

Research Article

Teachers' Perceptions of Integrating Tower Gardens into Pre-K4 Curriculum

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Abstract

Schools play an integral role in providing opportunities for children of all ages to be exposed to nutrition education. There are a variety of ways children can receive nutrition education in the school setting, such as explicit lessons, modeled dialogue, and exposure to nutrition-based principles. However, there continues to be a disconnect between teacher perceptions of nutrition education and time spent implementing it in the classroom. Nutrition education can come in many forms, including hands-on gardening and explicit discussions on the impact of food choices on overall health. Effective nutrition education in any form elicits numerous benefits for children, but there are a multitude of barriers that inhibit teachers from implementing hands-on gardening into their classrooms—such as time, space, and teacher self-efficacy. Tower Gardens, otherwise known as hydro- and aeroponic, vertical gardening systems, offer an alternative to the space and time required for traditional gardening. Nonetheless, the body of literature surrounding the impact and feasibility of implementing tower gardening systems is limited, specifically in the preschool setting. Therefore, this study explored teachers' perceptions of and experiences with implementing Tower Gardens into pre-kindergarten 4-year-old (pre-K4) classrooms. A qualitative approach was employed wherein a focus group was conducted with pre-K-4 teachers who integrated Tower Gardens



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through the *Growing Healthy Minds, Bodies, and Communities* Curriculum. Findings were analyzed and four themes emerged as follows: (a) novelty of Tower Gardens increases opportunities to learn; (b) a multitude of interactions with growing and food; (c) increased engagement from children; and (d) implementation and positive outcomes for teachers. These findings suggest that Tower Gardens can be implemented with relative ease in the classroom and produce positive outcomes for student engagement and interactions with foods.

Keywords

Tower Garden; nutrition education; preschool gardening; teacher perceptions

1. Introduction

Establishing healthy eating habits in early childhood nutrition can have a lasting impact on children's health. In today's obesogenic environment many children are at a higher risk of developing asthma, type 2 diabetes, heart disease, and high cholesterol than in generations before. Finding effective ways to incorporate nutrition and food education into the early childhood classroom is imperative [1]. Increasing healthy food intake is also critical for mitigating these health risks for young children. The MyPlate program is an example of outlining the variety and quantity a preschool child needs of fruits, vegetables, grains, proteins, and dairy. The program is the current nutrition guideline published by the United State Department of Agriculture to promote healthy eating for young children [2]. Increasing fruit and vegetable intake is key to helping children develop and maintain healthy eating habits. There are a myriad of factors that affect the specific quantities and types of food a child needs, but it is recommended that a preschool-age child consume 1 cup of fruit per day and 1-1/2 cup of vegetables per day [3]. Helping families establish healthy eating habits, such as regular family meals and modeling healthy eating, can increase a child's consumption of daily fruits and vegetables [4]. Effectively implemented nutrition education in schools can further develop a child's healthy eating habits. All experiences a child has with fruits and vegetables can affect preferences and intake for subsequent years to come [5]. Explicit nutrition education intentionally addresses the experiences a child has by exploring why and how certain foods can affect health [6]. MyPlate is used to address the quantity and type of food consumption among this group, but there are few nation-wide programs that regulate and encourage explicit nutrition education. Many schools' nutrition education programs focus on dietary regulation and no-sugar campaigns for dental health. While these programs can yield positive outcomes and encourage healthy eating, they do not establish lifelong healthy eating habits. Hands-on nutrition education, however, allows students to make meaning of nutrition and drives these lifelong healthy eating behaviors [7]. Therefore, implementing an effective nutrition education program in early childhood education is critical.

One approach to the type of hands-on nutrition education that encourages healthy eating is school gardening. School gardening can encourage students to consume more fruits and vegetables and improve their experiences with healthy food habits [8, 9]. However, the time necessary to integrate gardening into curricula, space needed to effectively plant, and lack of training inhibit

many teachers from incorporating gardening into their classrooms [10-13]. Therefore, a two-tier approach to build capacity for sustaining nutrition education programs inclusive of gardening education is necessary. The first tier includes the collaboration between institutions and preschools. The second tier encompasses the integration of Tower Gardens, an aeroponic and hydroponic vertical growing system, as a potential to mitigate the aforementioned barriers while still providing effective gardening experiences and hands-on nutrition education for children. Beyond traditional and aeroponic methods, compact hydroponic growing kits, indoor herb garden growing kits, and even do-it-yourself hydroponic grow boxes serve as viable alternatives for the integration of garden-based education.

