

Original Paper

Elementary Teachers' Perceptions and the Impact of a Nutrition-Integrated Pilot Curriculum

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Abstract

Studies have demonstrated the positive effects of nutrition education on elementary students' overall well-being. However, teachers continue to report a lack of instructional time, suitable curriculum, self-efficacy, and support as barriers to integrating nutrition into the daily curriculum. To address these barriers, this study developed and implemented a 16-week standards-based nutrition-integrated curriculum entitled Fuel to Learn. Participants included fourth-grade teachers (N=9) across North Mississippi. Qualitative observational data were collected via teacher feedback after each Fuel to Learn lesson through a web-based portal. Three themes emerged from the qualitative data and were categorized as follows: (a) supporting student engagement of nutrition and academic skills with integration; (b) ease of delivery with integrated methods; and (c) meeting the demands of classroom differentiation. Quantitative data were also collected at the conclusion of the study through a curriculum evaluation survey, providing further insight into teachers' perceptions of the curriculum. Similar to the qualitative findings, survey results suggest that teachers perceived the curriculum to be engaging, suitable, and developmentally appropriate.

Keywords

curriculum integration, teaching methods, nutrition, student engagement

1. Introduction

Literature abounds with evidence that many children and adolescents in the United States do not receive adequate nutritious meals on a consistent basis and are not exposed to sufficient nutrition education (Banfield, Liu, Davis, Chang, & Frazier-Woord, 2016; Edwards & Cheeley, 2016; Ning et al., 2015; O'Dea, 2016;). Unfortunately, this is not a new epidemic, as literature points to the historical pattern of

inadequacy shown in the diet of school-age children (Banfield et al., 2016; Eichler et al., 2018; O’Dea, 2016; Nelson, Carpenter, & Chiasson, 2006). In addition to the deficiency of young children’s diets, opportunities to experience nutrition education that exposes children to healthy eating behaviors at school are limited due to barriers teachers encounter. These barriers include a lack of funding, time, knowledge, suitable curricula, and support (Jones & Zidenberg-Cherr, 2015; Perera, Frei, Frei, Wong, & Bobe, 2015). Although the benefits of including nutrition in the academic curriculum are well-known (e.g., Black et al., 2015; Hall, Chai, & Albrecht, 2016), most studies have focused on child nutrition and specific nutrition programs, such as the national school breakfast program (e.g., Andrade, Lotton, & Andrade, 2018; Lambrinou et al., 2020; Rahman, Jomaa, Kahale, Adair, & Pine, 2018; Rampersaud, Pereira, Girard, Adams, & Metz, 2005; Stage, Kolasa, Diaz, & Duffrin, 2018). Conversely, minimal studies have utilized the integration of nutrition concepts into the core curriculum (i.e., math, English language arts, science) as a pedagogical approach to addressing teachers’ barriers and perceptions of nutrition education. Despite the fact that integrating nutrition into the classroom has clear health benefits for children and can promote pro-academic behaviors (Berezowitz, Bontrager Yoder, & Schoeller, 2015; Tiles-Tirkkonen, Sinikallio, Poutanen, & Karhunen, 2018; Vileger et al., 2019), this practice is not widely used. O’Dea (2016) noted that teachers perceive there to be a lack of instructional time to include lessons on nutrition, and that nutrition topics are too unrelated on their own compared to core subjects addressed on standardized tests. While the majority of the United States requires elementary school teachers to teach health education, nutrition education is only one of the 15 topics that must be covered in health education and is often not taught in favor of tested subjects (Perera et al., 2015).

1.1 Benefits of Nutrition Education

Although nutrition is not consistently taught in schools across the United States, numerous studies have documented the use of food and nutrition as an effective tool for teaching academic subjects (Carraway-Stage, Roseno, Hodges, & Hovland, 2016; Harley et al., 2018; Hovland et al., 2013). However, there is minimal data on whether students are more engaged and focused with both the academic content and nutrition concepts when food is used as a tool to learn (Duffrin et al., 2010). One of very few studies focused on engagement with a nutrition-integrated curriculum was conducted at the preschool level. Results of the study revealed that teachers were surprised by the initiative students took in the lessons and how following a recipe in class improved students’ ability to sequence, work independently, and improve language and reading skills. Teachers also reported that students were more engaged and vocal throughout the lesson (Sepp & Höijer, 2016). While these findings are promising, more data is needed to support the correlation between nutrition-integrated curriculum and student engagement.

