TRAINING IN FAMILY GARDENS AND FOOD SECURITY EVALUATION OF AN EDUCATIONAL INTERVENTION IN A CHILDREN'S HOME

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ABSTRACT

Training in family gardens is an educational strategy that strengthens practical skills, supports food security, and promotes sustainable practices. In group homes, working in gardens is especially relevant for the cognitive development and well-being of vulnerable adolescents. The objective of this research was to evaluate the knowledge acquired from vegetable production training, in order to verify the learning achieved and assess the effect of the intervention. The study was conducted with 29 adolescents from the San Martín de Porres and Juan XXIII group homes, using a 13-question multiple-choice instrument administered before and after the training. Responses were coded dichotomously (1 = correct; 0 = incorrect) and analyzed using SPSS software. Statistical analysis included a paired-samples t-test to identify the overall effect of the intervention and McNemar 's test with continuity correction to analyze changes in learning for each question. The results showed a statistically significant increase in the participants' overall knowledge level ($p < 0.01$). Furthermore, eight questions showed a significant increase in the proportion of correct answers ($p < 0.05$), while five showed no relevant changes. These results demonstrate the effectiveness of the training as an educational tool and its usefulness in increasing students' knowledge of food security and sustainability in institutional contexts.

Keywords: Learning, intervention effect, paired sample, sustainability.

INTRODUCTION

The population increase, estimated at 9 billion people by 2050, has increased the demand for food and, if not met, will raise levels of hunger and food insecurity in families (Gwacela *et al.* , 2024; Korpelainen , 2023). Based on the sustainable

development goals of the 2030 agenda (United Nations Nations , 2018) in which the eradication of poverty and hunger, care for the environment and the production of sufficient, safe, affordable and nutritious food under the principle of sustainability are highlighted, various strategies have been implemented to achieve these goals, considering the locality, climate, geographical, ecological, socioeconomic and cultural conditions of each territory (Ibarrola-Rivas & Galicia, 2017).

Given that approximately 805 million people worldwide suffer from malnutrition and have difficulty accessing food, there is an urgent need to implement actions that reduce food insecurity (Muñoz-Rodríguez *et al.* , 2020) without compromising the integrity of the environment and respecting the sociocultural structures of communities. In Mexico, 23% of the population lacks access to food; in rural areas, this figure is 32%, and in urban areas, it is 21% (Muñoz-Rodríguez *et al.* , 2020).

In this context, family gardens represent an alternative for food security, by maintaining continuous access to sufficient, safe and nutritious food for all people of present and future generations (Gwacela). *et al.*, 2024; Ibarrola-Rivas & Galicia, 2017). This approach considers the capacity of natural systems to conserve biodiversity, linking agroecosystems with the natural, sociocultural, technological and political wealth of the territories (Monroy & Martínez, 2024).

This form of production is one of the main means of livelihood for those who do not have land in addition to their household and has demonstrated the capacity to supply dense populations of up to 500 people km -2 (Mellisse *et al.*, 2018). They are also important because they guarantee quick access to food and can be consumed regularly by low-income households (Gwacela *et al.*, 2024) and represent key spaces for the conservation of plant genetic resources (Korpelainen , 2023).

To contribute to the sustainability of community gardens and extend their benefits over time, it is important to produce high-quality vegetables, ensure that people demonstrate a genuine need to cultivate them, involve family members, and locate them in areas with available soil and water. Furthermore, participants should be trained to carry out the core activities in these production units (Muñoz-Rodríguez *et al.*, 2020). Non-formal training or education (Martínez and Romo, 2019) is the process by which people acquire knowledge and skills to perform a job more effectively (Cortés-Rodríguez *et al.*, 2024). Through this training, learners can incorporate fundamental concepts into their cognitive structure to achieve the establishment and sustainability of these gardens (Muñoz-Rodríguez *et al.*, 2020).

In this sense, learning about the usefulness of a garden, the types of vegetables and the nutrients they provide, the activities necessary to produce them, the use of organic fertilizers to reduce environmental impact, as well as pest and disease management, are crucial for producing quality vegetables.When training includes a

theoretical phase of assimilating concepts linked to what already exists in the cognitive structure of individuals, the development of skills through field practice and collaborative work leads to meaningful learning (Ausubel *et al.*, 2003) that lasts throughout life (Martínez, 2020).

This study aimed to evaluate the learning outcomes, before and after, of residents of the San Martín de Porres and Juan XXIII children's homes, in vegetable production with a focus on sustainability and food security. The training was conceived as a planned and structured process that involved selecting topics, organizing sessions, formulating objectives, designing the program, selecting materials, and choosing teaching techniques for group work based on a theory that promotes meaningful learning (Cortés-Rodríguez *et al.*, 2024). It was based on the principle that this training would strengthen cognitive and practical skills for vegetable production and contribute to food security by promoting sustainable production practices, as well as fostering an understanding of the nutritional value of food.