2. Literature Review

2.1 Food Preference Factors in Pre-Kindergarten

2.1.1 Teacher Interactions

While nutrition education programs for preschool children provide opportunities to increase healthy food behaviors, it is critical to note that outside variables, such as the home and school environments, can also impact children's nutrition behavior. One school variable is how preschool teachers approach eating and mealtimes. Their interactions can play a role in the development of healthy food behaviors and, in many cases, serve as the most opportune time for nutrition education [14]. The way a preschool teacher approaches mealtimes can have a significant impact on a child's relationship with food. Teacher's varying levels of demandingness and responsiveness lay a foundation for a child's current and future relationships with food, and it is suggested that the approach should vary in preschool versus home environment. Teachers who are authoritative during mealtimes develop children who are more eager and willing to eat new foods, as opposed to teachers who are indulgent, uninvolved, or authoritarian [15]. This suggests that teachers' knowledge and approach to feeding children can play a pivotal role in the development of food behaviors for children.

2.1.2 Social Observations from Children

Ultimately, a myriad of factors affects a child's food choices. Family involvement, teacher-led implementation, and family meals are three of the main identified factors affecting food intake. The involvement of home and school factors reiterates the uniqueness of nutrition education [16]. Experiential education has been considered an effective method to bridge the gap between these two environments. Experiential education occurs when children learn by having experiences with a concept or content material. Direct contact with food strongly correlates to food dislikes and likes. Taste exposure and experiential education in young children is suggested to yield the most long-term effects [17-19]. Practically, experiential-based nutrition education would manifest as school gardening and other relevant hands-on experiences. Additionally, gardening is a form of experience-based nutrition education that has played a pivotal role in both the economic and educational scenes across the world for centuries.

2.2 School Gardening Benefits and Implications

School-based gardening has evolved as an alternative way to approach nutrition education in the schools and combines exposure, hands-on gardening, and personal connection to influence children's nutrition knowledge in and out of the classroom. Experiential based education provides nutrition-related activities via gardening in an academic setting [18]. When implemented, though novel to many preschool curricula, school-based gardening has been found to not only improve fruit and vegetable intake but also to make the process of eating them more enjoyable [8, 20, 21]. Because food behaviors lay a foundation of nutrition-based skills, exposing children to produce and gardening practices can affect their food perceptions and choices, as well as their overall health [9]. Second graders who received both nutrition education and gardening were able to better identify fresh vegetables such as spinach and lettuce, and they were more likely to choose these foods after hands-on experience [22-25]. Similarly, gardening-based education for young children (ages six and under) that involves planting, harvesting, and preparation have shown healthy outcomes such as increased fruit and vegetable consumption [26].

Overall attainment and recognition of health is another end goal of many school gardening programs [27]. However, achieving this goal is affected by the ease teachers are able to implement gardening in their own classrooms. Surveyed teachers consistently show that they perceive school gardens as a useful tool in promoting healthy eating habits [28, 29]. Despite this perception, teachers reported the three main barriers to implementing gardening education in their individual classrooms are teacher preparedness, school resources, and practical issues—including season of planting and weather [30].

2.2.1 Addressing Barriers to School Gardening

While research-based evidence supports the benefits of implementing gardening in classrooms for young children, teachers and administrators reported the barriers that prevent the implementation of traditional gardening into schools were time, funding, administrative support, space, limited technology, and lack of teacher training [10-13, 31]. Many of these barriers can be addressed by additional resources and effective implementation. However, space and time issues cannot be addressed solely by additional support. To mitigate space and time, vertical hydroponic gardens have become a popular alternative to traditional gardening. These systems can grow multiple plants in a small space without the requirements of natural light and water [32]. Rather, Tower Gardens utilize attached LED lights and a self-pumping water reservoir that does not rely on an outside environment. Though Tower Garden systems specifically are utilized in this study, there are other more economical alternative gardening forms that can be utilized. These include hydroponic and homemade gardening devices and indoor growing kits. While research is still in its infancy, Tower Gardens have become an integral part of many schools for all grade levels. Gardening with these devices differs from traditional gardening because they can yield more harvest in less time, use less water, and are accessible despite weather/seasons [33]. Across the United States, there are 7,500 schools utilizing Tower Garden technologies, with 49 out of 50 states having Tower Gardens in some sector [34]. There is limited research on the outcomes of utilizing these devices in schools and its impact in the classroom.

2.3 Integrated Tower Garden Curriculum

One program that utilizes Tower Gardens is The *Growing Healthy Minds, Bodies, and Communities* (GHMBC) Curriculum. The preschools GHMBC works with are in North Mississippi and the Delta region. They are all state-funded and part of an early learning collaborative in Mississippi, comprised of school districts, Head Start agencies, childcare centers, and private non-profit organizations. These preschools across the state work in tandem and, because they are state-funded, are required to adopt a state-approved curriculum. The GHMBC curriculum was created as a supplement to the state approved pre-K4 curriculum, Opening the World of OWL (OWL). Specifically, GHMBC integrates the required academic content embedded in OWL with social-emotional integration through concepts such as yoga, nutrition/gardening, anti-bias/anti-bullying, and physical activity. Specific to the GHMBC curriculum is a unit on Tower Gardens. This unit was developed as a four-lesson unit spread out over a month, or one lesson per week (see Appendix A). Participating teachers are provided with an unboxed Tower Garden, pH testing kit, rockwool pods (e.g., soil), seeds, and in-depth instructions for preparing and maintaining the Tower Garden. Tower Gardens are utilized as part of this curriculum, as the funding provided for this study specifically outlines this mechanism for gardening, there are certainly other tools that teachers may utilize to provide gardening experiences for their students. Examples of alternative growing platforms include indoor tabletop herb growing kits and indoor hydroponic growing systems that vary in size compared to the large size of a Tower Garden system.

