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A pilot test implementing a food science toolkit designed to increase student awareness, interest, and knowledge of food science academic and career pathways in Mississippi Career and Technical Education (CTE) courses was conducted to determine teachers' perceptions of the food science education resources. After implementing the food science toolkit in their CTE course, four teachers individually participated in a semi-structured interview to capture each teacher's detailed experience implementing the food science toolkit. The results of this study revealed that teachers are interested in teaching food science at the secondary education level to increase student knowledge of food science and enhance student performance at the FFA food science career development event. Teachers also revealed their positive experience implementing the food science toolkit and their intentions to continue to use the food science toolkit in their CTE courses to further increase their exposure to food science competencies. Teachers perceived that the food science toolkit increased student exposure to, engagement in, and interest in food science academic and career pathways, which encourages students to select and pursue a career in food science.

Keywords: teaching toolkit, secondary education, curriculum implementation, career pathways

Introduction

Mississippi is primarily an agricultural state that sends most agricultural commodities to food companies in other states for added-value processing, which has led to Mississippi's lack of

focus on developing “new economic activity” through state-based raw commodities (Meter & Goldenberg, 2014). With the decline of agriculture-related businesses and an increased interest in exporting agricultural commodities, many youths lack basic skills and knowledge about farming and agriculture-based concepts. Specifically, youth lack an understanding of food science concepts and basic acknowledgment of commonly consumed foods. Education in food science at the secondary education level will help train students for jobs in the food industry as well as produce a trained workforce so that food companies have greater opportunities and incentives to open added-value food plants in Mississippi.

Students are generally exposed to food concepts in agriculture-based career technical education (CTE) courses that are taught in Mississippi public school districts; however, there is limited time allotted for teaching food science concepts in CTE courses as well as few professional development opportunities to enhance teachers’ ability to teach food science-based instruction effectively. In addition, Food Science is not taught in schools in Mississippi; however, there are career development events hosted for students in Mississippi (FFA) to showcase skillsets learned in various technical learning fields, including food science. Teachers in Mississippi schools lack the training to teach food science in the classroom and to train students for FFA contests.

Several studies describe the development, dissemination, and implementation of food-related interventions to promote food science-related concepts at the secondary education level (Bell, 2014; Jideani & Jideani, 2010; Kahnke et al., 2006; McEntire & Rollins, 2007; Shearer et al., 2014). These findings indicate that providing teacher training and educational resources enhanced the implementation process of the food-science-related resources as well as increased interest in the food science career pathway among high school students and teachers. However, few qualitative studies exist related to teachers’ perceptions of implementing food science educational resources in CTE courses. More specifically, there were no formal professional development opportunities available for Mississippi CTE teachers to enhance their knowledge and teaching strategies to support the high-quality implementation of food science-related concepts in their classes.

Our research group trained teachers to implement food science lessons and observed an increase in Mississippi CTE teachers’ self-perceived knowledge, skills, and self-efficacy to teach food science (Hendrix et al., 2021). Han and Weiss (2005) investigated similar factors that impacted teachers’ perceptions towards implementing various school programs, and they determined that evaluating and understanding teachers’ perceptions is highly important and impactful towards the implementation and continued use of school program resources. Therefore, there is a need to provide teachers with educational materials, expert support, and training to deliver food science material to students confidently.

The purpose of this qualitative research study was to understand and describe Mississippi CTE teachers' experiences when implementing food science educational resources. The following research questions were answered in this study:

1. Why are Mississippi CTE teachers interested in teaching food science in secondary career and technical education courses?
2. How do Mississippi CTE teachers characterize their experiences implementing food science educational resources in their secondary career and technical education courses?
3. What were the perceptions of the CTE teachers towards the quality of the food science educational resources and implementation process?
4. Why would CTE teachers continue to use food science educational resources?

