Impact of Teacher Self-Efficacy on Elementary STEM-Based Agricultural Curriculum

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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 was to determine how teachers' previous knowledge and self-efficacy in agriculture impacted student interest in the turkey industry. Four hundred eighty-two elementary 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 six 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: teacher self-efficacy, agriculture, curriculum

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). It is expected that between the years 2020 to 2025, 59,400 new jobs will be available for college graduates in the field of agriculture (Fernandez et al., 2020). In order to fulfill these career opportunities, interest in agricultural industries needs to be developed. 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, many teachers do not have the resources or training to implement agricultural literacy lessons in their classrooms. 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 (National Institute of Food and Agriculture, 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 agricultural literacy (Pense et al., 2005). In the poultry industry, the US Poultry and Egg Association and American Egg Board have curricula available that educate youth on poultry production (US Poultry and Egg Association, 2021; The Incredible Egg, 2021). Even with agricultural-related curricula 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) theory of self-efficacy, 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 science as well. Elementary teachers in particular have a low self-efficacy in teaching science topics (Avery & Meyer, 2012). However, through proper teacher training, improving teacher self-efficacy can increase and lead to better learning experiences for students (Dutton, 2016).

The purpose of our study was to examine how teacher self-efficacy in teaching poultry science content, prior experience, prior knowledge, and demographics impact students' interest. Our study examined how teachers and students responded to a STEM-based online agricultural-related curriculum for elementary students and was guided by the following two questions:

1. Does the level of teacher agricultural 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?

Methods

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 one 4th and one 5th grade teacher 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. The program was designed to be completed asynchronously during a 30 to 45-minute period each day. 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). Teachers utilized this program to replace other learning activities in the classroom that included similar learning outcomes. All activities occurred in the classroom during normal school hours.

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 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 and Energy; Food, Health, and Lifestyle; Science, Technology, Engineering and Math; Culture, Society, Economy & Geography (Spielmaker & Leising, 2013). By integrating curricula with these five themes, educators can provide students with skills to become more agriculturally literate to 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.

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 research team set out to recruit 500 student participants, 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 teacher attendees learned 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 listserv. Information about the POULT Program and a recorded webinar were shared with teachers. Teachers registered via email and were then provided more details about program implementation. Registration was on a first-come, first-serve basis and ended when 500 student participants were registered. Spots for the program became full before the registration deadline (July 15, 2021), but 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. One teacher registered and was included in the program, but decided at the last minute not to participate. Class size ranged from 12 to 31 (mean=20.83±4.63). Grade distribution consisted of 43.50% 4th grade, 52.20% 5th grade, and 4.30% 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 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.

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 (attentive, relevant, confidence building, satisfying) 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 to 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 agricultural content. By providing

Table 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 4th and 5th grade students.

students with hands-on activities, they could make decisions and apply their new knowledge to other new and relevant contexts (Liao et al., 2021). Similar to Marks et al. (2021) and Erickson et al. (2019), the POULT Program curriculum was designed to promote awareness of the turkey industry as well as provide students with interesting knowledge of the poultry industry and its relevance to their own lives.

Interactive Student Notebooks

As students worked through the online module, they also completed activities in their interactive student notebook. Each student received a printed, hardcopy of the 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 with the online module's learning outcomes and could be answered after completing the respective online modules.

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 digestive 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 at key points in the game and had to answer questions correctly before moving forward. These challenges encouraged students to stay focused and work until they learned the material correctly.

Class Project

There are many benefits to teamwork in the classroom, including the opportunity for students to collaborate and share information and ideas. This can lead to the 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 teacher-led class project. Students were divided into groups of three and assigned roles. By assigning roles to students, they were given a defined, important responsibility. The roles assigned in the POULT Program were recorder, manager, and speaker, that were based on the Process Oriented Guided Inquiry Learning method (The POGIL Project, 2021). Posters identifying the different farm to fork stages were set up at the front of the classroom. Groups were then 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 career's responsibilities. 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.

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 to 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. In order to include a student's data, the student needed to complete a student assent form and have a parent or legal guardian complete the parent consent form. Several students did not return both of these items. Although participants were encouraged to complete the entire study, it was within their right to withdraw at any point. Purdue University's Institutional Review Board approved this study and its components.

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 a Likert-scale ranging from 1 to 6 (1= strongly disagree; 2=moderately disagree; 3=disagree slightly more than agree; 4= agree slightly more than disagree; 5= moderately agree; and 6= strongly agree) (Appendix A). 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 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.