Additionally, as part of participating in the GHMBC curriculum teachers receive professional development during the summer at a retreat that consists of a 3-day training and exploration of all elements of the GHMBC curriculum. The retreat during 2022 was held in Brandon, Mississippi and teachers were provided hands-on training regarding the Tower Garden unit, enabling them to work together to put together a Tower Garden. Teachers are also provided with professional development throughout the year as well as prior to beginning implementation in unit 4. In the first lesson of this unit (unit 4), teachers introduce children to an alternative way to grow plants in rockwool and have children plant lettuce mix, dill, chive, and basil seeds into rockwool pods. Additionally, children count seeds and create their own seed snack to learn about the different ways to use seeds. In the second lesson, the Tower Garden is unboxed by having children observe the teacher opening each part of the Tower Garden and making inferences about what it is. Teachers are encouraged to explain each part of the aeroponic growing system and allow children to help in developmentally appropriate ways to assemble the Tower Garden. There is also an assembling guide and video provided for the teachers. The third lesson has children transfer the starter plants that they planted in rockwool in the first lesson to the growing pods of the Tower Garden. This lesson explains the process of germination to children and allows them to see the alternative ways that sun, soil, air, and water can be given to aid in plant growth. The final lesson of the specified Tower Garden unit has children visually and kinesthetically observe the different parts of plants. Children create a "Plant Part Wrap" using tortillas, hummus, and various vegetables to illustrate the different plant parts that they observe growing in the Tower Garden. During the next two units, approximately eight weeks, children observe the Tower Garden growth and document it in their "growing journal." At the end of the sixth unit, the Tower Garden is harvested, and children make their own healthy ranch—using dill grown in the Tower Garden—and balsamic vinaigrette dressings.

They then taste test and vote on a poster whether or not they liked the lettuce harvested from the Tower Garden unit [35].

To examine the feasibility and teachers' experiences with the GHMBC Tower Garden unit, the researchers explored the following research questions:

1. What are teachers' perceptions of feasibility in regard to Tower Gardens in pre-K4 classrooms and curriculum?
2. What are teachers' experiences with utilizing Tower Gardens in the classroom?
3. What are the perceived benefits and barriers to implementing Tower Gardens in the pre-K4 classroom?
4. To what extent do Tower Gardens impact children's food behaviors at school, as observed by teachers in the classroom?

3. Methods

A phenomenological qualitative approach described as "a method focusing on the shared experiences of a topic and how that experience affects understanding" [36] was utilized for this study. Participants were 8 teachers from 3 high need schools in the North Mississippi and Delta regions. Participant demographics were 50% White/Caucasian and 50% African American. All participants were females between the ages of 22- and 60-years old. Data collection took place in Brandon, Mississippi from 5:00 p.m. to 6:00 p.m. on July 12, 2022 (see Appendix B). Teachers who participated in the focus group were voluntary attendants at the GHMBC summer retreat where they partook in professional development and training pertinent to the GHMBC Curriculum from July 11-13, 2022, thus a purposive sample was used. Inclusion criteria for this study were teachers who had participated in piloting GHMBC for at least one year and had utilized a Tower Garden in their classroom. Prior to the focus group discussion, approval from the university's Institutional Review Board was obtained and all participants consented to join in the study via a consent form on the day of the study.

3.1 Data Collection

One researcher moderated the focus group with 8 pre-K4 teachers who implemented the GHMBC Curriculum and utilized Tower Gardens as a central component for one four-week gardening integrated unit during the 2021-2022 school year. As part of their commitment to implementing the GHMBC curriculum, it is important to note that each teacher also received a free Tower Garden. A focus group was conducted in which data were collected to understand teachers' perceptions of the feasibility of Tower Garden implementation in the classroom. In order to maintain confidentiality, pseudonyms were chosen by participants and used as an identifier before speaking. These pseudonyms were used during the transcription process as well. This method was chosen for its ability to receive unstructured participant responses, as well as the opportunity for participants to respond to others' responses. Responses could then be compared and sorted in order to find trends across teachers' perceptions. This specific method of phenomenology data collection allowed for participants to share in detail the experiences of a topic [37]. Thus, participant responses and shared experiences served as the main source of data for understanding teachers' perceptions of the feasibility of implementing Tower Gardens.