There is a much larger body of evidence supporting the notion that nutrition-focused programs increase academic success when they are implemented in the classroom (Asigbee, Whitney, & Peterson, 2018; Babatunde, 2017; Head Zauche et al., 2017; Soltero, Parker, Mama, Ledoux, & Lee, 2021). One particular study revealed that implementation of the FoodMASTER curriculum led to an increase in

fourth grade students' overall multidisciplinary knowledge in science (Duffrin et al., 2010). Results demonstrated that when nutrition education is connected to core subject content, specifically science, it is likely to increase students' core content knowledge, as compared to students in typical curriculum programs. Similarly, Stage et al. (2018) explored the associations between nutrition, science, and mathematics. Findings revealed that students in the intervention group showed significantly higher scores in math and science knowledge compared to students who did not receive the intervention (Stage et al., 2018). The Researchers suggest that at a young age the mind is actively engaged in creating new forms of knowledge, and food and nutrition can aid in this journey by acting as a natural foundation for learning, and also as a "vehicle" (p. 2) for teachers to deliver more difficult topics (Stage et al., 2018). Even though these studies suggest that nutrition can act as a catalyst to positive academic outcomes, they do not examine teacher barriers, perceptions of program feasibility, or children's engagement when learning nutrition content.

1.2 Teacher Barriers and Perceptions of Nutrition Education

1.2.1 Extra-Role Behavior and Support

A critical barrier to implementation of nutrition education is a teacher's motivation to engage in this type of extra-role behavior (Hall et al., 2016; Rapson, Conlon, & Ali, 2020). Perera et al. (2015) conducted a cross-sectional anonymous survey among 106 teachers, wherein the teachers expressed their feelings towards the importance of nutrition education and the barriers of implementing nutrition education. Results indicated that 97% of the teachers found nutrition education to be somewhat to very important in elementary classrooms, and 87% of teachers indicated that it was the responsibility of teachers together with students' parents to impart nutrition education to children (Perera et al., 2015). Teachers have also reported difficulty in integrating nutrition into lessons because of cost restraints and lack of administrative support (Metos, Sarnoff, & Jordan, 2018; Sepp & Höijer, 2016). This lack of support can mitigate teachers' motivation to incorporate nutrition into their classrooms and take on this extra-role behavior (Prelip et al., 2006).

1.2.2 Deficiency of Time

Successful nutrition education programs generally require at least 15 hours per year to make changes in student knowledge and at least 50 hours per year to create long-term changes in students' lives (Perera et al., 2015). However, the average time spent on nutrition education in today's classroom is only three and a half hours per school year (Perera et al., 2015). The notion that time is limited in the classroom is a constant perceived barrier noted among teachers in the literature (Cunningham-Sabo, Balgopal, Seedig, & McGuin, 2017; Dev et al., 2017). Subsequently, instructional time for tested subjects and time for nutrition are perceived as competitors. As a remedy to these barriers, Berezowitz et al. (2015) suggests that if tested subjects and nutrition concepts are fused through an integrated curriculum, positive academic results may be rendered.

1.2.3 Suitable and Feasible Curricula

Beyond the barriers of time and support, teachers have noted a lack of suitable curricula that is easy to deliver, readily available, and embedded across all other core curriculum (Pererra et al., 2015). However, this barrier contradicts the wide array of available and suitable nutrition education programs and curriculum such as Food Friends, Cooking with Kids, Action for Healthy Kids, The Nourish Curriculum, Family Cook Productions, and FoodMaster. The following question then arises: Why are teachers who indicate such a high concern and responsibility for nutrition education (e.g., Perera et al., 2015), not utilizing developed materials and available training opportunities? Perhaps a major reason is that although many teachers believe nutrition is important, it is not prioritized due to a lack of instructional motivation—nutrition is not on state tests. Since the No Child Left Behind Act (2001) was passed, raising the pressure for high performance on standardized tests, the average time spent on health education has steadily decreased (Perera et al., 2015).

1.3 Purpose of the Study

Factors such as limited instructional time, pressure for high performance on standardized tests, motivation, and lack of support continue to emerge as barriers to integrating nutrition in the classroom. Nonetheless, the benefits of teaching nutrition cannot be ignored. Thus, this study was guided by the following research questions:

- 1) What are teachers' perceptions of the *Fuel to Learn* curriculum in regard to lesson feasibility, suitability, support, and curriculum resources provided?
- 2) What are teachers' perceptions of student engagement with the *Fuel to Learn* curriculum?

1.4 Theoretical Framework

Underpinning this study is the theory of social constructivism which asserts that learning new ideas occurs most beneficially through social interactions that can give personal meaning to new concepts (Kalina & Powell, 2009; Vygotsky, 1978). This perspective emphasizes the student's role in meaning making of newly acquired knowledge. Social constructivism in the classroom also places an emphasis on the teacher's role as a facilitator of these beneficial peer-to-peer or teacher-to-student interactions. The *Fuel to Learn* curriculum was developed to embody social constructivist strategies within each lesson through the lens of situational interest, which has been linked to increased student attention and engagement (Hui, Li, & Qian, 2019; Krapp, Hidi, & Renninger, 1992). Through instructional design that promotes hands-on, relevant experiential learning activities grounded in social constructivism, the *Fuel to Learn* curriculum sought to foster the affective and cognitive domains that cultivate situational interest (Renninger & Hidi, 2016). Ultimately, the researchers aimed to increase student engagement and improve teachers' perceptions of teaching nutrition in the classroom by mitigating the barriers revealed in the literature through an integrated approach to the curriculum.