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 and the Wald Chi-Square tests were run to identify the relationship between teachers' demographics and prior experience (independent variables) to their self-efficacy and the impact of teachers' self-efficacy on students' situational interest (dependent variables). 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).

Results and Discussion

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. However, 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 that 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.

Teacher Self-Efficacy

Cronbach's alphas for teacher self-efficacy subscales ranged from 0.80 to 1.00, which supports that our 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 $\pm$ 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 was found between elementary teachers' self-efficacy in teaching science and their engagement with teaching (Membiela et al., 2021).

In contrast, teachers had lower poultry science content knowledge self-efficacy. This is consistent with the global trend in the separation of the farm to fork process (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). Agricultural experience was determined by the number and variety of experiences they had ranging from visiting a county fair to visiting a production farm, whereas agricultural knowledge was self-reported. 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 to make the material more relevant. However, in contrast, teachers that self-reported that they have agricultural knowledge (p=0.03) had lower motivational self-efficacy. This is similar to a study by Ghaith and Yaghi, which showed that teachers had lower teaching self-efficacy the longer they stayed in the profession, and they were more likely to believe that they had little impact on student learning (Ghaith &Yaghi, 1997). Although the teachers in this population do not teach an agricultural subject, many utilize animal and plant agricultural models in the classroom. Our study did not analyze the length of time participants have been teachers; however, more knowledgeable teachers may doubt their ability to motivate students to learn about agriculture. This could be due to these teachers knowing students' preconceived notions towards agriculture. Additionally, teachers' level of agriculture knowledge was self-reported and based on subjective knowledge, which could

Table 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
Cronbach's alpha	0.97	0.95	0.80	1.00	0.97

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).

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.

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 lower challenge ($p = .02$). 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). Students who felt less challenged in the project were associated with teachers that a high belief in their ability to teach poultry science. This is because teachers can play a direct role in developing students' interest, and teachers with more self-efficacy in instruction may have presented the information in a way that was easier for students to understand and resulted in feeling less challenged. The complete results of student situational interest and agricultural literacy are reported in Simmermeyer et al. (2022).

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 by other studies that reported that while teachers' content knowledge does not directly impact students' situational interest, it still plays a role (Rotgans & Schmidt, 2011). When a teacher is more confident in the content that they are teaching, they are better able to support students, leading to an increase in students' interest in the activity (Rotgans & Schmidt, 2011). After increasing their agricultural literacy, teachers 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 potentially increasing students' interest and positively impacting their learning and achievement.

Teacher Feedback

Teachers ranked the difficulty of the program implementation and completion slightly higher than neutral (Table 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

Table 3.

Mean comparison of difficulty of program implementation and completion

Statement	Mean Agreement Score	Min, max	Standard Deviation
Difficulty of program implementation in the classroom.	6.09	1, 8	2.21
Difficulty of program completion for students.	6.91	3, 10	2.26

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.

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.

Additionally, teachers were also asked whether or not they would recommend the program to other teachers (Table 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, five teachers (45.45%) were unsure and three (27.27%) indicated that they probably would again. Technology issues could be one deterrent to implement or recommend the program.

Another possibility could be the time commitment that the program required. Nine teachers (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. Four teachers (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." Student 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.

Five teachers (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-

Table 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.

on activities in the POULT Program may be beneficial on impacting students' motivation (Holstermann et al., 2010). Hands-on approaches to learning have been shown to be 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).

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.

Summary

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. More tools and agricultural resources need to be created by faculty for use in K-12 classrooms, and the development of professional activities and continuing education activities for K-12 faculty to learn about agriculture. 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.

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Appendix 1

Poultry Science Pedagogical Content Knowledge Self-Efficacy

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.

Motivational Self-Efficacy

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.

Instructional Self-Efficacy

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.

Engagement Self-Efficacy

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.
25. I can encourage my students to think critically when participating in poultry science activities.
26. I can encourage my students to interact with each other when participating in poultry science activities.

Outcome Expectancy

27. I am generally responsible for my students' achievements in poultry science.
28. When my students do better than usual in poultry science, it is often because I exerted a little extra effort.
29. My effectiveness in poultry science teaching can influence the achievement of students with low motivation.
30. When a student gets a better grade in poultry science than he/she usually gets, it is often because I found better ways of teaching that student.
31. If I increase my effort in poultry science teaching, I see significant change in students' poultry science achievement.
32. I am responsible for my students' competence in poultry science.