Focus group questions were asked in an open-ended format and prepared prior to the scheduled session (see Appendix D). Questions included probing words such as... “In what ways...,” “What are your experiences...,” and “Do you think it is important to...,” as well as additional follow-up questions [38]. Wait-time was used after asking each question in order to ensure the opportunity for all participants to respond. The researchers avoided interjection or affirmation/non-affirmation responses in order to gain a general unbiased overview of the context [39]. Questions focused on personal experiences with gardening, nutrition, and Tower Gardens in both the teachers’ lives and classrooms. The conversation concentrated on teachers’ observations of children’s behaviors during Tower Garden curriculum integration and the attitudes towards the workability of Tower Gardens in their own classroom settings.

3.2 Data Analysis

The focus group was audio recorded and transcribed using Otter.ai [40]. After the focus group was recorded and transcribed, the researchers then read through the transcript multiple times in order to become familiar with the data. After familiarity was achieved, the lead researcher began memoing the data using a word processing system. Overarching concepts that arose in the focus group were extracted in order to construct a framework for the data. Memoing is defined as “attempts to synthesize [data] into higher level analytic meanings” and is a key step in data analysis ([41], p. 95). These memos were then broken down into codes, utilizing the MAXQDA 2022 analysis software [42]. Initially, the researcher extracted inVivo codes in order to use the participants’ experiences to form the main themes. From the inVivo codes, the researcher grouped like phrases into initial themes. This step in the data analysis process is defined as “making sense of the text collected” ([43], p. 259). The initial themes were then broadened to construct sub-themes and, subsequently, main themes that summarized the results of the study. This helped the researcher narrow data and identify commonalities, which ultimately emerged as overarching themes. This step includes recognizing patterns within the data [40]. The lead researcher then shared the process with the remaining researchers in order to ensure similarity in intercoder data analysis. The researchers then transferred the coding process into a table in order to visualize the transition from initial codes to themes (Table 1).

Table 1 Coding extrapolation.

| Main theme | Sub-Themes | Initial Themes | Initial Theme Examples |
|--|---|--|--|
| | Minimal prior experiences | Traditional Gardening | “might be planting every now and then” |
| Novelty of Tower Garden increases opportunities to learn | Perceptions of Tower Garden prior to implementation | Child experience with gardening | “really have no concept...” |
| | Overcoming challenges | Learning experience for teachers during implementation | “first time seeing Tower Garden” |

| | | | |
|---|--|--|--|
| | Increased likelihood to taste vegetables | Willingness of children to participate | “willing to try it” |
| Multitude of interactions with growing and food | Aware of growing process | Inquisitiveness | “predict where it came from” |
| | Hands-on involvement | Harvesting experience | “look in and see the roots” |
| Increased engagement from children | Child observation of growing process | Child reaction | “excited as they watched it grow” |
| | Ownership | Child buy-in | “they are more involved” |
| Implementation and Positive Outcomes for Teachers | Accessibility to implement | Ease for teacher | “is very easy” |
| | Teacher perceptions after implementation | Outcomes and experiences | “it is important” |
| | Community involvement and awareness | Family reactions | “relatives show up to the school to ask” |

4. Findings

A detailed analysis of the focus group interview was conducted and served to illuminate teachers’ perceptions and experiences of implementing Tower Garden integrated curriculum into their pre-K4 classrooms. After data analysis occurred, the coding process resulted in four themes as follows: (a) novelty of Tower Gardens increases opportunities to learn; (b) a multitude of interactions with growing and food; (c) increased engagement from children; and (d) implementation and positive outcomes for teachers.

4.1 Novelty of Tower Gardens Increases Opportunities to Learn

4.1.1 Minimal Prior Experiences

Participants shared their prior experiences with both traditional and aeroponic gardening systems, as well as the format in which they took place. Participants had little personal experience with gardening, but instead shared memories of exposure and interactions. The phrase “when I was younger” emerged frequently and marked family-oriented gardening experiences for two participants.

When I was younger, we would have a little family garden in the backyard with corn and squash and different types of beans and stuff. But we really only did that a few summers ago. So aside from that, I really had no prior gardening experience... and then my husband, thinking

about it now, had like 50-gallon drums. We did tomatoes that summer and some squash plants. But aside from those two experiences, I guess I'd never done much before the Tower Garden. (Jenny, pre-K4 Teacher)

My great uncle had a garden, and my grandparents, when I was younger, but I barely remember. I don't remember picking as much as I remember sitting in the kitchen and shelling peas and butterbeans. (Beth, pre-K4 Teacher)

Participants also discussed how their prior experiences in the classroom were focused on traditional gardening. Traditional gardening presented a challenge that was addressed by integrating Tower Gardens into the classroom. For example, one participant commented that “traditionally, it takes a lot more time.” While employing traditional gardening systems, participants had to account for time as a factor and determinant in planting. One participant remarked about her efforts to incorporate traditional gardening into the classroom. Destiny said, “I always tried to plant with my students, at least once a year, usually during the spring.”

