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Impact of school gardens on secondary schools' agricultural science education in east Berbice Corentyne, Guyana

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Abstract

This study aimed to investigate gender disparities among Agricultural Science teachers in Region 6, East Berbice Corentyne, Guyana, focusing on their perceptions of school gardens and their influence on the pedagogy of agricultural science in secondary schools. Data were collected via electronic questionnaires from 30 teachers across 17 secondary schools to examine the integration of school gardens and their impact on teaching agricultural science.

The results revealed that students participating in school gardening activities showed a greater propensity towards considering agriculture as a potential career and demonstrated an enhanced understanding of its practical aspects. Furthermore, incorporating school gardens facilitated interdisciplinary learning, bridging agricultural science with subjects such as social studies, language arts, and mathematics. This interdisciplinary approach promoted a deeper understanding of real-world applications across various disciplines.

The findings emphasised the significance of creating conducive learning environments to support effective agricultural science instruction. Providing teachers and students with comfortable teaching and learning spaces fosters engagement and enhances pedagogical efficacy. This study contributes to the expanding body of literature advocating for integrating school gardens into educational curricula, particularly in agricultural science instruction. By recognising the multifaceted benefits of school gardens, educators and policymakers can better support the development of holistic and engaging learning experiences for secondary school students.

Keywords: Agricultural education; Career Inclination; Gender disparities; Interdisciplinary Learning; Pedagogical Impact; School Gardens

1. Introduction

Agricultural Agricultural education in Guyana's high schools is essential, providing students with crucial knowledge and skills in farming science, including livestock husbandry and crop cultivation [1]. The Ministry of Education's agricultural science curriculum covers topics such as animal anatomy, physiology, nutrition, livestock management, and the preparation and marketing of livestock products. It emphasises sustainable farming practices, enhancing students' personal and professional development and overall quality of life. Afriyie and colleagues [2] and Kidane and colleague [3] emphasised students' pivotal role in the future of agriculture, asserting their responsibility for land management and global food security. Engaging agriculture-loving students with up-to-date industry knowledge is imperative.

School gardens, with a rich tradition in education, offer numerous benefits. Graham [4] highlighted their role in teaching science, nutrition, agriculture, environmental science, and healthy living, while Desmond [5] associated school gardens

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with experiential learning and environmental education. Austin [6] noted the rising popularity of school gardens, benefiting students of all educational levels. Gardening activities promote healthy eating habits and environmental stewardship and provide a break from screen time. Gardens also offer practical projects that engage students and integrate them into various subjects [2] [5].

In the Corentyne area of Guyana, school gardens facilitate hands-on, interdisciplinary learning, linking classroom lessons to practical applications. This move enhances students' understanding of science, biology, ecology, and other subjects while promoting physical health through fresh produce.

Teachers' perceptions of school gardens significantly impact agricultural science education. Positive attitudes towards school gardens can enhance teaching methods, engage students, and address contemporary agricultural issues, fostering critical thinking and problem-solving skills.

School gardens in Guyana also foster social skills, promoting collaboration, communication, and responsibility among students. They engage the broader community, strengthening school-community connections. Agricultural Science Education (ASE) is crucial for sustainable agricultural practices, food security, and economic growth in Guyana. This research evaluates how school gardens can improve ASE and address educational challenges in East Berbice Corentyne, Guyana, focusing on:

- The impact of teachers' attitudes towards school gardens on agricultural science pedagogy
- The influence of school gardens on the effectiveness of agricultural science instruction

2. Material and methods

2.1. Research Design and Population

This study employed a quantitative approach, known for its efficacy in gathering substantial data across various research domains, including social sciences, psychology, and education [7]. A descriptive methodology coupled with a cross-sectional design was utilised to assess the impact of school gardens on secondary school agricultural science in East Berbice Corentyne [7]. The study population comprised 60 agriculture science teachers, 37 males and 23 females, aged 18 to 55, representing diverse ethnic backgrounds, financial statuses, religions, and intellectual orientations.

2.2. Sampling and Instrumentation

A stratified random sampling technique was employed to select a representative sample of 30 teachers—15 males and 15 females. Teachers were stratified by gender, and schools were coded alphabetically. Students assisted in the random selection process, ensuring unbiased results [4]. Data collection was conducted using a self-designed questionnaire, which included demographic questions and twenty Likert-scale items to evaluate the impact of school gardens on agricultural science education. The Likert items were rated on a modified four-point scale based on the teachers' level of agreement.

2.3. Validity and Reliability

To ensure the validity of the questionnaire, expert reviews were conducted by a measurement and evaluation professional, a content specialist, and a language specialist. Reliability was tested through a pilot study involving secondary school agriculture science teachers in Region 5 - Guyana, which yielded a Cronbach's alpha value of 0.943, indicating high reliability.

2.4. Data Collection Procedures

Permission to conduct the study was obtained from the Chief Education Officer of Guyana and the Regional Education Officer for Region 6 - Guyana. Correspondence was sent to school principals, and department heads facilitated the distribution of the survey via Google Forms. Accommodations were made for teachers without access to technology by delivering printed questionnaires. Participants were given three days to complete the survey, after which the data were collected and analysed.

2.5. Ethical Consideration

The privacy and confidentiality of the respondents, objectivity in the interpretation of the data, integrity in conducting the research, and acknowledgement of the information sources were strictly adhered to in this study. In addition, respondents had the option to fully withdraw from the survey or to have their information incorporated into the research outcomes.

3. Results

Table 1 delineates the mean, standard deviation, standard error of the mean, and median scores for each dimension explored in the survey, alongside gender-based differentials. Notably, the mean scores surpassed 3.00 across all dimensions. The lowest agreeing mean scores were for 'Teachers believe school gardens foster a deeper connection between students and nature, leading to greater environmental stewardship' and 'Teachers perceive school gardens as essential to a holistic education, nurturing students' intellectual, emotional, and social growth in agricultural science' for males (3.27 and 3.33, respectively) and 'Teachers perceive school gardens as essential to a holistic education, nurturing students' intellectual, emotional, and social growth in agricultural science' (3.40) on a general scale. Female teachers, on average, exhibited higher scores across all dimensions. The dimension 'Teachers believe that school gardens foster a sense of ownership and responsibility among students towards their learning in agricultural science' secured the highest agreeing means (3.70) irrespective of gender.

The data gleaned from the survey underscore the teachers' acknowledgement of the efficacy of school gardens as instrumental tools in agricultural science education. Furthermore, it highlights their potential to stimulate curiosity, foster inquiry, promote ecological literacy and sustainability, celebrate cultural diversity and heritage appreciation, and facilitate holistic educational experiences. The findings also suggest a propensity for female teachers to hold more favourable attitudes toward school gardens than their male counterparts.

The positive attitudes exhibited by teachers towards integrating school gardens resonate with previous research findings. Work done by [8], [9], [10], and [11] provided complementary evidence, emphasising the significance of hands-on learning experiences, such as those facilitated by school gardens, in fostering curiosity, inquiry, ecological literacy, sustainability, ownership, responsibility, and connection with nature among students.

Table 2 includes 14 items examining the influence of school gardens on agricultural science instruction. These items address multiple dimensions of agricultural science education, such as providing practical applications of agricultural science concepts, accommodating diverse learning styles, enhancing appreciation for the interconnectedness of agriculture and the environment, improving problem-solving skills, facilitating connections between theoretical knowledge and real-world agricultural practices, cultivating an understanding of the importance of food systems and food security, encouraging interdisciplinary collaboration, enabling exploration and application of innovative technologies, supporting the development of lifelong skills, promoting health and wellness education, promoting experiential learning, and inspiring curiosity.

The mean scores for all items exceeded 3.00, indicating that teachers perceive school gardens as effective tools for advancing agricultural science education. Female teachers reported higher mean scores than male teachers in certain areas, such as providing practical applications of agricultural science concepts, enhancing appreciation for the interconnectedness of agriculture and the environment, and facilitating connections between theoretical knowledge and real-world agricultural practices. Conversely, male teachers had higher mean scores in areas like promoting interdisciplinary collaboration and enabling the exploration and application of innovative technologies.

Overall, the data suggests that school gardens positively impact the effectiveness of agricultural science instruction in secondary schools across East Berbice Corentyne, Guyana. These findings align with previous research, indicating that school gardens enhance students' learning experiences and promote various educational outcomes in agricultural science education [12].

Table 1 Teachers' attitudes towards school gardens on the pedagogy of agriculture science in secondary schools across East Berbice Corentyne Guyana

Report							
Gender		**Teachers recognise school gardens as effective tools for fostering curiosity and inquiry in agricultural science education.**	**Teachers perceive school gardens as catalysts for promoting ecological literacy and sustainability among students.**	**Teachers believe that school gardens foster a sense of ownership and responsibility among students toward their learning in agricultural science.**	**Teachers recognise school gardens as platforms for promoting cultural diversity and heritage appreciation through agricultural science education.**	**Teachers believe school gardens foster a deeper connection between students and nature, leading to greater environmental stewardship.**	**Teachers perceive school gardens as essential to a holistic education, nurturing students' intellectual, emotional, and social growth in agricultural science.**
Male	Mean	3.47	3.47	3.67	3.67	3.27	3.33
	N	15	15	15	15	15	15
	Std. Deviation	0.516	0.516	0.488	0.488	0.799	0.816
	Std. Error of Mean	0.133	0.133	0.126	0.126	0.206	0.211
	Median	3.00	3.00	4.00	4.00	3.00	3.00
Female	Mean	3.60	3.60	3.73	3.47	3.73	3.47
	N	15	15	15	15	15	15
	Std. Deviation	0.507	0.507	0.458	0.516	0.458	0.516
	Std. Error of Mean	0.131	0.131	0.118	0.133	0.118	0.133
	Median	4.00	4.00	4.00	3.00	4.00	3.00
Total	Mean	3.53	3.53	3.70	3.57	3.50	3.40
	N	30	30	30	30	30	30
	Std. Deviation	0.507	0.507	0.466	0.504	0.682	0.675
	Std. Error of Mean	0.093	0.093	0.085	0.092	0.125	0.123
	Median	4.00	4.00	4.00	4.00	4.00	3.00

Table 2 Influence of incorporating school gardens on the effectiveness of agricultural science instruction in secondary schools across East Berbice Corentyne Guyana

Report															
Gender		**School gardens enrich the learning experience by providing practical applications of agricultural science concepts.**	**School gardens serve as dynamic learning environments that cater to diverse learning styles in agricultural science.**	**Integrating school gardens into the curriculum enhances students' appreciation for the interconnectedness of agriculture and the environment.**	**School gardens enhance students' problem-solving skills within the context of agricultural science.**	**School gardens facilitate meaningful connections between theoretical knowledge and real-world practices in agriculture.**	**Integrating school gardens into lessons cultivates students' understanding of the importance of food systems and food security.**	**Using school gardens encourages interdisciplinary collaboration between agricultural science and other academic subjects.**	**School gardens allow students to explore and apply innovative technologies in agricultural practices.**	**The presence of school gardens supports the development of lifelong skills such as teamwork, leadership, and problem-solving in students.**	**Teachers perceive school gardens as effective tools for promoting health and wellness education alongside agricultural science.**	**Integrating school gardens into the curriculum promotes experiential learning and active engagement in agricultural science education.**	**School gardens create a sense of wonder and awe, inspiring students to explore and inquire further about agricultural science topics.**	**School gardens serve as living laboratories where students can observe and analyse ecological processes firsthand in agricultural science.**	**The presence of school gardens encourages students to develop empathy and appreciation for the hard work of farmers and agriculturalists.**
Female	Mean	3.93	3.53	3.87	3.73	3.80	3.73	3.47	3.53	3.60	3.47	3.60	3.47	3.53	3.47
	N	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Std. Dev.	0.258	0.516	0.352	0.458	0.414	0.458	0.516	0.516	0.507	0.516	0.507	0.516	0.516	0.516
	Std. Error of Mean	0.067	0.133	0.091	0.118	0.107	0.118	0.133	0.133	0.131	0.133	0.131	0.133	0.133	0.133
	Median	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	4.00	3.00	4.00	3.00	4.00	3.00
Male	Mean	3.73	3.80	3.80	3.73	3.67	3.67	3.40	3.40	3.40	3.20	3.53	3.07	3.07	3.20
	N	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Std. Dev.	0.458	0.414	0.414	0.458	0.488	0.488	0.507	0.828	0.507	0.775	0.516	1.163	0.961	1.207

	Std. Error of Mean	0.118	0.107	0.107	0.118	0.126	0.126	0.131	0.214	0.131	0.200	0.133	0.300	0.248	0.312
	Median	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	3.00	3.00	4.00	3.00	3.00	4.00
Total	Mean	3.83	3.67	3.83	3.73	3.73	3.70	3.43	3.47	3.50	3.33	3.57	3.27	3.30	3.33
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Std. Dev.	0.379	0.479	0.379	0.450	0.450	0.466	0.504	0.681	0.509	0.661	0.504	0.907	0.794	0.922
	Std. Error of Mean	0.069	0.088	0.069	0.082	0.082	0.085	0.092	0.124	0.093	0.121	0.092	0.166	0.145	0.168
	Median	4.00	4.00	4.00	4.00	4.00	4.00	3.00	4.00	3.50	3.00	4.00	3.00	3.00	4.00

3.1. Hypothesis testing

H_0 – There is no statistically significant relationship between the gender of the teacher and their perception of the influence of incorporating school gardens on the effectiveness of agricultural science instruction in secondary schools across East Berbice Corentyne, Guyana.

Table 3 Anova: Two-Factor Without Replication

Anova: Two-Factor Without Replication				
SUMMARY	***Count***	***Sum***	***Average***	***Variance***
Female	15	57	3.80	0.60
Female	15	56	3.73	0.64
Female	15	54	3.60	0.69
Female	15	50	3.33	0.67
Female	15	56	3.73	0.64
Female	15	56	3.73	0.64
Female	15	47	3.13	0.55
Female	15	52	3.47	0.70
Female	15	48	3.20	0.60
Female	15	46	3.07	0.50
Female	15	46	3.07	0.50
Female	15	53	3.53	0.70
Female	15	52	3.47	0.70
Female	15	50	3.33	0.67
Female	15	53	3.53	0.70
Male	15	56	3.73	0.35
Male	15	50	3.33	0.38
Male	15	50	3.33	0.38
Male	15	54	3.60	0.40
Male	15	52	3.47	0.41
Male	15	43	2.87	2.12
Male	15	50	3.33	0.38
Male	15	49	3.27	0.35
Male	15	49	3.27	0.78
Male	15	56	3.73	0.35
Male	15	53	3.53	0.41
Male	15	46	3.07	0.64
Male	15	51	3.40	0.83
Male	15	48	3.20	0.74
Male	15	53	3.53	0.84

School gardens enrich the learning experience by providing practical applications of agricultural science concepts	30	45	1.50	0.26
School gardens serve as dynamic learning environments that cater to diverse learning styles in agricultural science	30	115	3.83	0.14
Integrating school gardens into the curriculum enhances students' appreciation for the interconnectedness of agriculture and the environment.	30	110	3.67	0.23
School gardens enhance students' problem-solving skills within the context of agricultural science	30	115	3.83	0.14
School gardens facilitate meaningful connections between theoretical knowledge and real-world practices in agriculture.	30	112	3.73	0.20
Integrating school gardens into lessons cultivates students' understanding of the importance of food systems and food security	30	112	3.73	0.20
Using school gardens encourages interdisciplinary collaboration between agricultural science and other academic subjects	30	111	3.70	0.22
School gardens allow students to explore and apply innovative technologies in agricultural practices.	30	103	3.43	0.25
The presence of school gardens supports the development of lifelong skills such as teamwork, leadership, and problem-solving in students.	30	104	3.47	0.46
Teachers perceive school gardens as effective tools for promoting health and wellness education alongside agricultural science.	30	105	3.50	0.26
Integrating school gardens into the curriculum promotes experiential learning and active engagement in agricultural science education.	30	100	3.33	0.44
School gardens create a sense of wonder and awe, inspiring students to explore and inquire further about agricultural science topics.	30	107	3.57	0.25
School gardens serve as living laboratories where students can observe and analyse ecological processes firsthand in agricultural science.	30	98	3.27	0.82
The presence of school gardens encourages students to develop empathy and appreciation for the hard work of farmers and agriculturalists.	30	99	3.30	0.63

ANOVA						
Source of Variation	***S.S.***	***Df***	***MS***	***F***	***P-value***	***F crit***
Rows	25.520	29.000	0.880	2.744	6.03722E-06	1.496
Columns	133.387	14.000	9.528	29.707	1.23831E-53	1.716
Error	130.213	406.000	0.321			
Total	289.120	449.000				

Table 3 provides critical insights into the impact of integrating school gardens on the effectiveness of agricultural science instruction in secondary schools across East Berbice Corentyne, Guyana. The dataset is organised according to a two-factor design without replication, incorporating factors such as gender (Male/Female) and perception statements related to school gardens. The ANOVA analysis applied to this data facilitates an exploration of the interactions between these factors.

The ANOVA results reveal that the teacher's gender and the perception statements significantly influence the variability observed in the data. The P-values associated with these factors are markedly below the conventional alpha level of

0.05, signifying statistically significant differences in perceptions between male and female teachers and across various perception statements concerning the role of school gardens.

In particular, the P-value for the gender factor indicates a notable disparity in the perceptions of male and female teachers regarding the effectiveness of school gardens in agricultural science instruction. Likewise, the P-value for the perception statements factor demonstrates significant variation in responses across different statements about the influence of school gardens.

The rejection of the null hypothesis—asserting no relationship between the teacher's gender and their perception of the effectiveness of school gardens—suggests a meaningful association between these variables. This implies that gender substantially influences teachers' views on the impact of school gardens on agricultural science instruction.

The observed differences in perceptions between male and female teachers underscore the importance of considering gender dynamics within educational settings. Previous research has shown that gender can affect teaching styles, educational priorities, and attitudes toward various pedagogical approaches. For instance, female teachers often emphasise collaborative and experiential learning approaches more than their male counterparts, which may affect their perceptions of the benefits of school gardens in agricultural science [13] [14].

Moreover, the variability in responses across different perception statements highlights the complex nature of teachers' views on the role of school gardens in education. Each statement likely addresses unique aspects of pedagogy, environmental awareness, and student engagement [10]. Understanding these nuances is essential for designing targeted interventions and support strategies to effectively integrate school gardens into the curriculum.

Additionally, the specific context of East Berbice Corentyne, Guyana, introduces further complexity to this discussion. Socioeconomic factors, cultural norms, and resource availability can significantly influence teachers' perceptions and the practical implementation of educational initiatives such as school gardens. Thus, efforts to enhance agricultural science instruction through school gardens must be contextually relevant and attuned to local needs and conditions [12].

4. Discussion

The observed gender differences in perceptions underscore the necessity of considering gender dynamics in educational settings. Gender influences teaching styles, educational priorities, and attitudes toward pedagogical approaches. Research indicates that female teachers often emphasise collaborative and experiential learning more than their male counterparts, potentially influencing their perceptions of school gardens' benefits in agricultural science instruction [13] [14].

The variability in perception statements highlights the multifaceted nature of teachers' views on school gardens' role in education. Each statement likely addresses aspects of pedagogy, environmental awareness, and student engagement [9] [10]. Understanding these nuances is crucial for designing effective interventions and support mechanisms to integrate school gardens into the curriculum [11].

In the context of East Berbice Corentyne, Guyana, socioeconomic background, cultural norms, and resource access significantly influence teachers' perceptions and the feasibility of implementing initiatives like school gardens. Hence, promoting agricultural science instruction through school gardens must be contextually relevant and sensitive to local needs and realities [12] [14].

Positive attitudes towards school gardens among teachers can enhance student engagement, improve academic performance, and provide a more holistic approach to teaching and learning. Ala'i-Rosales et al. [15] found that teachers with positive attitudes towards school gardens reported increased student engagement and better academic performance in science subjects. Similarly, Lohr and Park [16] noted that school gardens offer a unique context for teaching and learning, promoting experiential, hands-on learning and environmental stewardship.

In Guyana, teachers' positive attitudes towards school gardens have been linked to a higher likelihood of incorporating them into their curriculum and teaching methods, leading to increased student engagement and improved academic performance [17]. The Journal of Environmental Education suggests that school gardens effectively promote students' environmental knowledge, attitudes, and behaviours due to their hands-on, experiential learning opportunities [18].

The National Agricultural Library reported that school gardens help students develop a sense of stewardship and responsibility for the natural world, highlighting successful programs that have helped students acquire essential agricultural science skills such as plant identification, soil conservation, and pest management [19]. Wang and Gaffney [20] and Williams and Dixon [21] emphasise that school gardens promote a sense of ownership and responsibility among students towards their learning in agricultural science.

A study in the International Journal of Science Education found that school gardens effectively promote students' interest and engagement in science, including agricultural science, by providing authentic, real-world contexts for learning [22].

Understanding students' attitudes towards agricultural science is crucial for successfully developing the agricultural sector and educational programs in Guyana's hinterland areas. These regions face challenges such as restricted access to resources, transportation issues, and cultural dynamics that impact educational priorities [23]. The positive impact of school gardens on students' nutrition-related knowledge, attitudes, and behaviours has been demonstrated in studies in various contexts, such as Burkina Faso [14].

School gardens also foster interdisciplinary learning, integrating subjects like mathematics, language arts, and social studies, helping students connect different areas of knowledge [15] [23]. This interdisciplinary approach can enhance students' understanding of the world and promote holistic education.

5. Conclusion

Incorporating school gardens into agricultural science instruction in secondary schools in East Berbice Corentyne, Guyana, can significantly enhance the effectiveness of this instruction. By improving students' learning experiences, fostering a sense of ownership and responsibility, and promoting sustainable agricultural practices, school gardens contribute to the development of well-rounded, environmentally conscious individuals.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

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