2. Method

2.1 Procedures

Prior to implementation of the curriculum, the University's Institutional Review Board and each school's principal approved this study. Participants were fourth-grade teachers (N=9) at three elementary schools in Northwest Mississippi. Teacher consent was obtained during a daylong summer training on the curriculum that was administered by the *Fuel to Learn* research team. All teachers were provided with hands on training over a period of seven hours. The training included access to the *Fuel to Learn* online platform, which provided teachers access to all of the lesson plans and accompanying documents, supplemental videos, and the lesson submission feedback portal. At the end of the training, all participants were given a *Fuel to Learn* curriculum box and all tangible materials needed to teach the *Fuel to Learn* lessons.

Once the training commenced, the pilot study took place from August-December 2018. With a total of 20 nutrition-integrated lessons (10 English language arts/10 mathematics), the pilot teachers were asked to implement at least two lessons per month at their discretion (See Appendix A). All lessons were standards-based and included either a Mississippi College and Career Readiness English language arts or mathematics standard (Mississippi Department of Education, 2016) in addition to a nutrition standard from the Mississippi Contemporary Health Frameworks (Mississippi Department of Education, 2012). The nutrition content delivered through the *Fuel to Learn* curriculum centered on the five key nutrition concepts of hydration, fruits and vegetables, healthy snacks, portion sizes, and dairy. These key nutrition messages were deemed the most important by conducting an electronic poll of Registered Dietitians (RDs) in the state of Mississippi. These RDs (n=36) were asked to report the five top nutrition pitfalls that they see in their clientele. All key messages were integrated with either the mathematics or English language arts standards. The lessons were not taught sequentially, but rather teachers were asked to choose at their discretion lessons that best aligned with what they were teaching during each month of the pilot. Due to time constraints and discussions with the pilot school administrators, the *Fuel to Learn* research team found this to be the best way to approach implementation of the curriculum.

2.2 Design

A mixed methods approach was utilized during the present study wherein the quantitative data were supplementary to the qualitative data (Caracelli & Greene, 1997; Creswell, Plano Clark, Gutmann, & Hanson, 2003). Qualitative data were collected from teachers during the study through the online portal for the *Fuel to Learn* online portal. Quantitative data were collected at the end of the study through a curriculum evaluation survey in order to assist with corroborating or dispelling the qualitative findings. Teachers were asked to teach at least two lessons per month in no particular order (i.e., minimum of 10 lessons). After teaching a lesson the teachers were asked to complete a self-report lesson feedback form on the *Fuel to Learn* website. Teachers provided feedback in regard to student engagement, suitability, and feasibility in addition to any changes they would suggest.

At the conclusion of the study teachers were asked to complete an evaluation survey of the *Fuel to Learn* curriculum that was adapted from a teaching practices survey related to the integration of nutrition and academic content (Shriner et al., 2010). The survey consisted of three categories: (a) lesson plan; (b) teaching; and (c) resources. Teachers were asked to rank the statement related to the curriculum on a scale from 1 to 5, with 5 being strongly agree and 1 being strongly disagree (See Appendix B).

2.3 Data Analysis

After lesson feedback was submitted through the online portal, data were placed into an excel spreadsheet and organized according to the key messages (dairy, hydration, portion sizes, fruits and vegetables, and healthy snacks). Once organized by category, analysis occurred through a coding process. Upon reading through the data several times the researchers reviewed the teachers' notes for overall key ideas. Data were condensed into chunks and placed into a secondary spreadsheet, so as to unitize the data (Lincoln & Guba, 1985). After coding occurred, the constant comparison method was employed (Lincoln & Guba, 1985). Findings were then member-checked to ensure that data were sufficiently analyzed and the main themes from the data were identified. Excerpts from the findings are provided in the results section below and examples of each theme are identified. However, the researchers do not imply that all participants held identical perceptions.

Data for the curriculum evaluation survey were analyzed by deriving a mean for all three categories: (a) lesson plan development; (b) teaching; and (c) resources. Weighted means for the six individual survey items were then calculated by finding the midpoint number of respondents and by identifying where the midpoint fell within the cumulative number of responses and then subtracting the midpoint of respondents by the cumulative number of respondents by that number. The total was then divided by the total number of respondents and that outcome was added to where the midpoint of the scale met the midpoint of the cumulative responses. Descriptive statistics were provided for each category and placed into a table. This visual assisted in providing a summary about the sample and the measures derived from the analysis (Trochim, 2000).