Traditional gardening in the classroom is often integrated with nutrition-related education. Participants discussed that prior traditional gardening in their classrooms often had ties with nutrition-based education but was done so in the paradigm of recommended food intake. Two participants recalled their experiences with nutrition programs relating to food prior to Tower Garden curriculum integration as follows:

Before the Tower Garden, we might be planting something every now and then, but most of the nutrition was when we talked about the food pyramid and that kind of stuff—when we talked about different fruits and vegetables. That was the extent before. (Beth, pre-K4 Teacher)

4.1.2 Tower Garden Experience for Teachers

Participants frequently noted that being introduced to a Tower Garden was a novel experience for them both personally and professionally. One participant stated, “this opened up a whole new level to me of gardening.” The following conversation emerged within the focus group about teachers’ experiences, perceptions, and reactions to the novelty of Tower Garden integration:

This was a new experience for me, too, because that was my first time seeing a Tower Garden. So, we were all learning it for the first time. I was learning. I was amazed. (Darla, pre-K4 Teacher)

As Darla was saying, a Tower Garden was a first for me. I had never even heard of a Tower Garden. I had only seen gardens outside. And when we learned about it, I was excited to teach the students about it... We didn't know about it, so it's not just for the students. It's for us, too! (Renee, pre-K4 Teacher)

Responses of initial experience and reactions differ from prior experiences with gardening. Many participants noted phrases indicating a lack of self-efficacy while discussing traditional gardening, such as “I’m not a good gardener” and “I try not to kill everything.” However, the phrases that emerged about implementing the Tower Garden included words such as “learning,” “excitement,” and “amazed.”

4.1.3 New Experience for Children

Three participants highlighted the fact that their students have likely not experienced any form of gardening, either aeroponic, hydroponic, or traditional. One participant in particular, Jenny, stated, “Some of them may have never had experience with [gardening education].” Another said, “They really have no concept, most of them.” The following statement was recorded from a participant responding to how teachers perceive children’s experience of gardening. Melissa said, “I think that it brings great new experiences to students who otherwise would never [have] had that experience or be able to see growth traditionally.”

4.1.4 Learning to Modify and Address Challenges and Barriers

Challenges that arose during integration were discussed as additional opportunities for learning. Participants frequently noted that “assembling” and “cleaning” the Tower Garden were the most difficult tasks of implementation and initially presented as a barrier to implementation. Specifically, it took significant time to learn the appropriate methods of cleaning and assembling the Tower Garden. Melissa said, “That first year, it was very hard. It was confusing.”

While recounting the experience of the participants’ pilot year of implementing Tower Gardens, many discussed how it was difficult to learn the logistics of planting in this new format at the same time as their students. Beth said, “When you’re learning at the same time, there’s so much downtime for them, which is not always best.” Though five participants discussed how it was challenging to assemble the Tower Garden with the children’s help, one participant shared anecdotally how she addressed the difficulties in initially setting up and disassembling the Tower Garden (Figure 1).



Figure 1 Children assembling Tower Garden with their teacher.

The first year, my assistant and I worked together. We just took the kids and all and we just sat there and were like this is what we’re getting ready to do today–take it out of the box. We didn’t look at the videos, y’all were talking about the videos [curriculum team member] [was] doing, we were looking at a video that was online...So we took step, step, step. And to take it apart, it’s a learning process. So, we put it together and we’re like, ‘nah, that doesn’t work.’ And we were like ‘nah this doesn’t go that far,’ so it took us like that day to do that. And they were right there in the room with us. (Darla, pre-K4 Teacher)

Though participants often struggle with initially putting together and cleaning the Tower Garden, those who participated in the pilot program for more than one year often repeated time-marking phrases such as “it gets easier,” “at the beginning,” and “the first year” that indicated the challenges were addressed through experience with the program.

4.2 A Multitude of Interactions with Growing and Food

4.2.1 Willingness to Try New Foods

As a result of hands-on gardening experience, participants observed noticeable student willingness to try new foods. Words such as “eager” and “excited” were used to describe the children trying new foods. Renee said, “I think it encouraged them to try new foods.” Jenny added that children are “more likely to actually try the food or at least be aware of the nutritional value of different vegetables and things that we do throughout the program.”

