge negatively impacted their motivational self-efficacy. These results may indicate that teachers are able to share their experiences with students in order to motivate them. In contrast, teachers who are knowledgeable on the subject may feel as if they cannot motivate students due to students' pre-perceived notions towards agriculture. Second, teachers' instructional self-efficacy positively impacted students' challenge, meaning that teachers who believed they could teach about poultry were able to challenge students to think more about the topic. Third, qualitative data was analyzed to determine teachers' experience with the POULT Program. Generally, teachers ranked the difficulty of the program implementation and completion slightly higher than neutral. The majority of teachers spent 30 to 45 minutes on program implementation each day and recommended that the program should be shortened or broken up more. Additionally, teachers reported technology and navigation issues with the online portion of the program, which may impact their likelihood of implementing similar programs again. Teachers generally agreed that their favorite aspect of the POULT Program was the opportunity to provide students with agricultural-related curriculum, and some also liked the class project that was implemented on the last day of the program.

Overall, these studies demonstrate that agricultural-related curriculum can impact students' interest and knowledge in agriculture. This can then lead to students pursuing a future career in the industry, as students are more likely to pursue a career in something they are interested in. Additionally, teachers can have an impact on students' interest. By preparing teachers to implement agricultural-related curriculum in their classrooms, we can increase their self-efficacy, which can also impact students' interest. In order to continue to feed the growing population, the agriculture industry needs more people to fill the current job openings. One way to work towards this goal is by creating awareness of the industry, beginning with elementary students.

APPENDIX: QUESTIONNAIRES

Table 5-1 Student questionnaire 1 (T1)

Individual Interest Scale	DIRECTIONS: Please select the face that matches how much the sentence is true for YOU.  Turkey Industry = the production, marketing, and selling of turkey products
	1. The turkey industry is useful for me to know about.
	2. The turkey industry helps me in my daily life outside of school.
	3. I enjoy learning about the turkey industry.
	4. I like the turkey industry.
	5. The turkey industry is exciting to me.
Demographics and Prior Experience	DIRECTIONS: Please choose the best answer that describes you.
	1. What best describes your residence? a. Farm b. Rural, non-farm (<10,000 citizens) c. Town (10,000-50,000 citizens) d. Suburb (<50,000 citizens) e. Central city (>50,000 citizens)
	2. Do you have any experience with any of the following animals currently or in the past? (check all that apply) o Dog o Cat o Fish o Poultry (chickens, turkeys, ducks) o Cows o Horses o Sheep o Goats o Pigs o Other
	3. Have you ever visited an animal farm? a. Yes b. No
	4. Have you participated in 4-H? a. Yes b. No
	5. Have you visited the county or state fair? a. Yes b. No

	6. Do you have any knowledge about agriculture? a. Yes b. No c. A little
	7. Do you have any knowledge about turkey production? a. Yes b. No c. A little
Agriculture Literacy	Directions: Choose the best answer.
	1. What is agriculture? a. Caring for the environment, growing plants, and raising animals b. Selling pop culture magazines to local citizens c. Designing computer programs and repairing technology d. Building houses, furniture, and other woodworking projects
	2. Which of the following is NOT a product of agriculture? a. Corn b. Blue jeans c. Plastic d. Jell-O
	3. Today, the majority of Indiana's turkeys are raised___________. a. In large open barns b. In small cages c. Outdoors d. In a combination of indoor and outdoor spaces
	4. What are the two main ingredients found in turkey feed? a. Oats and soybeans b. Oats and corn c. Corn and soybeans d. Sunflower seeds and oats
	5. What is a hatchery? a. Where turkeys are sold b. Where turkeys are processed c. Where turkeys are raised d. Where turkeys are hatched
	6. What does sustainability mean? a. Being mindful of the environment and resources available b. Using Earth's resources carelessly c. The amount of energy released into the environment d. Producing turkeys in controlled environments
	7. True or False: Turkeys have beards. a. True b. False
	8. How many days does it take for a turkey egg to hatch? a. 28 days b. 21 days c. 7 days d. 12 days
	9. What is the "gizzard" in the turkey digestion tract? a. Where food enters the digestion tract

	b. Where food is stored and softened before moving to the proventriculus c. Where energy and other nutrients are absorbed d. Where stones and other grit physically break down food into smaller pieces
	10. What is animal welfare? a. How much an animal weighs b. How healthy and happy the animal is c. How wealthy a farmer is d. The amount of feed an animal receives
	11. What is biosecurity? a. Locking the barn at night b. Leaving the animals outside at night c. Preventing the spread of disease d. Preventing animals from eating too much
	12. Which of the following is NOT a biosecurity guideline? a. Keep your distance b. Keep it clean c. Share with neighbors d. Don't haul disease home
	13. True or False: Carbohydrates are building blocks for strong muscles and bones. a. True b. False
	14. Turkey should be cooked to an internal temperature of ______ degrees F. a. 110 b. 125 c. 165 d. 200
	15. Turkey is high in which of the following: a. Protein b. Water c. Carbohydrates d. Fat