3. Result

This study is novel in that it approached teachers' barriers of time, support, and feasibility through a nutrition-integrated curriculum designed to meet the needs of both teachers and students. As outlined below, findings revealed that the *Fuel to Learn* pilot curriculum mitigated teachers' barriers to teaching nutrition education and delivered positive outcomes in regard to learning engagement.

3.1 Supporting Student Engagement of Nutrition and Academic Skills Through Integration

Data from teacher feedback consistently indicated that students were engaged with both the academic skills and nutrition concepts. As noted in one teacher's anecdotal observation below, active engagement and situational interest emerged while participating in the *Fuel to Learn* lesson:

The students really enjoyed this lesson with all the moving around today. The students all seemed to realize that the water group would survive longer. They enjoyed the informational text. They did great on finding the inferences in the text under their headings. The students were all smiles as they presented their inferences to the class. Some students were surprised that the boys and girls need to be drinking a different number of cups of water a day. They liked taping their exit ticket to the board and covering my person I drew. Many students wanted to read and find out more about water. (*What is Hydration* lesson, *Teacher, 4th Grade*)

The notion that “Many students wanted to read and find out more about water” indicates that they were interested in the content and motivated by the lesson—both behaviorally and academically. Studies have revealed that motivation is an essential construct of classroom engagement (Olson & Peterson, 2015; Saeed & Zyngier, 2012).

In one of the dairy lessons, *Moo...ving Milk Vocabulary*, students were asked to identify unknown vocabulary using context clues within an informational passage. In relation to engagement with this lesson it was noted that the students were “very involved and seemed to do well and enjoy it.” Another teacher noted that “they were excited about the content” and yet another teacher stated that her students said “It was fun!” Reiterating this point, another teacher reported that her students were “very interested in how milk was processed.”

In another lesson entitled *Portion Distortion* students identified the theme of a picture that showed the difference between portions of food from 20 years ago to today. Students then engaged in analysis of the “On Portion Size” poem and finished with determining the theme and summarizing the poem. One teacher noted that her students found the image “interesting” and that she found the poem very “informative,” while “the students seemed to really enjoy both the content of the poem and summarizing information they had never learned before about nutrition.” The appeal of the visual image continued into additional feedback from another teacher who noted that the students “enjoyed the discussion about the image on portion distortion” and that it “was a good way for them to see change over time and identify the theme instantaneously.”

One of the fruit and vegetable lessons, *Don't Get Tense When it's Fruit and Veggie Time* asked students to engage with writing sentences using verb tenses after participating in a fruit and vegetable movement video. Although one of the teachers noted, “The students in one group were more hesitant to move with the video,” conversely, “The other group did not hold back.” In regard to creating sentences, one teacher stated, “The students really liked making up names for the fruit and vegetables and trying to see who could make the most humorous name.” However, what students did not realize is that they were building their skill set of writing sentences while also learning about the importance of fruits and vegetables in their diets.

Another set of nutrition-integrated lessons focused on portion sizes. In regard to these lessons one teacher noted that she was “amazed at the different classes... One class was about correct in their serving size on cereal, whereas the other class was way off... They thought a serving size should be greater.” This

difference in students' knowledge exemplifies the need for such integrated lessons. Not only were students learning about correct portion sizes, but also they were engaged in the academic content of responding to informational text about serving versus portion size. One teacher stated, "I gave them index cards to make a chart listing the item, what they think a serving would look like, and then we wrote the actual serving size and discussed our findings. They are looking forward to the next lesson on portion sizes."

Teachers commonly noted that the integrated lessons and student interest facilitated high levels of student engagement. Most observations revealed that students were engaged because they were learning about novel content and that the methods utilized in the lessons supported both feasible integration and an environment of fun.

3.2 Lesson Feasibility Promotes Buy-In

Studies indicate that the barriers to integrating nutrition content in the classroom include a lack of time and deficiency of suitable curricula that can be delivered with ease (Cunningham-Sabo et al., 2017; Dev et al., 2017). Although the curriculum development team for *Fuel to Learn* aimed to create lessons that could be feasibly integrated into the existing curriculum, the feedback elicited from the teachers provided evidence to support the integrated approach taken.

Due to the fact that teachers do not have a lot of spare time in the classroom, one of the most important aspects of buy-in for any new curriculum is the ability to have a lock-step lesson in hand that enables it to be taught with ease and minimal extra work (Margolis, 2009). The ease of teaching the lessons was noted in the feedback provided by one of the teachers in the following statement: "The lesson flowed from opening set, to procedures, to closure without any disruptions." Another teacher commented that, "Overall, the lesson was set up well. It really flowed."