Another participant shared about children’s willingness to try new foods, even if they did not like that food:

They watched it every day. I mean, you know, they didn’t focus every single day, but as stuff got bigger we would try some stuff as it grew. And when we harvested it, I mean they loved it. There were some who were willing to try it all. But of course, they didn’t like some of it. (Beth, pre-K4 Teacher)

Jenny discussed the experience of harvesting the Tower Garden and seeing the children try the produce in the following statement:

I also think because when we did the harvesting, we, all four classes, sat in the hallway together and we passed out all the lettuces and salad dressings and it’s almost like positive peer pressure. Because the two children on either side of them are trying it, they’re like ‘Ok, you know if he’s going to try it, I’ll give it a bite’, you know? Just the exposure of it and willingness to try it because it’s something they helped grow in the room. (Jenny, pre-K4 Teacher)

4.2.2 Inquisitiveness About Food and Growth

As children began to try and interact with food in the lessons that integrated the Tower Garden, participants shared that many began to ask questions, predict, and observe the origins of their food sources. One participant noted the following observation when children tried new foods:

And then they kind of use their predictions as to where it comes from sometimes. So sometimes they may say, ‘Do you think we can grow this in the Tower Garden?’ So, you know it kind of gives them critical thinking. (Melissa, pre-K4)

Other phrases that occurred frequently during the focus group when conversing about observations of children and food interaction included “intrigue” and “ask.” Melissa said that the children in her classes consistently ask about the Tower Garden growth every single day. She said, “They are intrigued to ask about it every day. Like every day.” Jenny said once the plants started growing in the Tower Garden, children asked questions such as “When can we eat it? Can I pick this leaf off and eat it?” (See Figure 2).



Figure 2 Child observing growth on Tower Garden.

4.2.3 Hands-On Food Experiences

As part of the GHMBC Curriculum, participating teachers are encouraged to harvest the Tower Garden with the children. Jenny said that her class and three other classes set up a community harvest for all of the pre-K4 children at this school. These participants put all of the children in the hallway and passed out the lettuce and salad dressing to the children. Darla and the teachers at her school had the children harvest their own produce from the Tower Garden and help make the salad dressings.

One participant discussed the benefits of having children see parts of the plants that they might otherwise not have the ability to observe.

So, they really have no concept, most of them, especially when you're harvesting and you're pulling out the plants and they can see the roots coming out. I know we did. I did let them look in and see the roots. But still, that was different for them to say or explain what's in the ground that you don't see. (Beth, pre-K4 Teacher)

4.3 Increased Engagement from Children

4.3.1 Observation of Reactions and Interest

Teachers who recalled their students' engagement during the Tower Garden implementation frequently used words such as "intrigue", "love", "excited", and "amazed". One participant shared student intrigue from the initial set-up of the Tower Garden to the final harvest day:

When you first put it together, they are very intrigued by it because they've never seen it. They want to know what it is, what it does. You know, you explain it to them, but when they actually see it, they are very excited. Like the very first year, a lot of our students thought it was a robot and they were like 'What is a robot going to do? Are the plants going to grow from the robot?' (Melissa, pre-K4 Teacher)

Other participants remarked about the children's "love" for planting the Tower Garden during the process as well. For example, Beth said, "the students love being able to plant it." She continued to say, "And when we harvested it, I mean they loved it."

Student reactions signified increased student interest during lessons that integrated the Tower Garden, according to teachers. Jenny said, “It just made them that much more interested. Because it was something new and different to them.”

4.3.2 Ownership and Buy-in During Integration

Student buy-in and ownership when interacting with the Tower Garden was a common theme discussed among participants in the focus group. As a result of the hands-on experience children were able to participate in, teachers remarked that student ownership and responsibility for the plants increased (see Figure 3).



Figure 3 Students planting seeds in rockwool pods.

I’ve found that if the children are involved in helping grow those healthy foods and different experiences where they are more involved in it, they will kind of take ownership of it and be more likely to actually try the food. (Jenny, pre-K4 Teacher)

Though different school settings provided varied levels of participation for children, responses regarding student buy-in were consistent throughout all participants. Many discussed how children consistently asked questions about the Tower Garden, specifically about when they could harvest or try the vegetables, providing examples with questions children were asking such as “Can I pick this and eat it?” and “Do you think we can grow this in the Tower Garden?” Melissa said, “They are intrigued to ask about what is going on with it every single day.”

Buy-in and integration, though a common remark by all participants, may be impacted by the level of child involvement in the growing process. The lesson plan was designed to have all children participate in the assembling and harvestings. However, some teachers chose to include the children in their class in the maintenance process, including watering, checking pH levels, and making daily observations. Darla recounted, “They did everything. They even put in the water.”

One participant also remarked how the children’s interactions and engagement with growing food sparked conversations at home as well, demonstrating buy-in reaching beyond school. Peaches said, “I like the fact that they took it home with them, too. You know, ‘Mom, I tried this today and I liked it. Can we go buy this?’” Increased student buy-in traveled past the boundaries of the school and demonstrated true ownership by children in the program.

4.4 Implementation and Positive Outcomes for Teachers

4.4.1 Accessibility of Implementation

While discussing overall implementation with participants who have piloted Tower Garden integrated curriculum, time and ease were the two main factors discussed that determined the accessibility for teachers to implement Tower Gardens in the classroom.

Time. Time is a key factor in implementing class gardening in any medium. Participants discussed how this form [Tower Gardens] of gardening took less time than traditional gardening, making it more flexible and manageable in the midst of academic and supplemental curricula. Melissa discussed how less required time meant more children could be exposed to gardening. She noted, “Traditionally, it takes a lot more time. During that time, we would usually plant [over winter break], they get a chance to be ‘Wowed’ when they return to school.”

Ease. Participants also discussed an overall ease of implementation. The words “easy” and “effort” emerged during the conversation. There was relative ease for teachers and children who participated in the pilot integration. Both teacher upkeep for the Tower Garden and student interaction were discussed. One participant discussed her own self-efficacy with traditional gardening compared to her experience with the Tower Garden. Beth said, “When I get plants, I mean, I try to take care of them, but I either water them way too much or I forget about them. The Tower Garden was very easy.”

4.4.2 Community and Family Awareness

Participants noted observations of family awareness for what was being implemented in the classroom. Participants described this interaction through observing children’s impact of taking home their knowledge of how things grow and familiarity with vegetables. Two participants recounted how they heard family feedback and awareness of the integration as a result of a student sharing their experience. Peaches stated that children “took it home with them” and they would ask families if they could buy the different vegetables they grew at school. Destiny added:

...we also would have relatives show up at the school to ask what their child had been talking about getting more explanation about what was going on in classrooms. So, they were going and talking about this with their families.

4.4.3 Curriculum Integration and Experience

Perceived Importance. Participants shared “I think” and “I feel” statements that illustrated a perceived importance of integrating Tower Gardens in the curriculum. Both direct and experience-related questions yielded participant responses regarding their overall view of importance. The following conversation took place during the focus group and illustrates a response to a direct question about the teachers’ view of importance. Jenny said, “I do think it’s important, especially the age group that we work with, because, you know, some of them may never have had any experience with that.”

Jenny stated in a subsequent conversation, “I feel like it is a wonderful thing to let them experience.” She explained how gardening allowed her class to see what they usually would not be able to see in the growing process.

Overall Experience. Words such as “great” and “positive” emerged within discussions of teachers’ experiences. Melissa said, “I think that it brings great new experiences to students who otherwise would never have that experience or be able to see growth traditionally.” Beth also added her overall experience with integration in her classroom, “I think it was a positive experience...I think it’s a great experience, it was in my class.” Renee agreed. She said, “It was a great experience for us all and to learn, you know, a new way for the right way to grow.”

5. Discussion

Existing research supports the notion that there are barriers to gardening integration such as time and training, as also indicated by participating teachers in this study [12]. However, there is a deficiency in the research focusing on teachers’ perceptions of the opportunities to address these barriers through integration and observable student behaviors during and post-integration. More specifically, there is minimal research specifically addressing Tower Garden implementation in a supplemental curriculum setting. This study adds to the current research by synthesizing responses of focus group participants who have experienced integrating hands-on gardening in their classrooms and linking the existing knowledge of the effects of gardening integration. Additionally, the present study identifies the research gaps regarding teachers’ perceptions of integrating Tower Garden-specific pedagogical practices. This study also emphasizes the positive outcomes reported by teachers for children’s increased exposure to vegetables and healthy eating as a result of hands-on gardening integration.

The four main integration challenges examined by the literature surrounding gardening integration were time, space, administration, and funding [12, 44, 45]. Funding and administration were not applicable to participants in the present study because all supplies were provided to participating teachers and administrators signed a memorandum of understanding to adhere to the outlined curriculum. However, both the issue of time and space was addressed through conversations with participating teachers. Many said that assembling and disassembling the Tower Garden was the most challenging and time-consuming part of implementation. Resources and experience, however, were a helpful tool in addressing these barriers. One participant who has piloted the program for three years said, “It gets easier.”

This study further addressed teacher perceptions of Tower Garden-specific implementation at each stage of the process. Participants used words such as “positive,” “great experience,” and “excited” to describe their perceptions of integration both before and after implementation. The current body of research serves to share teachers’ perceptions of hands-on gardening experiences—non-Tower Garden specific. A majority of these perceptions are reported as barriers, rather than overall experience and reactions [12]. Therefore, this research adds to the breadth of knowledge regarding educators’ practical experiences integrating Tower Gardens into a classroom environment. Teacher comments suggest that similar experiences would result from alternative garden systems that address barriers to time and space.