Reference And Contextual Framework

The concept of a family garden has multiple definitions given its diverse functions such as: the combined production of multipurpose trees, intercropping with other agricultural crops and livestock around the farm (Mellisse *et al.*, 2018). Family gardens are commonly identified as cultivated spaces around houses where a variety of foods providing micro and macronutrients can be obtained, such as vegetables, fruits, spices, herbs, ornamental and medicinal plants; as well as the raising of animals that are an important source of food energy, nutritional security, and economic sustenance for families (Korpelainen , 2023; Monroy; Martínez, 2024; Thamilini *et al.*, 2019; Wyatt, 2023).

In addition to providing nutritious food, family gardens generate cash income that contributes to household stability and allows for the conservation, maintenance, and fertility of the soil (Vibhuti e*t al.*, 2019). In this sense, these spaces serve as a strategy for local food and economic sustainability, through the generation of local markets, which directly impacts the variation of families' diets.

In this way, training on family gardens becomes a key tool for promoting healthy diets through variety; for improving food self-sufficiency and reducing dependence on processed foods, which are linked to an increase in chronic degenerative diseases (Figueroa-Piña *et al.*, 2021; Ibarrola-Rivas & Galicia, 2017). It also offers women of reproductive age the opportunity to nourish themselves and reduce risks during pregnancy, preventing the development of malnutrition-related

diseases in newborns (Korpelainen , 2023). Similarly, this type of intervention enables the development of skills and strategies that contribute to the empowerment of those involved in cultivating the gardens and increase their access to nutritious food and supplemental income (Gwacela *et al.*, 2024).

Several studies have shown that training in vegetable production not only allows the development of knowledge and skills in science, but also encourages participation in classes, promotes emotional well-being and commitment to sustainable production practices (Blair, 2009; Eugenio- Gozalbo *et al.*, 2020; Smith & Motsenbocker , 2005). It also sparks the interest of participants (Martínez & Romo, 2019) and a critical awareness of agri-food systems, contributing to the formation of resilient citizens who are aware of their environment (Savary *et al.*, 2022).

In this sense, working in a garden can become a transformative experience for residents of a group home who face emotional, familial, and social challenges stemming from vulnerable circumstances (Ibarra & Romero, 2017). This activity strengthens self-esteem, fosters social connections, and develops healthy eating habits, thus contributing to overall well-being (Blair, 2009). Therefore, this study evaluated the learning outcomes of an intervention designed to improve nutrition in a group home as a productive activity and a means of knowledge transfer.

San Martín de Porres and Juan XXIII Children's Home

The San Martin de Porres children's home was founded in December 1965, and in April 1973, the name Juan XXIII AC was incorporated (CHSMPJ, 2025). Currently, it is run by three Catholic nuns who care for orphaned and abandoned children in vulnerable situations. The home's population fluctuates because it houses a group of orphaned and abandoned children of different ages in special circumstances while their legal status is being determined by the Federal Attorney General's Office.

The institution receives children of different ages, classified by the World Health Organization (WHO, 2017): early childhood (0-5 years); childhood (6-11); adolescence (12-18); and others who, due to physical or mental vulnerability, remain permanently at the home during their youth (14-26) and adulthood (27-59). The population is diverse in terms of sex, age, life histories, educational levels, etc. Of the 70 members, 29 were adolescents nearing adulthood, from whom data were obtained for this study.

To ensure their well-being and development, the children's home has the mission of protecting all its residents and instilling values in them so that they

become individuals with a desire for self-improvement (CHSMPJ, 2025). Regarding its vision, this institution seeks to empower them to be responsible for themselves by offering: psychological support, spiritual guidance, formal and non-formal education, housing, clothing, food, and recreational activities.

The training provided encompasses the physical, psycho-emotional, cultural, and social dimensions (CHSMPJ, 2025). In the cultural dimension, personal growth is fostered through participation in activities such as documentary research, museum visits, literature studies, cultural programs, and theatrical performances, leading to knowledge acquisition and cognitive development. Regarding the social dimension, students are educated to strengthen their interaction skills and develop an awareness that human beings are social by nature. Furthermore, teamwork is prioritized, encouraging a spirit of service and camaraderie. In this way, they not only ensure that the basic needs of their residents are met, but they go further by offering them a dignified life.

Methodological Design

The article was structured in five sections: first, the introduction is presented, reflecting the importance of vegetable production for food security and sustainability; the second indicates the referential and contextual framework where the study was carried out, the San Martín de Porres and Juan XXIII Children's Home; the third details the methodological design (population, sample, method, technique and instruments for data collection) and describes the data processing; the fourth section shows the analysis of results and the discussion where the findings were presented and compared with the published literature; and finally, the conclusions are presented.

Study area

During July and August 2022, training was provided at this home using funds from the Institutional Strategic Project "Analysis of Policies, Programs, and Projects in Socio-ecological Systems for Sustainability in Mexico: The Sembrando Vida Program and University Projects," with resources from the Autonomous University of Chapingo. As part of the project's activities, a greenhouse of approximately 100 m^2 was renovated so that participants could put the knowledge acquired during the training into practice. This home is located in the municipality of Texcoco de Mora, State of Mexico, at the geographic coordinates 19°31'07.2" north latitude and 98° 50'26.9" west longitude (Figure 1).

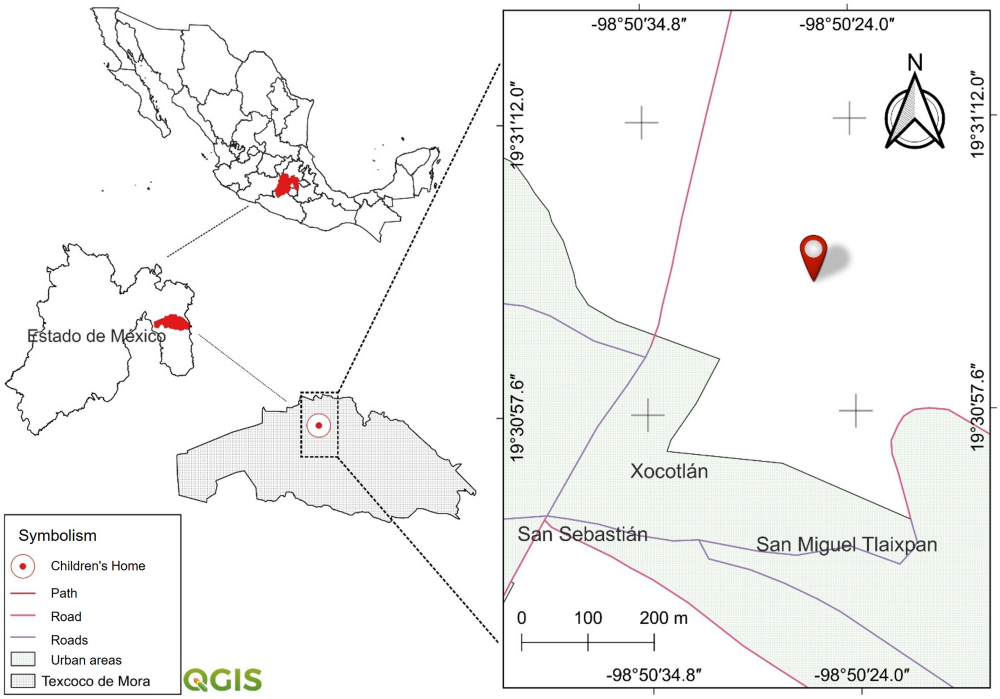

Figure 1. Location of the San Martín de Porres and Juan XXIII children's home.

Method, Population and Sample

The training was conducted with all members of the children's home, including 70 children of different ages and support staff. However, for the purposes of this research, a pre-experimental pretest- posttest design (Chávez *et al.*, 2020) was used with purposive sampling, including only 29 adolescents who were transitioning from childhood (age 10) to adolescence. The age range considered was 10-18 years, and participants were selected based on the following criteria: they were able to complete the survey titled " *Instrument to Evaluate Learning Before and After Training on Vegetable Garden Production*," designed using *Google Forms* ; they were able to review, understand, and answer the questions independently, without adult assistance, thus minimizing the risk of response bias; and they were likely to take responsibility for and monitor vegetable production after the training.

Method, Population and Sample

Prior to the diagnostic assessment and activity definition stage, the establishment and management of the vegetable garden was carried out (Rendón *et al.*, 2023), where the instrument and topics designed and developed by the trainer