The feasibility of the lesson plans are a testament to the time spent by the *Fuel to Learn* team ensuring that the nutrition and academic content were interconnected as seamlessly as possible. The team aimed to ensure that the teachers did not view the nutrition concepts as a side note or extra "thing" added to the lesson, but rather two skills that were both essential and being taught and learned simultaneously. In a reflection of the *Write Along the Milky Way* lesson, one teacher noted that she "was surprised how well the lesson flowed." During this lesson, students were asked to write a narrative in response to the following prompt: How does milk help improve our health? The narrative writing came after students read an informational passage on the health benefits of milk. During the closure of the lesson students developed a tweet that summarized the benefits. One teacher commented, "It didn't even feel like I was teaching and the students were learning about nutrition." Another teacher noted, "The integration in this lesson was interwoven very well between the passage, writing, and exit ticket. This is very similar to lessons I already teach."

Not only was the design and organization of the procedures important to the feasibility of the lessons, but so too were the materials that supplemented each of the *Fuel to Learn* lessons. Teachers are often asked to implement new programs without support or readily accessible materials. However, the *Fuel to Learn*

team ensured that all tangible materials needed for the lesson were already created and organized according to a lesson plan code in the curriculum boxes. Feedback provided by one of the teachers noted how the materials enabled the lesson to be taught with ease:

The questioning and handout [Fuel up with Milk] really helped to give students information on what to write. It was wonderful to have an example to go over and discuss before they began writing. It really helped them to understand what they needed to do. The tweets were a great idea for the exit slip and they were already printed out and ready for me to distribute. This made the lesson so easy to teach. (*4th Grade Teacher*)

Not only did the organization and scaffolded lessons enable students to construct knowledge and build upon it in subsequent activities, but another teacher mentioned that in the lesson, *Fraction Fare*, “Because of the well developed scaffolding, the lesson went really well. It just moved nicely from one set to the next.” This notion of feasibility and flow, while it may seem a minute point, in fact may be the very thing that teachers need to build their confidence in teaching material that they may not be as familiar with or feel as efficacious implementing into their daily teaching.

3.3 Meeting the Demands of Classroom Differentiation

Although high levels of student engagement were noted throughout the feedback and teachers found the lessons to be feasible to implement, one of the recurring themes noted was the need for differentiation within the lessons. Differentiation in its simplest form is tailoring instruction to meet the needs of all students. However, most of the suggestions provided for differentiation of the *Fuel to Learn* lessons were in reference to the process, or how students acquire information during instruction. Because many of the English language arts lessons had accompanying reading passages, one of the teachers noted, “It would be nice to have differentiated passages with the same content. We could use the same questions but have passages at different reading levels.” Another teacher focused on the same ideas in regard to the *You Are What You Drink* lesson in the following suggestion: “For the informational text, ‘Healthy Drinks, Healthy Kids’, it would be great if it was available for different reading levels. With differentiation being pushed, it would definitely help teachers.”

In the *Make Good Use of your Moo...la* lesson, differentiation was already embedded into the product of the lesson as described in the following comment: “A few students wanted more problems. They liked that they could choose how many of each item they could get.” However, the same teacher mentioned, “It would be really neat if we could find a way to differentiate this lesson.” Another note regarding differentiation came from the *Don't Get Tense When it's Fruit and Veggie Time* lesson. Due to varying levels of student knowledge in the classroom one teacher noted, “For the verb tense worksheet where they chose the verb to complete each sentence, I would try to have three different levels of difficulty. This would make it easier for differentiation.” Another teacher suggested, “On the ‘Portion out your Day’ worksheet, I might add an example for students to follow.” Beyond differentiation of the reading passages for all levels of students, one of the teachers noted, “The higher students in my class mentioned that they would have liked to have more problems on ‘The Price is Right’ worksheet.”

In addition to adding a variety of reading levels to the lessons, several teachers stated that some of the lessons needed “more visual aids.” Although the portion distortion lesson did provide a visual image of a plate showing portions from now and then, one teacher noted, “I would love to have a large color poster of the portion distortion image to hang in the room to go along with the lesson.” Beyond visual static images with the lessons, a few teachers suggested that adding or changing the videos provided would be helpful in further understanding of the concepts. One teacher wrote, “A video that shows how milk goes from a cow to the store would help my students understand the informational text,” while another teacher noted that “a video is needed” for the *Portion Distortion* lesson. These anecdotes provide evidence to suggest that differentiation should be addressed within the lesson plans to meet the demands of differentiated instruction in order to meet the needs of all students.

3.4 Curriculum Evaluation

The curriculum evaluation survey consists of six items that are sub-divided into the following three categories: (a) lesson plan development; (b) teaching; and (c) resources (See Appendix B). Percentages of each survey item were determined first in order to analyze the overall data (see Figure 1). Findings revealed that teachers either agreed or strongly agreed with the survey items.