Both the literature and the present study points toward positive outcomes of observable student food behaviors. Children who are exposed to hands-on gardening were said to have improved social-

emotional skills, specifically social communication [46]. Students' positive interactions with their peers in the study additionally demonstrated the positive impact for children's social-emotional skills. Literature surrounding children's food behaviors found that children are more likely to choose healthier foods when they see their peers doing so as well [47]. The participants in this study noted similar observations for children in their classes. One participant discussed how children's experiences both growing and harvesting the Tower Garden increased children's likelihood of trying the foods when the class harvested together. She described it as "positive peer pressure" and suggested that if the children on either side of a student are trying the vegetables grown in the Tower Garden, then they will be more likely to do so.

The participants also recounted that if children were involved in hands-on growing throughout the process, they would be "more likely to actually try the food." This aligns with the body of research supporting the notion that experiential gardening increases children's likelihood of trying and overall enjoyment of vegetables [8, 20, 21]. Children's intrigue about vegetables and healthy food choices also increased both inside and outside of the classroom. Participants stated that the children "took [the learning] home" and asked their parents/guardians to buy some of the vegetables that they had grown in the Tower Garden. This outcome could support the gap that exists between the school and home environment when it comes to food choice [16].

The researchers' findings of observable student behavior, barriers, solutions, and experience implementing Tower Gardens paralleled the body of literature currently available for understanding the feasibility of hands-on gardening implementation, while also expanding on the breadth of research available for Tower Garden-specific integration. Nutrition education programs focus on food, eating choices, and their effects [48]. Preschool interventions that incorporate hands-on gardening and nutrition programs are a critical tool in establishing healthy habits for children [49, 50] in addition to improving overall children's well-being. Responses during this study aligned with the research findings that children can benefit emotionally, psychologically, and physically from effective nutrition and gardening education [29, 51, 52]. Participants acknowledged and addressed barriers and solutions during the implementation process. They also shared children's excitement, intrigue, and increased willingness to try the harvest of the Tower Garden. Overall, teachers' willingness, adaptation, and "positive" experiences with the Tower Garden point towards the feasibility of Tower Garden integration for teachers and the positive effects for students and teachers alike.

5.1 Limitations

While the findings of this study regarding Tower Garden integration are in alignment with the body of literature surrounding hands-on gardening, there were a few limitations that emerged during data analysis that are important to consider. The participants were from schools across Mississippi who participated as pilot teachers in the GHMBC curriculum. The researcher was only able to administer a focus group with 8 GHMBC teachers. Thus, it is important to acknowledge that additional focus groups with GHMBC teachers may reveal subsequent relevant topics related to this study. The Tower Garden was fully funded for all participants, and they received training and administrative support through their schools and GHMBC support personnel. The researchers acknowledge that these curriculum factors could differ across different schools with less administrative support and if the feasibility was not dependent on funding. Grant funding also paid

for small teacher incentives such as curriculum t-shirts and gift cards for program participation which could have impacted teacher buy-in.

5.2 Future Research

There is currently limited research on the topic of teachers' perceptions of the feasibility of Tower Garden implementation. The current body of research mainly addresses the barriers and solutions of nutrition education and hands-on traditional gardening education for teachers and the benefits of these programs for children. However, future research might add to the current knowledge and understanding of the outcomes of Tower Garden-specific education and feasibility of implementation. Creating a study from a wider geographical population of teachers and with different implementation experiences would increase the availability of data on this topic. It would also be beneficial to study teachers' perceptions in kindergarten through secondary classroom settings in order to expand on the role that settings play in Tower Garden feasibility. The impact of Tower Gardens on children's home environment and/or family engagement could also be examined and would add to the breadth of literature available in regard to the impacts of nutrition education on children's families.

5.3 Conclusion

This study adds to the body of literature available for understanding the feasibility and impacts of Tower Garden integration in the pre-K4 classroom. Overall, findings revealed that implementation was feasible and fostered positive experiences for teachers, as well as positively impacted children's engagement and food choices. Though barriers and challenges were addressed in both the literature and the study, results indicated that these barriers were overcome with additional experience. Teachers who implemented Tower Gardens in this study were able to do so effectively and with relative ease. Results of this study should serve to support and encourage teachers' implementation of Tower Gardens in curriculum in order to benefit the development of children's overall well-being.

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Author Contributions

Ms. Kaitlyn Sills was responsible for conceptualizing the present study; writing and editing the entirety of the paper; conducting data collection and analysis; and formatting the manuscript. Dr. Alicia Stapp was responsible for conceptualizing the present study along with Ms. Kaitlyn Sills. Dr. Alicia Stapp was also responsible for editing and revising all sections of the manuscript. Dr. Laurel Lambert was responsible for editing all sections of manuscript. Dr. Kenya Wolff was responsible for editing all sections of manuscript.

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Additional Materials

The following additional materials are uploaded at the appendix file.

1. Appendix A.
2. Appendix B.
3. Appendix C.
4. Appendix D.

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