MC Gamaliel López López in his Guide for Vegetable Production in Gardens were used. The topics presented by the trainer were the following : Chapter I Basic requirements for the establishment of the garden (water, soil or substrate, space, nutrient source, genetic material, irrigation system); Chapter II, Garden Design and Construction (orientation, protection requirements, composting area, raised beds or containers (what they are, how to prepare them, resistance, durability, depth, the substrate); Chapter III, Planting Schedule (classification of vegetables by growing season , classification of vegetables by use, types of vegetables such as fruit or root and bulb vegetables), technical data of the crops, diagnosis of consumption patterns, frequency of consumption, preparation of the planting calendar, harvest period, shelf life); Chapter IV, Establishing Vegetables in Family Gardens (seed management, direct sowing, establishing the seedbed or nursery, procedures for sowing, care in the nursery, transplanting, spacing between plants); Chapter V, Garden Maintenance (cultural tasks such as irrigation, pruning, weeding, specific practices for each crop such as staking and hilling, main vegetable pests, main vegetable diseases, symptoms and prevention, Pest control methods, recommendations for biopreparations , disease control; Chapter VI Crop Nutrition and Organic Fertilizer Production (organic fertilizer production, the different phases such as: mesophilic, thermophilic or sanitizing, cooling, and maturation; the composition of materials, compost without the use of non-biodegradable materials, procedures for compost production and care, sanitization and safety, use of compost in plant nutrition according to the type of vegetable: leafy and flowering, fruit-bearing, root, bulb, and tuber vegetables). The topics presented at the beginning of the course-workshop and the support during the practical portion were provided by the trainer. Only the instrument proposed by the trainer was reviewed and validated by a team of researchers involved in the institutional strategic project, along with the trainer. The evaluation instrument consisted of 13 multiple-choice questions, each with three answer choices, only one of which was correct. The questions The survey results are presented in Table 1.

Table 1. Instrument to evaluate learning before and after training on the production of horticultural gardens.

Ask	Description
p01	What is a garden?
p02	What is the purpose of a garden?
p03	What types of vegetables can be produced?
p04	What activities are carried out to produce vegetables?
p05	What is the purpose of growing vegetables in a garden?
p06	What tools are used in vegetable production?
p07	What is a seed?
p08	Where are the seeds planted in a garden?
p09	What is a raised bed?
p10	What is a fertilizer?
p11	What is a plague?
p12	What are the main pests and diseases of vegetables?
p13	How to control pests and diseases in vegetables?

Source: Own elaboration.

Data analysis

The responses were recorded in *Google Forms*. Subsequently, they were captured and coded in SPSS software , assigning a value of 1 to correct answers and 0 to incorrect answers. To measure whether the training influenced the participants' level of knowledge, two statistical tests were used: first, the paired samples t-test (Garzón; Villota, 2020), and then McNemar 's test with continuity correction (Ortega *et al.*, 2023).

The paired-samples t-test was useful for gaining an overview of the intervention's effect on adolescents' knowledge. This test compared the mean scores obtained before and after the training, using the same sample of individuals (Garzón; Villota, 2020). A statistically significant difference between the two scores suggests a substantial change in knowledge attributable to the training. The paired-samples t-statistic was calculated by subtracting the mean of the differences (x) from μ (which will equal 0) from the numerator of the equation, and dividing the standard deviation of the differences (Sx) by the square root of the number of trained adolescents (n) from the denominator. The degrees of freedom for this test are the number of pairs minus 1. This is summarized in the following formula:

$$t = \frac{x - \mu}{\frac{s_x}{\sqrt{n}}} \sim t_{p-1}$$

McNemar test , with continuity correction, was ideal for comparing dichotomous (correct/incorrect) responses to each question. Ortega et al. (2023) recommend using it when the sample size is small and the sum of incorrect answers is less than 25. A significant change in the number of correct and incorrect responses before and after the training provides detailed information about the subject area where knowledge improved. Contingency tables were used to systematize these changes (Table 2).

Table 2. Contingency Table.

	Post-test correct	Incorrect post-test
Pre-test correct	to	b
Incorrect pre-test	c	d

Source: Own elaboration.

Based on the information in the contingency table, the χ^2 statistic was obtained for each question . McNemar 's formula:

$$\chi^2 = \frac{(|b - c| - 1)^2}{b + c}$$

RESULTS

Characteristics of adolescents

Of the total number of adolescents considered, females predominated (62%) compared to males (38%). Regarding age, the highest frequencies were found in the 11- and 13-year-old groups (Figure 2). For females, the largest proportions were 11 years old (17%) and 13 years old (13%); while for males, the largest proportions were 10 years old (14%) and 13 years old (10%). Notably, all participants aged 16 to 18 years were female.

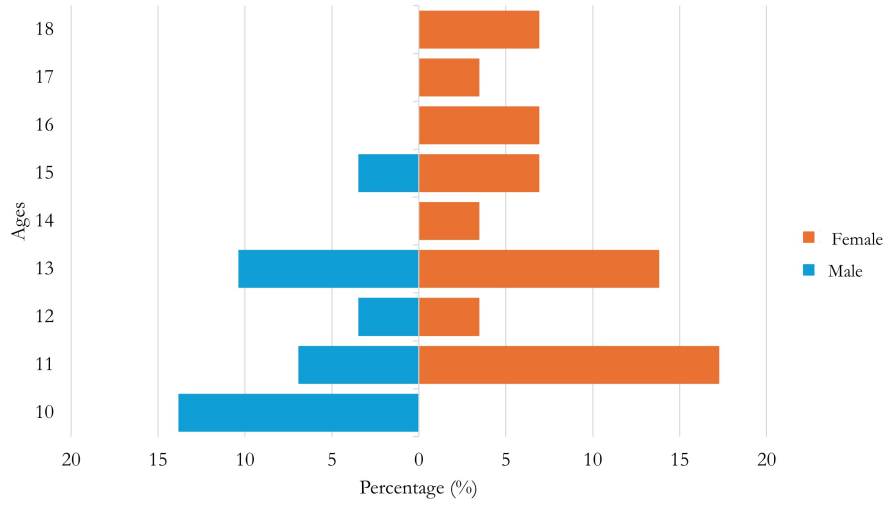

Figure 2. Sex and age of adolescents.
Source: Own elaboration.

Characteristics of adolescents

During the training, the teenagers acquired theoretical knowledge as well as practical field skills. In the theoretical phase (Figure 3), the concept of a garden and the basic requirements for its proper functioning were presented, such as water, space, quality soil or substrate, and seeds for planting vegetables. The importance of sunlight in plant development was emphasized, as was the need to establish a crop protection system (shade netting or a greenhouse) to provide better production control, making efficient use of water resources, controlling the microclimate, and ensuring the proper use of nutrients. The establishment of perimeter protection to safeguard the garden from animals, birds, or rodents was also highlighted, as was the concept of raised beds or containers for planting on the farm. Regarding planting schedules, vegetables were classified according to the season in which they thrive best, such as the spring-summer or autumn-winter cycle, which varies in the amount of light, humidity, and temperature. To have vegetables available year-round, ideas were presented that allow for staggered planting according to consumption needs, achieving a constant supply of food and nutrients.

The different types of sowing (direct sowing, seedbeds), their advantages and disadvantages, the transplanting procedure, and the spacing between seedlings based on their size to avoid competition were also explained. Regarding garden maintenance, cultural practices (watering, pruning, weeding, staking , and hilling) were highlighted. Participants were introduced to the concepts of pests and diseases, the main types that affect vegetables, and how to control or prevent them using natural

biopreparations (garlic, chili peppers, soap, tobacco, mineral solutions), hygiene practices, and vector control. Finally, crop nutrition and the use of organic fertilizers were discussed, including how to make compost and how to fertilize according to the type of vegetable (leaf, fruit, root, bulb).

Figure 3. Theoretical phase of the training process in vegetable production.

Note: (1) Formal presentation of the trainer by the Catholic nuns of the children's home; (2) Start of the course on family gardens; (3) Teenagers who attended the training.

In the practical phase (Figure 4), the participants applied the knowledge acquired in the classroom. First, they cleared the soil to remove weeds and stones that could hinder planting. The teenagers then experienced how to operate the greenhouse's side curtains, an effective mechanism for controlling humidity and temperature. They also learned that access to the garden must be controlled to prevent pests and rodents from entering.

The land was measured and three raised beds were prepared, incorporating nutrient-rich organic fertilizer. Two drip irrigation lines were then installed in each bed to provide water for the vegetables. Priority was given to planting vegetables that are frequently consumed at the home, as well as those species best adapted to the autumn-winter period due to the low temperatures. Among the vegetables planted were radishes, cilantro, chard, and lettuce.

Figure 4. Practical phase of training for adolescents.

Note: (1) Cleaning the work area to apply the acquired knowledge; (2) Opening and closing the side curtain of the greenhouse; (3) Measuring the land to establish the growing beds; (4) Preparing the soil and incorporating fertilizer; (5) Sowing and watering vegetables; (6) Vegetable that is about to be harvested.

Lessons learned from the training

According to the scores recorded before the training (Figure 5), there were adolescents who scored zero, while others reported a perfect ten from the outset. Overall, there was a wide dispersion in the level of knowledge, with the mean estimated at 6.2, a value slightly higher than 6.0, which is considered a passing grade in most Mexican educational systems. This result demonstrated that the participants had some knowledge of the topic, albeit basic.

Regarding the scores obtained after the intervention, the scores increased and the gap narrowed (Figure 5). The lowest score was 6.9, the highest was 10, and the average was 8.9, indicating learning derived from the training.

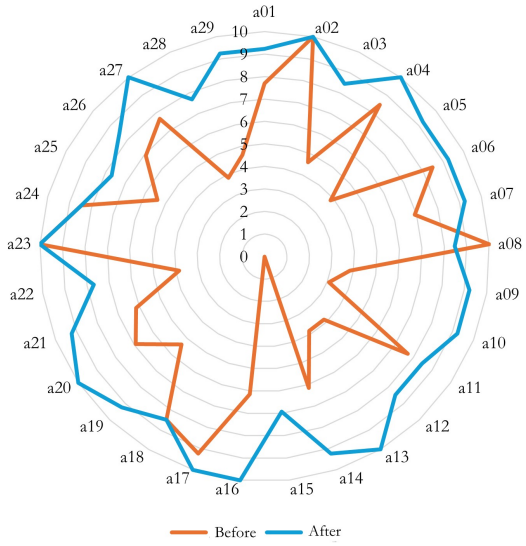

Figure 5. Distribution of scores by adolescent, before and after training.
Note: a= adolescent.
Source: Own elaboration.

Regarding the results of the paired-samples t-test (Table 3), the difference in mean scores before and after the training was found to be -2.6517. Since the t-statistic was estimated at -6.8970 and the p-value was less than 0.01, the statistically significant difference between the scores was confirmed. In other words, the improvement in knowledge after the intervention was confirmed. This result is consistent with that reported by Blair (2009) and Klemmer *et al.* (2005), who found that training promotes meaningful and contextualized learning.

Table 3. Result of the related samples t-test.

Moment	Average	Standard deviation	Difference of means	Standard deviation of the t differences		p-value
Before	6.2597	2.4546	-2.6517	2.0704	-6.8970	p<0.01
After	8.9114	0.8364				

Source: Own elaboration.

As Ibarrola-Rivas & Galicia (2017) point out, achieving food security requires the appropriation of agri-food knowledge. In this sense, the training provided to adolescents represents a step towards building local food systems, by fostering the development of skills for self-sufficiency, the selection of appropriate species according to the climate, and the ecological management of the garden.

Learning acquired in each question

Through knowledge analysis of each question, thematic areas were identified where adolescents improved or maintained their learning after the training. This information is fundamental because it provides elements for improving the course, as well as strengthening the work in the gardens as a policy tool promoting food security and sustainable development (Monroy-Miranda & Martínez-Gómez, 2024).

Before the training, the adolescents demonstrated knowledge about the usefulness of gardens (p02), as 24 of the 29 participants answered correctly (83%). In contrast, the most difficult question for the participants was "What is a pest?" (p11), as only 9 (31%) answered correctly (Figure 6).

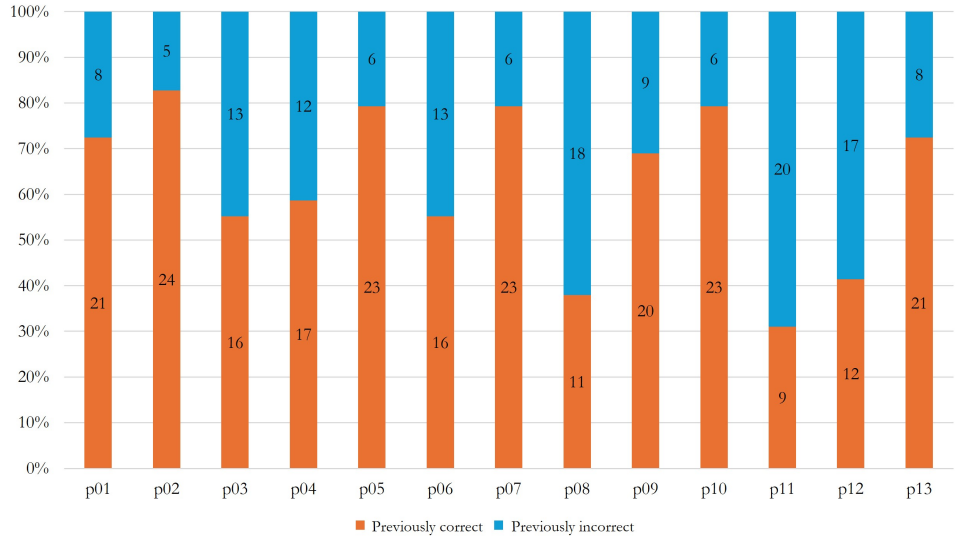

Figure 6. Correct and incorrect answers per question, before training.
Note: p = question.

Following the training, the number of correct answers increased for most questions (Figure 7). The most frequently answered questions were: What is a garden? (p01), What is the purpose of a garden? (p02), What is a seed? (p07), What is a raised bed? (p09), What is compost? (p010), and How can pests and diseases be controlled in the garden? (p13), with 28 out of 29 respondents answering correctly, representing 97%. This reinforces the idea that the adolescents successfully acquired useful knowledge to contribute to sustainable food production by growing nutritious vegetables with a low environmental impact, as recommended by Savary et al. (2022). One of the more challenging questions was: What types of vegetables can be grown? (p03), which 20 adolescents answered correctly (69%) and 9 answered incorrectly (31%).

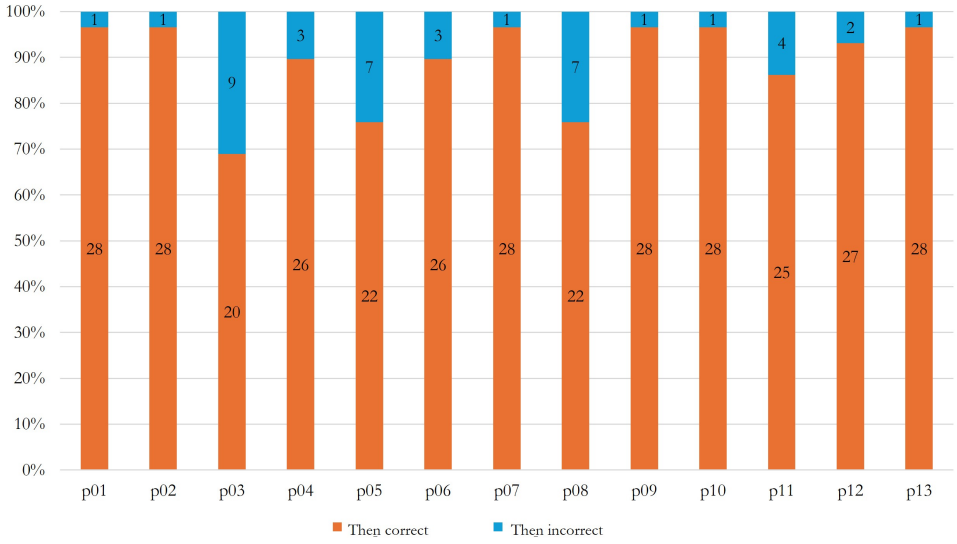

Figure 7. Correct and incorrect answers per question, after training.
Note: p = question.

By comparing the correct and incorrect answers obtained before and after the training, statistically significant changes in knowledge were identified (Table 4). Eight questions showed an improvement in the correct answer rate ($p<0.05$): p01, p04, p06, p08, p09, p11, p12, and p13. This means that learning increased in more than half of the questions. No differences were found in the remaining questions (p02, p03, p05, p07, p10), and therefore, an increase in knowledge could not be demonstrated in these areas. This suggests the need to reinforce content related to the importance of gardens, the types of vegetables available for dietary diversification, and the relevance of fertilizers for producing nutritious and safe vegetables (Savary *et al.,* 2022).

The question "What is the objective of producing vegetables in a garden?" (p05) was a particular case because it exhibited atypical behavior (Table 4). The number of adolescents who answered it correctly before the training was 23, and afterward, the number dropped to 22. Although the difference was minimal, this data represents a slight decline, which could be related to poor question design or the inclusion of confusing responses. Therefore, it is suggested that the question be reviewed to avoid future ambiguities and contribute to a better measurement of knowledge.

Table 4. Result of the McNemar test with continuity correction.

Question/ moment/ outcome			After		McNemar 's Test	
			Correct n(%)	Incorrect n(%)	χ^2	p-value
p01*	Before	Correct	21(72)	0(0)	5.143	0.016
		Incorrect	7(24)	1(3)		
p02	Before	Correct	24(83)	0(0)	2,250	0.125
		Incorrect	4(14)	1(3)		
p03	Before	Correct	12(41)	4(14)	0.750	0.388
		Incorrect	8(28)	5(17)		
p04*	Before	Correct	16(55)	1(3)	5,818	0.012
		Incorrect	10(35)	2(7)		
p05	Before	Correct	18(62)	5(17)	0.000	1,000
		Incorrect	4(14)	2(7)		
p06*	Before	Correct	13(45)	3(10)	5.063	0.021
		Incorrect	13(45)	0(0)		
p07	Before	Correct	22(76)	1(3)	2.286	0.125
		Incorrect	6(21)	0(0)		
p08*	Before	Correct	10(35)	1(3)	7,692	0.003
		Incorrect	12(41)	6(21)		
p09*	Before	Correct	20(69)	0(0)	6.125	0.008
		Incorrect	8(28)	1(3)		
p10	Before	Correct	22(76)	1(3)	2.286	0.125
		Incorrect	6(21)	0(0)		
p11*	Before	Correct	7(24)	2(7)	11,250	0.000
		Incorrect	18(62)	2(7)		
p12*	Before	Correct	12(41)	0(0)	13.067	0.000
		Incorrect	15(52)	2(7)		
p13*	Before	Correct	20(69)	1(3)	4,000	0.039
		Incorrect	8(28)	0(0)		

*Indicates statistically significant differences ($p<0.05$).
Source: Own elaboration.

Discussion

The results confirm that training in vegetable production through family gardens is an effective educational strategy for strengthening cognitive learning in adolescents living in vulnerable institutional settings, such as group homes. The statistically significant increase in the overall level of knowledge, evidenced by the paired-samples *t- test*, reflects that the intervention achieved its central objective: to evaluate the learning attained before and after a structured training process designed using a non-formal education and meaningful learning approach.

The increase in the average score, from 6.2 before the training to 8.9 after the intervention, suggests that the adolescents successfully incorporated fundamental concepts related to the establishment, management, and maintenance of vegetable gardens. This finding is consistent with that of Muñoz-Rodríguez *et al.* (2020), who emphasize that the acquisition of agri-food knowledge is a key component for advancing food security, particularly when training activities are developed in local contexts and with sociocultural relevance. It also aligns with Martínez and Romo (2019), who underscore that training processes, by combining theory and practice, promote the assimilation of technical content related to sustainable production.

From the perspective of meaningful learning proposed by Ausubel *et al.* (2003), the training structure, which integrated a theoretical conceptualization phase with a practical phase in the garden, allowed participants to connect new knowledge to their concrete experiences. The opportunity to immediately apply the content covered in the classroom to a physical space like the rehabilitated greenhouse facilitated the understanding of concepts such as soil preparation, seed use, pest management, and the application of organic fertilizers. This reinforces the idea that gardens function as pedagogical settings where learning transcends rote memorization and is grounded in direct experience (Blair, 2009; Eugenio- Gozalbo *et al.*, 2020).

McNemar 's test with continuity correction, provided relevant information on the thematic areas where the greatest progress was made. In eight of the thirteen questions evaluated, statistically significant increases in the proportion of correct answers were observed, particularly in those related to garden management, pest and disease identification, tool use, and understanding basic concepts such as raised beds and pest control. These results indicate that the training was especially effective in the operational and technical content, which is directly linked to daily vegetable production and low-environmental-impact practices, as noted by Korpelainen (2023) and Monroy & Martínez (2024) in their analyses of the sustainability of family gardens.

Conversely, five questions showed no statistically significant changes between the pre-test and post -test . In some cases, this can be attributed to the participants' already relatively high level of prior knowledge, as was the case with the question about the usefulness of the garden, which limits the potential for observable improvement. In other cases, such as the identification of vegetable types or the objective of producing them, the results suggest the need to reinforce this content in future training sessions, either through clearer teaching strategies or additional practical activities that facilitate conceptual differentiation. This type of finding is particularly valuable, as it not only allows for evaluating the impact of the intervention but also for adjusting and improving the design of training programs (Savary *et al.,* 2022).

One relevant finding was the atypical behavior observed in one of the questions, where a slight decrease in correct answers was recorded after the training. Although this change was not statistically significant, it highlights the importance of carefully reviewing the design and wording of assessment instruments. As Ortega *et al.* (2023) point out, in small samples and pre-experimental designs, the clarity of the questions is fundamental to avoiding ambiguous interpretations that could affect the measurement of learning. In this sense, the results not only reflect the effect of the training but also provide input for strengthening the instruments used in future assessments.

From a contextual perspective, the study gains relevance because it was conducted in a group home, an institutional environment characterized by heterogeneity in age, educational background, and vulnerability. Although this work focused exclusively on measuring cognitive learning, the results suggest that training in family gardens can constitute a solid foundation for building capacities oriented towards self-sufficiency and the responsible use of resources, key elements for local food security (Ibarrola-Rivas & Galicia, 2017; Gwacela *et al.,* 2024). In this sense, strengthening technical knowledge represents an essential first step towards consolidating sustainable food production practices.

Conclusions

This research explored the learning acquired by adolescents at the San Martín de Porres and Juan XXIII children's homes after training focused on vegetable production in a family garden. The results show that the training promoted learning related to vegetable production, while also strengthening cooperative work within an institutional context.

Before the intervention, participants obtained an average score of 6.2, which increased to 8.9 after the training, demonstrating a significant improvement in learning. Additionally, eight questions showed a significant improvement in the proportion of correct answers ($p < 0.05$), while five questions showed no substantial change. These findings allow us to assess the effect of the training, identify thematic areas that can be strengthened, and provide empirical evidence to improve educational practices related to food security.

This study contributes to the literature on learning processes in institutional contexts, particularly among adolescents living in group homes. Unlike most studies focused on school gardens, this study focused on a population with specific psychosocial conditions, providing a perspective that has been little explored in research on educational gardens.

Limitations of the study include its focus on a single age group within the children's home. Therefore, future research could consider including other age groups, from childhood and adolescence to adulthood, as well as people with disabilities, to broaden the analysis of the impact of these types of interventions.

Finally, the results suggest the importance of continuing the training support to foster meaningful lifelong learning focused on food security from a sustainable perspective. The experience following the training, in which the support continued and horticultural production was expanded according to the food needs of the group home, reinforces the potential of gardens as a viable alternative for strengthening food production in institutional settings such as group homes, nursing homes, prisons, or social rehabilitation centers.

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