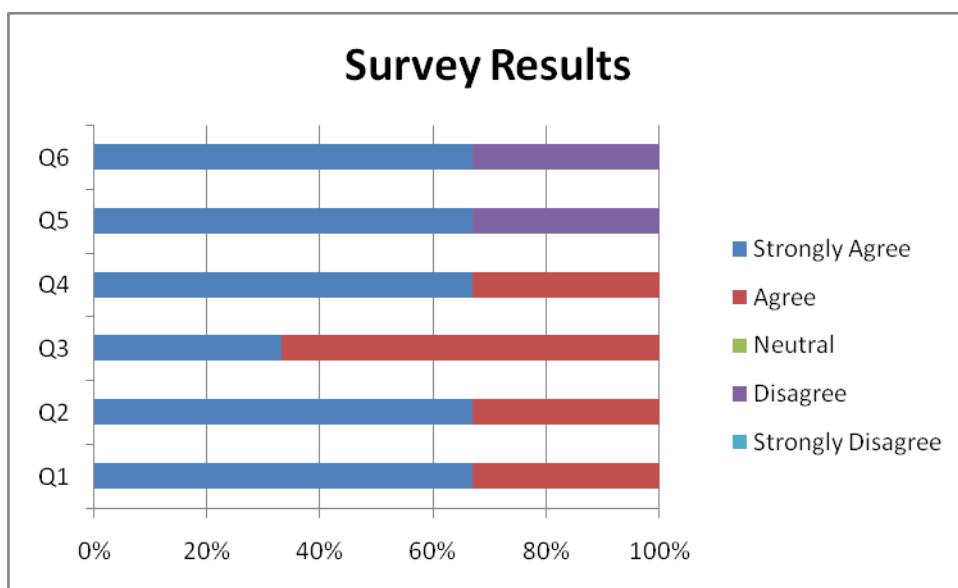


Figure 1. Curriculum Evaluation Survey Item Percentage Results

To provide further analysis of the data, weighted means were determined for each of the survey items. Items one and two on the teacher evaluation survey for the nutrition integrated curriculum addressed teachers’ perceptions of how the lesson plans were developed (see Table 1). Results indicated that the weighted mean of the two survey items were (M= 4.66) Thus, on average, teachers were between agree and strongly agree that the lesson plans were sufficiently developed. Survey items three and four were related to teachers’ perceptions regarding feasibility of teaching the lesson plans. Results indicated that

on average teacher's agreed ($M = 4.45$) that they were able to follow the lesson plans with ease. The last two survey items addressed suitability and ease of use of resources provided with the *Fuel to Learn* lesson plans. Although results did not reveal as high of a score within this category ($M = 3.66$), results revealed that the teachers mostly agreed that the resources provided were suitable and easy to utilize. Overall analysis of the six survey statements revealed that most teachers agreed or strongly agreed ($M = 4.23$; $SD = .49$) that the curriculum was appropriately developed, easy to follow, and that adequate and appropriate resources were provided.

Table 1. Mean Scores of Curriculum Evaluation Survey Items

Survey Item	Mean Score
1. The learning objectives are clear and appropriate to the needs of the learners. (Lesson Plan Development)	(4.66)
2. The lessons are engaging and successful in the classroom (Lesson Plan Development).	(4.66)
3. I followed the lesson plan very closely (Teaching).	(4.34)
4. The lesson plans were easy to follow and teach (Teaching).	(4.66)
5. The resources provided are well suited to the lesson plans (Resources).	(3.66)
6. The resources are easy to use and prep for lessons (Resources).	(3.66)

4. Discussion

Studies centered on incorporating nutrition in the classroom have demonstrated increased levels of academic achievement, initiative, and core content knowledge (Berezowitz et al., 2015; Duffrin et al., 2010; Sepp & Höjjer, 2016; Stage et al., 2018). Despite this evidence, the integration of content related to nutrition as a pedagogical approach is often perceived by teachers as a daunting task with multiple barriers such as lack of support, instructional time, and responsibility towards delivering nutrition education (O'Dea, 2016; Hall et al., 2016; Perikkou et al., 2015). However, it is important to emphasize that schools provide an opportune environment to deliver effectively designed nutrition education curricula while increasing levels of core academic knowledge and student engagement (Black et al., 2015; Berezowitz et al., 2015; Perera et al., 2015).

In the present study, researchers aimed to garner both teachers' perceptions of student engagement with the integrated curriculum and teachers' evaluation of a nutrition-integrated curriculum that addressed the barriers of time, feasibility, and support. Congruent with results found in the literature (Sepp & Höjjer, 2016; Stage et al., 2018), observational feedback provided by the teachers revealed that students demonstrated high levels of engagement with academic and nutrition concepts during the lessons.