Materials and Methods

The Development of the Food Science Teaching Toolkit

Members of the Mississippi curriculum development team identified a growing interest and participation of middle and high school CTE students and teachers in the Mississippi FFA Food Science Career Development Event. A collaborative team consisting of Research and Curriculum Unit (RCU) members, Mississippi Food Science faculty, and Mississippi CTE teachers developed a secondary education food science curriculum framework that consists of competencies in food microbiology, food sanitation and safety, food processing, food chemistry, and professionalism in the field. To further promote food science career pathways in Mississippi secondary education CTE courses, a food science teaching toolkit was created to support the development of the food science curriculum framework and offer Mississippi CTE teachers educational resources to implement food science lessons in their CTE courses.

The food science teaching toolkit was developed using lessons created by the research team and adapted versions of existing food science secondary education resources provided by the Institute of Food Technologists (Institute of Food Technologists, n.d.). The food science teaching toolkit includes six introductory lessons featuring experiential learning opportunities to increase CTE students' awareness, interest, and knowledge of food science concepts. Each lesson was structured as a 1-hour lesson that included a warm-up activity to introduce the specific food science topic, a knowledge-based lecture and/or discussion, and an experiential learning activity to practice food science skills (see Table 1). A panel of Mississippi CTE teachers with experience teaching Family and Consumer Sciences and Agriculture and Natural Resources courses, CTE administrators, and agriculture and Extension education faculty reviewed lesson objectives and ease of implementation in CTE courses and provided suggestions for improvement.

The Food Science Toolkit

Within the food science teaching toolkit, teachers were provided a loose-leaf notebook containing (1) lesson plans consisting of a lesson summary, objectives, overview of lesson activities, and lists of supplies needed for the lessons; (2) lesson notes and teaching scripts; (3) student activity worksheets and instructional handouts; (4) PowerPoint presentations; and (5) consent forms and evaluation tools. Teachers were also provided access to an electronic file containing all documents included in the loose-leaf notebook. The food science teaching toolkit also included various non-perishable supplies (i.e., biuret solutions and food fragrances) needed for conducting the learning activities. The specific food science lessons included (1) an introduction to food science, (2) food product development, (3) food chemistry, (4) food safety, (5) food processing, and (6) sensory evaluation. The related experiential learning activities allowed students to explore various food science disciplines and careers, food product development steps for producing ice cream, fermentation, protein identification in food samples, candy chemistry and production, identification and correction of hazards in food processing facilities, and food sample and aroma identification. All toolkit supplies were disseminated to CTE teachers after acquiring their consent to participate in the research study and acquired approval from the district and school officials.

Implementation Procedures and Participants

A food science professional development training featuring an introduction to and teaching strategies on implementing the food science toolkit resources was conducted for Mississippi CTE teachers (Hendrix et al., 2021). At the end of the food science professional development training, teachers were invited to participate in a pilot study to assess the implementation of the food science teaching toolkit resources. Teachers who committed to participate in the study:

- Implemented the food science educational resources during the 2019-2020 school year,
- Assisted the research team in acquiring parent permission and student consent before implementing the food science teaching toolkit in their CTE courses,
- Administered a student assessment before and after implementing the six food science lessons and activities in their classes, and
- Participated in a post-implementation interview to capture their experience implementing the food science teaching toolkit.

High school CTE teachers (N = 4) participated in this pilot study, and those teachers reached approximately 70 students. Participating teachers were from public school districts located in rural communities of Mississippi. Teaching experience among the teachers ranged from 6 to 21 years of teaching 8th–12th-grade agriculture and natural resources, agricultural sciences, and/or agriculture-related courses.

Measurements

After the implementation period, post-implementation interviews were conducted to capture each teacher's detailed experience implementing food science lessons and activities in their CTE classroom. A semi-structured interview protocol was developed and used to maintain consistency and limit opportunities for bias during the interview process. The interview protocol highlighted the following topics:

- Teacher interest in teaching food science in Mississippi career and technical education courses,
- Teacher perceptions towards implementing the food science lessons and activities in CTE courses,
- The perceived quality of the food science lessons and activities, and
- Continued use of food science lessons and activities in CTE courses.