Table 5-2 Student questionnaire 2 (T2)

Situational Interest	Think about your experience with the online turkey module activities. Choose only one answer that is TRUE for you.
	1. The turkey online activities were: a. Very exciting b. Somewhat exciting c. Rather dull d. Very dull
	2. The thinking I did in the turkey online activities were: a. Very complex b. Somewhat complex c. Rather simple d. Very simple

	3. The turkey online activities demanded me to pay: a. High attention b. Some attention c. A little attention d. No attention
	4. The turkey online activities made me: a. Very attentive b. Some attentive c. A little attentive d. Not attentive
	5. I did experiments in the turkey online activities: a. Everyday b. On most days c. A few days d. Not once
	6. The turkey online activities were: a. Very unique b. Somewhat unique c. Rather common d. Very common
	7. The turkey online activities made me think: a. A lot b. Some c. A little d. Very little
	8. The turkey online activities were: a. Very enjoyable b. Somewhat enjoyable c. A little enjoyable d. Not enjoyable
	9. The turkey online activities made me become: a. Very curious b. Somewhat curious c. A little curious d. Not curious
	10. The turkey online activities were: a. Very inventive b. Somewhat inventive c. A little inventive d. Not inventive
	11. The turkey online activities were: a. Very new b. Somewhat new c. A little new d. Not new
	12. The turkey online activities made me: a. Very focused b. Somewhat focused c. A little focused d. Not focused
	13. The thinking I did in the turkey online activities was: a. Very demanding

	b. Somewhat demanding c. A little demanding d. Not demanding
	14. The turkey online activities were: a. Very satisfying b. Somewhat satisfying c. A little satisfying d. Not satisfying
	15. The thinking I did in the turkey online activities was: a. Very hard b. Somewhat hard c. A little hard d. Not hard
Agriculture Literacy	Directions: Choose the best answer.
	1. What is agriculture? a. Caring for the environment, growing plants, and raising animals b. Selling pop culture magazines to local citizens c. Designing computer programs and repairing technology d. Building houses, furniture, and other woodworking projects
	2. Which of the following is NOT a product of agriculture? a. Corn b. Blue jeans c. Plastic d. Jell-O
	3. Today, the majority of Indiana's turkeys are raised__________. a. In large open barns b. In small cages c. Outdoors d. In a combination of indoor and outdoor spaces
	4. What are the two main ingredients found in turkey feed? a. Oats and soybeans b. Oats and corn c. Corn and soybeans d. Sunflower seeds and oats
	5. What is a hatchery? a. Where turkeys are sold b. Where turkeys are processed c. Where turkeys are raised d. Where turkeys are hatched
	6. What does sustainability mean? a. Being mindful of the environment and resources available b. Using Earth's resources carelessly c. The amount of energy released into the environment d. Producing turkeys in controlled environments
	7. True or False: Turkeys have beards. a. True b. False
	8. How many days does it take for a turkey egg to hatch? a. 28 days b. 21 days

	c. 7 days d. 12 days
	9. What is the "gizzard" in the turkey digestion tract? a. Where food enters the digestion tract b. Where food is stored and softened before moving to the proventriculus c. Where energy and other nutrients are absorbed d. Where stones and other grit physically break down food into smaller pieces
	10. What is animal welfare? a. How much an animal weighs b. How healthy and happy the animal is c. How wealthy a farmer is d. The amount of feed an animal receives
	11. What is biosecurity? a. Locking the barn at night b. Leaving the animals outside at night c. Preventing the spread of disease d. Preventing animals from eating too much
	12. Which of the following is NOT a biosecurity guideline? a. Keep your distance b. Keep it clean c. Share with neighbors d. Don't haul disease home
	13. True or False: Carbohydrates are building blocks for strong muscles and bones. a. True b. False
	14. Turkey should be cooked to an internal temperature of ______ degrees F. a. 110 b. 125 c. 165 d. 200
	15. Turkey is high in which of the following: a. Protein b. Water c. Carbohydrates d. Fat

Table 5-3 Student questionnaire 3 (T3)

Situational Interest	Think about your experience with the online turkey module activities. Choose only one answer that is TRUE for you.
	1. The turkey group project was: a. Very exciting b. Somewhat exciting c. Rather dull d. Very dull
	2. The thinking I did in the turkey group project was: a. Very complex

	b. Somewhat complex c. Rather simple d. Very simple
	3. The turkey group project demanded me to pay: a. High attention b. Some attention c. A little attention d. No attention
	4. The turkey group project made me: a. Very attentive b. Some attentive c. A little attentive d. Not attentive
	5. I did experiments in the turkey group project: a. Everyday b. On most days c. A few days d. Not once
	6. The turkey group project was: a. Very unique b. Somewhat unique c. Rather common d. Very common
	7. The turkey group project made me think: a. A lot b. Some c. A little d. Very little
	8. The turkey group project was: a. Very enjoyable b. Somewhat enjoyable c. A little enjoyable d. Not enjoyable
	9. The turkey group project made me become: a. Very curious b. Somewhat curious c. A little curious d. Not curious
	10. The turkey group project was: a. Very inventive b. Somewhat inventive c. A little inventive d. Not inventive
	11. The turkey group project was: a. Very new b. Somewhat new c. A little new d. Not new
	12. The turkey group project made me: a. Very focused b. Somewhat focused c. A little focused

	d. Not focused
	13. The thinking I did in the turkey group project was: a. Very demanding b. Somewhat demanding c. A little demanding d. Not demanding
	14. The turkey group project was: a. Very satisfying b. Somewhat satisfying c. A little satisfying d. Not satisfying
	15. The thinking I did in the turkey group project was: a. Very hard b. Somewhat hard c. A little hard d. Not hard

Table 5-4 Teacher questionnaire 1 (T1)

	1. What best describes your residence? a. Farm b. Rural, non-farm (<10,000 citizens) c. Town (10,000-50,000 citizens) d. Suburb (<50,000 citizens) e. Central city (>50,000 citizens)
	2. Do you have any experience with any of the following animals currently or in the past? (check all that apply) o Dog o Cat o Fish o Poultry (chickens, turkeys, ducks) o Cows o Horses o Sheep o Goats o Pigs o Other
	3. Have you ever visited an animal farm? a. Yes b. No
	4. Have you participated in 4-H? a. Yes b. No
	5. Have you visited the county or state fair? a. Yes b. No
	6. Do you have any knowledge about agriculture? a. Yes

	b. No c. A little
	7. Do you have any knowledge about turkey production? a. Yes b. No c. A little
Teacher Self-Efficacy	DIRECTIONS: Please rank the following statements on the scale provided. Strongly disagree ------ Moderately disagree ------ Disagree slightly more than agree ------ Agree slightly more than disagree ------ Moderately ------ Strongly
	1. I can explain the different aspects of poultry science.
	2. I can discuss how given criteria affect the outcome of poultry science practices.
	3. I can explain poultry science concepts well enough to be effective in teaching poultry science.
	4. I can teach poultry science as well as I teach most other subjects.
	5. I can craft good questions about poultry science for my students.
	6. I can employ poultry science activities in my classroom effectively.
	7. I can discuss how poultry science is connected to my daily life.
	8. I can spend the time necessary to plan poultry science lessons for my class.
	9. I can explain the ways that poultry science is used in the world.
	10. I can describe processes involved in poultry science.
	11. I can create poultry science activities at the appropriate level for my students.
	12. I can stay current in my knowledge of poultry science.
	13. I can recognize and appreciate poultry science concepts in all subject areas.
	14. I can guide my students' solution development with poultry science.
	15. I can motivate students who show low interest in learning poultry science.
	16. I can increase students' interest in learning poultry science.
	17. Through poultry science activities, I can make students enjoy class more.
	18. I can use a variety of assessment strategies for teaching poultry science.
	19. I can adequately assign my students to work on group activities involving poultry science.
	20. I can plan poultry science lessons based on each student's learning level.
	21. I can gauge student comprehension of the poultry science materials that I have taught.
	22. I can help my students apply their poultry science knowledge to real world situations.

	23. I can promote a positive attitude toward poultry science learning in my students.
	24. I can encourage my students to think creatively during poultry science activities and lessons.

Table 5-5 Teacher questionnaire 2 (T3)

Program Feedback	Rank the following on a scale of 1-10. (1 being easy and 10 being difficult). Ease of program implementation in the classroom.
	Rank the following on a scale of 1-10. (1 being easy and 10 being difficult). Difficulty of program completion for students.
	1. How likely are you to recommend the POULT Program to other teachers? a. Very unlikely b. Unlikely c. Neutral d. Likely e. Very likely
	2. On average, how much time did students spend on each module? a. 10-20 minutes b. 20-30 minutes c. 30-45 minutes d. 45-60 minutes
	3. Do you plan to implement the POULT Program in the future? a. Definitely not b. Probably not c. Might or might not d. Probably yes e. Definitely yes
	4. What was your favorite aspect of the POULT Program?
	5. What would you change about the POULT Program?
	6. Please provide your overall feedback of the POULT Program.