Additionally students expressed enjoyment and interest towards concepts and even an eagerness to learn more. Findings also align with the literature on integration (Hall et al., 2016; Jones & Zidenberg-Cherr, 2015; Perikkou et al., 2015), as teachers explained through observational feedback that the integration of nutrition content into core subjects was key to making this pedagogical approach feasible and enjoyable. Another major theme in the observational feedback and curriculum evaluation was the level of feasibility that teachers revealed throughout the implementation of the *Fuel to Learn* lessons. The level of feasibility provided by the preparation and organization of the *Fuel to Learn* curriculum ensured ease of implementation. Teachers believed the lessons were feasible because they were “easy to follow and implement.” The ease of the lesson plans might be attributed to the fact that the lesson plans provided everything the teachers needed on one document and in one curriculum bin. Lessons included the standards (nutrition and academic), objectives, materials, assessments, skills, and even the links to all of the instructional aids.

Studies also indicate that teachers perceive new curriculum as difficult to implement (O’Dea, 2016; Hall et al., 2016; Perikkou et al., 2015). Therefore, ease of feasibility is critical to promoting teacher willingness, or buy-in, and engagement in extra role behavior towards implementing curriculum beyond core content. Unlike other nutrition education curriculum that teachers might find challenging to implement in their schedule or integrate with other core subjects, teachers using the *Fuel to Learn* lesson plans indicated that the lesson plans were “sufficiently developed to be easy to follow, delivered smoothly, and all the resources and materials were readily provided.” Subsequently, this promoted high levels of ease of delivery in the classroom. Ultimately, this study is novel in adding to the breadth of literature on nutrition integration, as it contrasts with the notion that teachers perceive numerous barriers and challenges when integrating nutrition into traditional classroom instruction (Perikkou et al., 2015). The present study also reveals that nutrition integration as a pedagogical approach can be an effective tool to increase student engagement and nutrition knowledge. Results indicated that students were actively engaged, both cognitively and behaviorally, as most teachers explained that the exposure to a new and different pedagogical approach (i.e., nutrition integration) fostered high levels of student engagement and an overall environment of “fun”. Teachers noted that this rise in engagement led students to become more “interested, curious, and motivated about the content.” Studies have shown that student enjoyment, interest, and eagerness towards learning translate into motivation towards learning (Turner, Christensen, & Meyer, 2009; Noland & Richards, 2015; Okoro & Chukwudi, 2011). Motivation towards learning is critical for students to develop, as Brophy (1998) noted that motivation is a prerequisite towards engagement.

In summary, the integration of nutrition into academic instruction is a beneficial pedagogical tool. While literature surrounding nutrition integration in the classroom is far from vast, evidence, including the current study, indicates that integrating nutrition into the classroom only increases or maintains student engagement and provides a feasible way for teachers to address both academics and nutrition content

simultaneously.

4.1 Limitations and Future Research

Although results of this study are promising, there are several limiting factors that prevent the findings from being generalizable. One of the limits of the study is that the curriculum was developed solely for fourth-grade. Since the curriculum was only developed and piloted in fourth-grade, the evidence can not be generalized to other grade levels. Furthermore, the pilot-study was only implemented in schools across North Mississippi. This limit in sample size and geographical location does not enable the results to be generalized to all schools across the country, as the study was conducted with a select group of teachers and students in one small select area of the United States. Another limiting variable is that teachers were not told when or exactly what lesson to teach over the duration of the five-month study. Therefore, the time of day or what lesson the teachers chose to implement was different for all the teachers who piloted the lessons. Students may have been more engaged or teachers more apt to be engaged with the lessons if they were taught at the beginning of the school day versus trying to fit them in at the end of the school day. Also, some lessons were taught at the beginning of the week while others were taught on Fridays, possibly limiting the level of engagement of both the teachers and students. Lastly, we acknowledge that garnering more in depth qualitative data through individual interviews may have provided a further breadth of data regarding teacher insights into the impacts of the pilot curriculum. Future research could address the above-mentioned limitations. A first step might be to pilot the study on a larger scale, to include a larger sample size of fourth-grade teachers and students in either a broader region and/or across the state in which the study took place. Secondly, in the development of a nutrition-integrated curriculum it would be helpful for those who develop the curriculum to closely work alongside the teachers and administrators in the school district to plan the lessons according to a pacing guide. This would enable the lessons to be taught in sequence and would provide useful evidence to further validate the results of this study. Lastly, future research should also evaluate not only the teachers' perceptions of the curriculum, but also students' perceptions. This study revealed positive perceptions of students' engagement, but it might prove beneficial to reveal students' perceptions of their interactions with a nutrition-integrated curriculum.