The interview protocol was piloted and reviewed to clarify interview questions and terminology and to approximate the time to conduct interviews. Interviews were hosted via an online meeting platform and were all audio-recorded and transcribed for analysis. Pseudonyms were assigned to the names of participating teachers when data was transcribed. Each interview lasted 45 minutes to 60 minutes. The guiding interview questions were aligned with the objectives of this research study. Approval to conduct this study was provided by Mississippi's Institutional Review Board (protocol # 18-396), and all IRB procedures were followed accordingly.

Statistical Analysis

Data were analyzed using a qualitative research approach (Creswell, 2009) that followed a conventional content analysis. Within the scope of a conventional content analysis, the knowledge gained and codes identified are generated directly from the data allowing new perceptions and understanding to result from the data without the influence of preconceived theories (Kondracki & Wellman, 2002; Hsieh & Shannon, 2005). All raw data were collected, organized, and read multiple times by two researchers. Initially, data were coded by two researchers independently via an open-coding approach. When interpreting the data, codes were examined and charted via recurring patterns and characteristics identified among the data. Recurrent themes among the data were identified, and direct quotes from participating teachers were also charted per category to support data analysis. Data analysis was repeated and validated by a member not involved in the interview process. This member was trained in content analysis (by the research team). This member (1) independently categorized the qualitative data for each research question, (2) compared and validated the researcher's analysis to arrive at a consensus, and (3) selected appropriate quotes for each theme and category of the data set.

Table 1. Food Science Toolkit Lesson Objectives and Sample Food Science Lesson Activities and Toolkit Supplies

| Lesson Title | Lesson Objectives | Sample Lesson Activities and Description | Food Science Toolkit Supplies |
|---------------------------------|--|--|--|
| Discover Food Science | <ol style="list-style-type: none"> 1. Define food science 2. Explain the farm-to-fork concept 3. Describe the branches of food science | I'm Eating What? ¹ - Students identify how raw materials are converted to final food products | <i>I'm Eating What?</i> Student Flashcards and Teacher Discussion Guide ¹ |
| Food Product Development | <ol style="list-style-type: none"> 1. Describe the steps involved in product development 2. Apply the steps of food product development in the process of making ice cream 3. Demonstrate leadership, teamwork, and creative thinking skills | Food Scientist for a Day ² – Students create an ice cream product following the steps of product development | <i>Food Scientist for a Day</i> Student Handout |
| Food Chemistry | <ol style="list-style-type: none"> 1. Define the term food chemistry 2. Identify and describe the six main components found in food 3. Define supersaturation and explain what that means in terms of candy production | Candy Chemistry ³ – Students learn to make hard rock candy | Candy molds Candy flavoring Candy thermometer |
| Food Safety | <ol style="list-style-type: none"> 1. Discuss the personal hygiene requirements of food handlers 2. List the seven steps of HACCP (Hazards Analysis Critical Control Point) as a method to prevent foodborne illness 3. Identify the types of food hazards and describe corresponding corrective action | <p>Glo Germ Handwashing Demonstration⁴ – Students learn proper handwashing procedures</p> <p>Sanitation Scenarios – Students identify all hazards and corresponding corrective action</p> | <p>Glo Germ™ Handwashing toolkit - Glo Germ solution and UV light</p> <p>Sanitation scenario cards</p> |
| Food Processing | <ol style="list-style-type: none"> 1. Define the term food processing and associated terms 2. Describe why foods are processed | Fermentation Balloons ⁵ - Students learn how gasses are produced when yeast, sugar, and water are mixed | Fermentation balloon demonstration kit (3 - 12 oz plastic bottles and balloons) |

| Lesson Title | Lesson Objectives | Sample Lesson Activities and Description | Food Science Toolkit Supplies |
|---------------------------|--|---|--|
| | 3. Identify the various food processing methods and explain procedures used to process food safely: Drying, dehydration, freezing, canning, etc. 4. Describe how food safety is monitored and regulated during processing | Food Tasting - Students taste and analyze food products that are processed differently | |
| Sensory Evaluation | 1. Define sensory evaluation 2. Define the term triangle test and explain its use 3. Practice how to conduct a triangle test Describe the steps of evaluating and identifying aromas | Aroma Identification ⁶ – Students learn how to identify various aroma samples One of These Things is Not Like the Other - Triangle Test ⁷ - Students learn how to conduct a triangle test and identify an odd sample using sensory evaluation techniques | Aroma sample kit (30 aroma samples) Triangle test and aroma identification student handouts |

Note. These lessons and activities were adapted by using the following resources: Rowley & Peacock (n.d.a)¹; Gardner (n.d.)²; Crist et al. (2021)³; Glo Germ (n.d.)⁴; Exploratorium (n.d.)⁵; Bohlscheid (n.d.)⁶; Rowley & Peacock (n.d.b)⁷

Results

Research findings were organized and presented by research questions. Four main categories were highlighted: (1) teacher interest in teaching food science, (2) teacher experience implementing food science education resources, (3) teacher perception of food science education resources, and (4) teacher's reasons for continued use of the food science education resources. Per category, prominent themes among participating teachers' responses were noted corresponding to each research question.

Research Question One: Why are Mississippi career and technical education teachers interested in teaching food science in secondary CTE career and technical education courses?

Teachers stated a range of reasons for their interest in teaching food science in their CTE courses. Two themes emerged from the data analysis: (1) to increase understanding of food science among students and (2) to enhance student training and performance for/at the FFA food science career development event (CDE).

Theme 1: Increase Knowledge of Food Science Among Students

Teachers' interest in teaching food science is motivated by their desire to increase their students' knowledge of food science principles. For example, Emma, a teacher with eight years of experience teaching high school agriculture courses, stated that students showcased a true interest in food science, but they did not understand concepts such as "how food is processed," "how food is brought to the table," and "how [food] is packaged." Additionally, one teacher, Sarah, thoroughly described how students she had previously exposed to food science concepts were confused about various food science principles. Sarah also expressed how she believed the students would benefit from correctly understanding food science principles. Sarah stated,

Firstly, anything related to food is going to get kids' attention automatically. ... I think from a personal standpoint, packaging really confuses kids and not just kids, even [teachers] for as what is healthy and what is not, or what does the terminology on the packaging mean? And I think they will be more educated consumers if they understand the words and the packaging and the labeling. And I think that's something that every one of them ... [will] benefit from it.

It was expected that all participating teachers discussed that their interest to teach food science is driven by increasing knowledge of food science among their students.

Theme 2: Enhancement of Student Training and Performance for/on the FFA Food Science CDE

A commonality for their interest in teaching food science among participating teachers was their desire to enhance student performance at the FFA food science career development event. All participating teachers train student FFA teams to compete annually in the state level FFA food science CDE. Some teachers expressed how their team competed and placed at the state-level food science CDE and participated at the national level. However, teachers desired to enhance training methods and student performance on the FFA food science CDE. This response coincides with the previous emerging theme of increasing student knowledge of food science concepts. Teachers observed increased interest in food science among students who participated in the FFA food science CDE; therefore, they began to pursue opportunities to increase their knowledge of food science further and acquire resources to teach food science concepts in their CTE courses. Christine specifically expressed,

I got started doing food science when I had a group of students that were interested in the food science competition when we first started with FFA ... and so the [students and I] both, we kind of dove in together and we started learning about all of it and it was really interesting [and] fascinating.

Sarah extended this idea beyond food science as the subject of focus when she expressed how food is a vehicle to teach various subject areas. Hence, she was interested in teaching food science among her students, and the increased desire of her students to compete instilled and motivated her to teach food science in her classroom curriculum.

Research Question Two: How do Mississippi CTE teachers characterize their experiences implementing food science educational resources in their secondary career and technical education courses?

Four prominent themes emerged among teachers' responses towards their experiences implementing food science educational resources: (1) teacher passion yields increased promotion, (2) teacher interest in specific lessons, (3) the implementation process was eased by the food science toolkit, and (4) student engagement.

Theme 1: Teacher Passion Yields Increased Promotion

Teachers' personal motivation to teach food science increased promotion of the food science educational resources among CTE students. Several teachers heavily promoted the food science lessons as fun and exciting before implementing resources of the food science toolkit. Mary stated,

[Food science is] something that I love, and kids can always pick up on that. Literally because I love it so much, I promoted it. ... We're just about to have some fun, and they loved it. ... They were super excited about it. ... I had gotten them pumped up, excited about it.

In addition to generating excitement and interest among the CTE students, Emma, who also promoted the food science lessons prior to implementing the food science toolkit, expressed that her students desired to participate in activities that are similar to the implemented food science activities on a daily basis.

Theme 2: Teacher Interest in Specific Lessons

All participants explained their interests and perspective toward specific food science lessons within the food science toolkit. Specifically, three teachers expressed that the food product development lesson was appealing to students, which resulted in heightened participation and engagement among students. It was also explained that the design of the food product development lesson created opportunities for teachers to extend the lesson for further exploration of various food science disciplines via intriguing questions presented by students. Sarah stated,

The [food product development lesson] was good. Um, most of them had done that at some point in their school year, but I will tell you ... after we did your lesson, they were very engaged. ... So that lesson, we ended up just really growing and stretching and doing a lot of stuff with ... they kept asking questions ... [the lesson] just had a good flow from their conversation, from the ice cream into ... labeling, which then kind of went into marketing and packaging ... [and] we gained a lot from that.

Teachers' interest in specific lessons, such as the food product development lesson, was also noted by increased creativity among students as they completed specific food science activities. The teachers' feedback confirms the intended design of the food science toolkit.

Theme 3: Implementation Process Eased by Food Science Toolkit

The participating CTE teachers characterized their experiences implementing food science educational resources by their ability to implement the lessons via the food science toolkit easily. All teachers expressed that it was convenient to teach the food science lessons based on the provided lesson plans, activity guides, and other supplemental teaching supplies. Several teachers expressed the demand to find new and innovative resources to teach agriculture topics; however, teachers have limited time to search for educational resources and effectively implement these educational resources in their classrooms. For example, during the school year, Mary explained the various tasks and roles (i.e., teacher of various courses, student organization leader) she has as a CTE teacher within her school district. Mary stated that she enjoys teaching food science in her courses; however, "it's just a lot on [her] plate, and to be able to just open the

[food science toolkit] book ... it helped organize my thoughts,” and Mary was able to implement the food science toolkit. In addition, other teachers explained their appreciation for the lesson plans, scripts, and other teaching resources that supported a positive and simple implementation experience.

Theme 4: Student Engagement

Teachers discussed that student engagement was the most meaningful experience acquired during the food science lessons and activities. For example, Emma described her experience teaching her students food chemistry concepts, and she expressed, “The most meaningful was seeing [the] kids’ reaction [to the candy chemistry activity].” During the candy chemistry activities, teachers explained the science involved in making hard candy. They observed that students were engaged and had positive reactions towards the simplicity of applying learned food science concepts to successfully make hard rock candy to enjoy at the end of class. In addition to observing how engaged her students were during the food science lessons, Sarah discussed how her students continuously presented intriguing questions during class discussions and the students’ desire to engage in additional food science lessons. Specifically, Sarah shared, “[food science] is a topic that [the students] are not scared to ask about [be]cause they feel good about food.”

Research Question Three: What were the perceptions of the CTE teachers towards the quality of the food science educational resources and implementation process?

Data analysis resulted in three prominent themes for teachers’ perceptions towards the quality of the food science toolkit and the implementation process: (1) organizational structure of resources, (2) useful and relatable resources, and (3) desire for additional resources/opportunities.

Theme 1: Organizational Structure of Resources

All teachers expressed that the food science education resources were well organized, and it was easy to follow the design of the lessons and the overall implementation process. One teacher expressed, “[the food science toolkit] made putting the lessons together a whole lot ... easier, which you’re more apt to do [the lesson] ... as a busy teacher, if you have it on hand ... so that was very beneficial.” A teacher also noted that “even if [a teacher is] not proficient [in] food science, ... everything’s laid out, it’s scripted, you’ve got examples and the videos and everything ... it’s a good set of information.” In addition, all teachers provided positive feedback regarding the organizational design of the food science teaching materials, such as the lesson plans, PowerPoint slides, and student activity guides and worksheets.

Theme 2: Useful and Relatable Resources

The usefulness and relatability of the food science toolkit to CTE students and teachers contributed to the quality of the toolkit. Emma described the objectives of the food science lessons as “adequate” for the targeted age group. She also expressed, “the kids understood it, and it was actually useful to them in their real life.” The food science toolkit was also described as a useful tool for teachers. One teacher expressed that “[the food science toolkit] would be very helpful for [teachers] that are still learning the whole food science process. ... This would definitely give them information on what they need to know [and what] to say.”

Theme 3: Desire for Additional Resources/Opportunities

All teachers expressed their desire for additional food science teaching resources to implement in their CTE courses. The teachers described how they incorporated lesson extensions to several of the food science lessons, and they also provided possible recommendations for enhancing the food science toolkit. Several teachers stated how they extended the food science lessons by showcasing additional food processing videos or invited guest lecturers to elaborate further on food science-related topics. One teacher conveyed that “after [her class] had done everything in [the food product development] lesson, [she] made them design a new product, and [she instructed] them [to] make a package” to continue students’ application of learned food science concepts. Additionally, the teacher further extended the lesson by “actually show[ing] [the students] how to come up with their carb[ohydrate]s, fats, protein[s] and get their calories.” Furthermore, one teacher expressed her desire for resources that provide students with opportunities to connect with food science professionals. Teachers’ desire for additional resources and learning opportunities identifies ways that the research team can enhance the food science teaching resources.

Research Question Four: Why would CTE teachers continue to use these food science educational resources?

All teachers stated that they would continue to use the food science toolkit in their classes and provided reasons to support their selected choice. Data analysis resulted in two emerging themes from the teachers’ responses: (1) preparation for FFA Food Science CDE and (2) new education experiences.

Theme 1: Preparation for FFA Food Science CDE

Considering teachers’ interest in teaching food science to enhance student training and performance for/on the FFA food science CDE, it is not surprising that teachers desired to continue to use the food science toolkit for preparation for the FFA Food Science CDE. For example, one teacher stated she would have teams participate in future FFA Food Science CDEs, and she expressed that “this is good training material” for the competition. Another teacher

discussed how she would continue to use the food science toolkit to prepare her FFA teams for the Food Science CDE; however, she would also “tie [the food science toolkit] in with [her] FFA, giving [the students] ... knowledge to see whether or not they are interested in the competition.”

Theme 2: New Education Experiences

Several teachers stated that they would continue to use the resources because of the new educational experiences that the food science toolkit provides. Christine stated that continuing to use the food science toolkit “would give [the students] an opportunity to learn something new and different and experience something new, like the sensory [evaluation content].” Additionally, one teacher expressed that food science is “very pertinent in our day-to-day life,” and the food science toolkit offers opportunities to “expose [the students] to some new things” and different experiences while forwarding the opportunity of “understanding the why’s” of food science.

Discussion

This research study was centered on four core topics of interest: (1) teacher interest in teaching food science, (2) teacher experience implementing food science education resources, (3) teacher perception of food science education resources, and (4) teacher’s reasons for continued use of the food science education resources.

Teacher Interest in Teaching Food Science

The study findings revealed that teachers are interested in teaching food science in secondary CTE courses because they desire to increase knowledge of food science among their students and to enhance student training and performance on the FFA food science CDE. Due to the growing demand for innovative food products, the current strong interest in food and overall wellness, and the steady growth in the U.S. population, there is a growing need for science-literate people who are more aware, knowledgeable, and technically trained in the field of food science and technology. In 2007, Peacock examined the effects of food science-based instruction on high school students. It was determined that teaching food science at the secondary level increased the number of students that were more aware and knowledgeable of food science and that would select food science as a college major (Peacock, 2007). These findings indicate that teachers’ interest in teaching food science should be cultivated further to extend food science-based instruction at the secondary education level and to increase knowledge of food science among students.

Teachers described how their interest in teaching food science is motivated by their desire to enhance student training and performance on the FFA food science CDE. The FFA Food Science and Technology (FST) CDE is a student professional development opportunity in which students

can showcase and apply their knowledge and skills pertaining to food product development, food safety issues, and sensory evaluation skills (National FFA Organization, 2019a, 2019b). As more Mississippi CTE teachers pursue opportunities to enhance students' training and performance for/on the FFA food science CDE, there is potential to increase CTE students' practical experiences in which they can apply their knowledge and skills in the field of food science, hence, supporting FFA's overall mission to "develop youth through premier leadership, personal growth, and career success" (National FFA Organization, 2021a).

Teacher Experience Implementing Food Science Education Resources

Four prominent themes were identified among teachers' responses characterizing their experience implementing the food science education resources: (1) teacher passion yields increased promotion, (2) teacher interest in specific lessons, (3) implementation process eased by food science toolkit, and (4) student engagement. The food science lessons were designed to be introductory lessons to expose students to food science curriculum competencies and the activities included in the food science toolkit. Teachers' pre-existing passion for food science supported the increased promotion of food science education resources among their students, and the teachers' feedback towards specific food science lessons and activities revealed how the food science education resources stimulated the students' interest and curiosity in the field.

Teachers discussed how their experience implementing food science education resources was made easier through the use of the food science teaching toolkit. These findings are similar to Kahnke and others (2006), who examined the effectiveness of a dairy foods curriculum package that they developed for high school agriculture education teachers in South Dakota. It was determined that providing teachers with "ready-made" educational resources enhanced high school dairy education (Kahnke et al., 2006). Developing and providing CTE teachers education resources to teach subjects like food science can be used to support curriculum design and development, ensure successful implementation of food science lessons and activities, and increase the amount of instructional time allotted to teach food science on the secondary education level.

In addition, teachers' experience implementing food science education resources was characterized by how the students were engaged in the food science lessons and activities. Schmidt and others (2012) examined the implementation of food science demonstrations at the secondary and postsecondary levels and obtained similar results. Students were highly engaged in the food science lessons and actively participated in the demonstrations by asking questions that generated further class discussion (Schmidt et al., 2012). The findings from this study indicate that implementing the food science toolkit in high school CTE classes can increase students' engagement in and satisfaction with their learning experiences, which ultimately can lead to them pursuing future food science academic and career opportunities.

Teacher Perception of Food Science Education Resources

Teachers' perceptions of education resources can impact curriculum design and development and curriculum adoption and usefulness. After implementing the food science education resources, teachers' perceived that the resources were organized, structured, useful, and relatable. Previous studies identified the absence of "appropriate" agriculture-related instructional resources for teachers as a potential barrier to the proper implementation of new learning material (Ham & Sewing, 1987; Trexler et al., 2000). Therefore, it is important to supply teachers with educational resources that are organized and designed for effective implementation. In addition, the organizational design of the food science toolkit can be used as a model for future CTE curriculum design and development.

With the extensive display and promotion of food, nutrition, and overall health on all varying media platforms, having food science-based instruction taught at the secondary education level is "extremely relevant" to supporting and/or combating food and health-related information that is presented to the public (Schmidt et al., 2012). Schmidt and others (2012) also determined that students observed food science's relevance and significance in their day-to-day lives when food science-based instruction was implemented at the secondary education level (Schmidt et al., 2012). Based on teacher perception of the lessons, these findings indicate that the food science toolkit has the potential to be a useful and relatable tool among students and teachers when implemented in Mississippi CTE courses.

Teachers' Reasons for Continued Use of the Food Science Education Resources

The research study revealed that teachers would continue to use food science education resources to prepare for the FFA FST CDE and to provide their students with new educational experiences.

The national FFA organization states that the food science CDE is designed to help increase student knowledge and technical skills in the field of food science (National FFA Organization, 2021b). Using the food science toolkit to prepare students for the FFA FST CDE has the potential to enhance student CTE learning experiences, which ultimately can increase the number of students who pursue academic and career pathways in food science. Additionally, providing students with new education experiences via food science education resources can further promote research findings by Brand (2008), who described how students are encouraged to pursue higher education when participating in CTE courses at the secondary education level because students can bridge their current interest to their future career goals. Schmidt and others (2012) also stated that the students who engage in food science demonstrations and lessons are more aware and interested in food science competencies and opportunities in the field. New education experiences that are provided by the implementation of the food science toolkit can further increase exposure to food science competencies among Mississippi CTE students and potentially help students make an inclusive decision about selecting food science as a postsecondary education or career pathway.

Limitations

The geographic scope of this study was limited due to the sole inclusion of Mississippi (MS) agriculture CTE teachers. Therefore, the results cannot be generalized to CTE teachers outside of MS. The small sample size also prevents the generalization of study results among varying populations. The abrupt closing of MS schools due to the onset of the COVID-19 pandemic caused changes to data collection procedures and decreased the number of teachers that were available to implement the food science educational resources.

Conclusions

There are several studies that examine the implementation of specific food science concepts at the secondary education level; however, there are a limited number of studies that examine teachers' perceptions towards the implementation of secondary education food science resources. The research results indicated that Mississippi CTE teachers had positive experiences implementing the food science toolkit and perceived that implementing the toolkit was useful in implementing food science education in Mississippi CTE courses. Teachers also expressed that implementing the food science toolkit increased student exposure to, engagement in, and interest in food science academic and career pathways, which empowers students to select and pursue a career in food science.

Implications for Future Practice

These research results cannot be generalized to all cases where food science educational resources are implemented; however, the results of this study offer several implications for curriculum developers, state and district-level school administrators, and university food science faculty and staff. Curriculum developers can use teachers' perceptions of specific food science lessons to assist with modifying and enhancing curricula design. Participating teachers cited several reasons for their interest in specific food science lessons (i.e., stimulated interest in food science among students and the ability to expand lesson content to teach other related topics) that would allow curriculum developers to enrich further teaching resources before reimplementation. Curriculum developers can also use the results garnered from the food science toolkit as a model to develop additional resources to enhance student performance in various FFA student competitions.

Research findings also offer implications for state and district-level school administrators. With an increased focus on ensuring students are college and career-ready, state and district-level school administrators can use teachers' insights to assess the adoption of innovative resources that are designed to prepare students for various career pathways. Additionally, teacher feedback from the food science toolkit provides students with new educational experiences and data to help state and district-level administrators approve food science curricula for classroom instruction.

The results are useful to university food science faculty and staff who desire to promote food science academic and career pathways. Teacher feedback can inform university food science faculty and staff on how to promote food science-based instruction among secondary education teachers more effectively. These findings also demonstrate how university food science faculty and staff can enhance student recruitment in the field of food science by strengthening university and secondary education partnerships.

Recommendations for Future Work

Future research should consider implementing the food science toolkit among a larger population of Mississippi CTE teachers to identify additional teacher perceptions when implementing the food science toolkit and to examine differences in implementation among participating teachers. In addition, future research should explore process indicators that depict implementation reach, dose, and fidelity to obtain an in-depth understanding of the implementation process, which can assist in improving the food science toolkit design. The studies can also examine non-CTE teachers' perceptions of the food science toolkit. By studying non-CTE teachers' perspectives, researchers can explore the cross-curricular aspects of the food science toolkit as well as converge CTE and non-CTE teachers' varying perspectives to determine consistency among study conclusions. In doing so, the food science toolkit can be implemented in additional STEM subject areas, ultimately increasing the number of teachers implementing food science curriculum and the number of students that are exposed to food science educational resources. It is also essential to evaluate how the students are impacted by the food science resources implemented in their classes; therefore, it is recommended for researchers to explore student awareness and knowledge of food science pre and post-implementation of the food science toolkit in MS CTE courses. Continuing this research to increase awareness of food science academic and career pathways at the secondary education level can help further develop a talent pipeline of educated and skilled food science graduates that enter the field of food science.

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