4.2 Conclusion

In summary, the positive impact of a nutrition-integrated curriculum developed to address teachers' perceived barriers was revealed through both teacher observation feedback and curriculum evaluation. Barriers such as lack of instructional time, inadequate curriculum and materials, and extra-role behavior will continue to be validated until programs or curriculum such as *Fuel to Learn* are developed, implemented, researched, and advocated for. Results suggest a need for an emphasis to be placed on nutrition-integrated curriculum as opposed to a stand-alone nutrition curriculum if teachers' perceptions of nutrition as insignificant and unmanageable to implement is to change. It is the hope that results of the present study and future implementation of a larger scale *Fuel to Learn* pilot curriculum further reveal not only the importance of nutrition-integrated curriculum to teaching and learning, but also to the

development of children who acquire both academic and nutrition knowledge and are provided with the tools to lead a successful and healthy life

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Appendix A

Lesson Title	Academic/Nutrition	Academic Standard	Skills
Sneaky Sugar	Math/Hydration	4.OA.2	Multiplicative Comparison, Nutrition Label Identification
Making Measurement Count	YourMath/Hydration	4.MD.1	Measurement Conversion (g, mg), Recording Measurement,

			Nutrition Label Identification
Fraction Fare	Math/Portion Size	4.NF.3D and 4.NF.2	Word Problems, Comparing Fractions, Portion Sizes
Dare to Compare	Math/Portion Size	4.NF.7 and 4.NBT.3	Comparing Decimals, Healthy Food Choices
Plotting Your Fruits and Vegetables	Math/Fruits & Veggies	4.MD.4	Line Plots with Fractions, Nutritional Value-Fruits and Vegetables
Eating Equally	Math/Fruits & Veggies	4.G.3	Symmetry, Opinion Statement
Dairy Decimal Detectives	Math/Dairy	4.NF.5 and 4.NF.6	Decimal Notation for Fractions, Dairy Product Nutritional Information
Make Good Use of Your Moo-La	Math/Dairy	4.MD.2	Word Problems, Decimals, Dairy Products
Fraction it Out	Math/Healthy Snacks	4.NF.3A	Adding and Subtracting Fractions, Reading Nutrition Labels
Picture Healthy Snacks at the Right Angle	Math/Healthy Snacks	4.G.1	Geometry, Healthy Snack Choices
What is Hydration?	ELA/Hydration	RI.4.1; RI.4.2; RI.4.4	Main Idea, Making Inferences, Hydration
You Are What You Drink!	ELA/Hydration	W.4.1A; W.4.1B; W.4.1C; W.4.1D	Opinion Writing, Identifying Unhealthy and Healthy Drinks
Talk it Up, Serve it Up!	ELA/Portion Size	SL.4.1A; SL.4.1B; L.4.1C; SL.4.1D	Collaborative Discussion, Portion vs. Serving Size
Portion Distortion	ELA/Portion Size	RL.4.2	Theme, Summarize, Portion Size, Food Behavior
Don't Get Tense When it's Fruit and Veggie Time!	ELA/Fruits & Veggies	L.4.1B; L.4.1D; L.4.1F	Verb Tenses, Nutritional Value of Fruits and Vegetables
Build a Haiku That's Right for You!	ELA/Fruits & Veggies	L.4.1D	Adjective Ordering, Poetry, Fruit/Vegetable Identification
Moo...ving Vocabulary	Milk/ELA/Dairy	RI.4.1	Drawing Inferences, Predicting, Sequencing
Write Along the Milky Way	ELA/Dairy	W.4.3C	Narrative Writing, Transitional Words, Summarize, Nutritional

Benefits of Milk

Snack Attack	ELA/Healthy Snacks	RL.4.1; RL.4.3; RL.4.4	Details in a Text, Setting, Characters, Drawing Inferences, Healthy Snack Choices
Champions for Healthy Choices	ELA/Healthy Snacks	W.4.2A; L.4.3A	Healthy Snacks, Informative Writing

Appendix B

Teacher Evaluation Survey of Nutrition-Integrated Curriculum

What subject(s) do you teach? _____ How many years have you taught? _____

*Please indicate your choice for each statement below by placing an X in the box you most agree with.	Strongly Agree 5	Agree 4	No Opinion 3	Disagree 2	Strongly Disagree 1
The learning objectives are clear and appropriate to the needs of the students (LP)					
The lesson plans are engaging and successful in the classroom. (LP)					
I followed the lesson plan very closely. If you disagree, please indicate in what ways you changed the lesson plans in the comment box provided below. (T)					
The lesson plans were					

easy to follow and teach. If you disagree, please indicate what would make the lesson plans easier to teach in the comment box below. (T)					
The resources provided are well suited to the lesson plans. (R)					
The resources are easy to use and prep for lessons. (R)					

Comment Box: