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A Case Study from south India

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Herbal Gardens of Educational Institutions and Entrepreneurship Development: A Case Study from south India

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Abstract

With the objectives of finding out the usefulness of establishing herbal gardens in every district educational institutions of India to further the knowledge of science students, help in the conservation of medicinal plant biodiversity and explore its scope in entrepreneurship development in rural India, an experimental study with 55 medicinal plants of the institutional herbal garden and 30 High school science teachers of class VI to X from Walajabad and Uthiramerur blocks (15 teachers from each block) of Thiruvallur District, Tamil Nadu, India, was taken up during 2020-2021. The descriptive statistical analysis and inferential T-test exhibited a significant difference between the experimental group and control group of science teachers and revealed that the institutional herbal garden promoted outdoor science education among the students and science teachers. Activity based learning is found enhancing the skills, knowledge, and motivation for better understanding of scientific concepts by the learners. Also, the field study by the learners through the institutional herbal gardens serve as an outdoor science education center, and instill comprehensive understanding on the ecology, morphology, physiology and ethnomedicinal uses of the cultivated herbals. Clubbing the techniques of organic cultivation in the herbal gardens and value addition to the raw drugs of the gardens through the training at district level across India by effective usage of Government projects will help the unemployed and underemployed rural youth to become successful entrepreneurs.

Key Words: entrepreneurship, herbal garden, medicinal plants, outdoor science education, unemployment

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INTRODUCTION

Science education in the upper primary level of Indian school education makes every student to understand the reality of nature and various phenomena that exist in nature. Moreover, an inquisitive learning of science through activity enhances their skills, knowledge, and provides motivation to understand scientific concepts. Understanding of observable fact is important in learning science which further leads to development of proper scientific attitude and values in life. Process skills and attitude towards science are important elements that may influence students' performance. Attitude towards science is positively correlated with science achievement. The researchers believe that herbal garden is a wonderful place for students and teachers to know more about herbals such as, where they come from, what they are for and why they are important. School herbal garden is a great way to use the schoolyard as an outdoor classroom. It reconnects students with the natural world and to know about the true source of their food. School herbal garden acts as a hub for learning about gardening and agriculture concepts. School herbal garden facilitates integrated learning of math, science, art, health, physical education and social studies.

Medicinal plants are of great value to mankind. Conservation of them confers sustainable utilization. Harvesting practices and developmental paradigm endangers plant species of medicinal importance. *Ex-situ and In-situ* conservation are the techniques of sustaining biological diversity in the man-made ecosystems. Herbal gardens are storehouse of information and facilitate appreciative learning by students regarding the rational use of natural resources and conservation with special reference to medicinal plants. Herbal gardens are special places for plants and all the collections are managed in a scientific way to undertake plantation in the garden. It is the hub of skill on horticulture, silviculture, organic farming of medicinal plants and training. It is an ideal place to teach pupils about the richness of the plant diversity and intricate relationship where plants have developed with their environment, how plants are beneficial economically, culturally and aesthetically. The worldwide demand for the medicinal plant resources is on rise every year in herbal formulations, herbal cosmetic products and nutritional supplements. A total of around 9,500 registered industries and hundreds of unregistered cottage-level herbal units heavily depend upon the continuous supply of raw drugs for the production of medicines by the traditional Indian systems of medicine and by the herbal healers in the villages of rural India. Hence, the present study was made with the following objectives:

1. To train the teachers about herbal gardening practices under experimental group.
2. To motivate teachers to create awareness about herbal gardening practices among students.
3. To encourage students to set up herbal gardening in existing kitchen garden through teachers.
4. To evaluate the outcome between test and control groups.

Research Hypothesis

i. There is a significant difference about the attitude towards herbal gardening between the control and experimental group.
ii. There is a significant difference in the practice of herbal gardening among test group before and after experiment.

Null Hypothesis

There is no significant difference among test and control group in herbal gardening practices.

METHODS

The present study on "Institutional Herbal Garden to Promote Outdoor Science Education" as an experimental study on science education was conducted by the researchers during March 2020 to August 2021. A total of 30 High school science teachers handling class VI to X from Walajabad and Uthiramerur blocks (15 teachers from each block) of Thiruvallur District in Tamil Nadu, India, were taken as experimental group for the study. This study was carried out by Pre-test – Intervention – activites – Post-test. The 30 high school science teachers of Sriperumbudur, Chengelput and Kanchipuram (10 from each block) were taken as control group. The control group were administered only with pre-test and post-test and they were not indulged in activities concerned with identification of plants in herbal garden and its values.

The following are the experimental tools used in the test group:

a. Land preparation – including leveling, fencing, creating footpaths, sourcing and irrigation facilities
b. Organic manuring of the land
c. Buying and plantation of seeds
d. Weeding and Continuous irrigation
e. Harvesting methods
f. Procurement of the medicinal parts for sales
g. Publicity to get people from nearby villages and schools to visit the herbal garden, through pamphlets and social media.
h. Demonstrating cultivation of the plants, procurement of the medicinal parts and giving information about the medicinal uses.
i. Documentation of practices for cultivation of medicinal plants using organic farming techniques, their processing and preservation

A questionnaire of 50 questions about the medicinal properties and taxonomic position of the plants maintained in herbal garden was administered as pre-test and post-test.

After the pre-test the science teachers were indulged to identify the taxonomic position of each plant using standard description published in scholarly journal articles and the appropriate ethnomedicinal properties of the 55 plants maintained in the institutional herbal garden (Table 1). The experimental group involved enthusiastically in activities concerned with identification of botanical name and family of the plants concerned (Fig 1 & 2). The control group was kept undisturbed by such activities. Later post-test was administered to both experimental and control group.

Figure 1 - Teachers involved in identification of medicinal plants in the experimental herbal garden

(a), (b), (c) & (d) The four different medicinal plants of the garden with the labels


பேய் மிரட்டி
Anisomeles
malabarica (L).
R.Br. ex sims -
Lamiaceae


Alpinia
calcarata
Roscoe. -
Zingiberaceae


Costus pictus
D.DON.
Costaceae

(e), (f), (g) & (h) The four different medicinal plants of the garden;

(i) (j) & (k) Dissemination of knowledge by teachers to the students

Table 1 – The 55 ethnobotanical uses of medicinal plants at institutional herbal garden used in the experimental study

S.No	Botanical name	Medicinal Uses
1.	*Acalypha indica* Linn. - Phyllanthaceae	Used for treating intestinal worms, gum problems, stomach aches, hernia, rheumatism, bronchitis, asthma, pneumonia, scabies and skin diseases. It can be used externally and internally for medicinal purpose.
2.	*Adhatoda vasica* Nees – Acanthaceae	Used to cure cough, asthma, breathing trouble, nasal congestion, bleeding disorders, allergic conditions, upper respiratory infections, excessive uterine bleeding, heavy menstruation, and epistaxis (nose bleed).
3.	*Aloe vera* Linn Burm.f. - Liliaceae	Prevents and cures Alopecia, it cures the redness of eyes and reduces the heat of eyes. Treatment for flatulence, treats ulcers, anti-ageing agent, hair conditioner, cure for pediatric constipation
4.	*Alpinia calcarata* Roscoe. - Zingiberaceae	Possess antibacterial, antifungal, anthelmintic, antinociceptive, anti-inflammatory, antioxidant, aphrodisiac, gastroprotective, and antidiabetic activities.
5.	*Andrographis paniculata* Nees. - Acanthaceae	Anti-viral, cures dengue virus fever, antibacterial, antidote for snake poison
6.	*Anisomeles malabarica* (L). R.Br. ex Sims - Lamiaceae	Used as a folkloric medicine to treat amentia, anorexia, fevers, swelling, rheumatism. The herb is reported possess anticancer, allergenic, anti-helminthic, antibacterial, anti-plasmodial properties.
7.	*Artocarpus heterophyllus* Lam. - Moraceae	Anticarcinogenic, antimicrobial, antifungal, anti-inflammatory, wound healing, and hypoglycemic effects.
8.	*Cardiospermum halicacabum* Linn. –	Anti-ulcer, anti-diarrheal, increases fertility, anti-arthritic, anti-inflammatory, and antioxidant

	Sapindaceae	
9.	*Centella asiatica* Linn. - Apiaceae	Extensively for the treatment of anxiety and hypertension. It improves the circulation of blood in the veins and capillaries. It is used in the treatment of arthritis. Elixir for nervous system
10	*Centratherum punctatum* Cass. - Asteraceae	Leaf extracts exhibit antimicrobial, antioxidant and anti-proliferative properties
11	*Chrysopogon zizanioides* Linn. Roberty - Poaceae	The essential oil obtained from the roots is used medicinally as a carminative, diaphoretic, diuretic, emmenagogue, refrigerant, stomachic, tonic, antispasmodic and sudorific
12	*Cissus quadrangularis* Linn. - Vitaceae	Used for diabetes, obesity, high cholesterol, bone fractures, allergies, cancer, stomach upset, painful menstrual periods, asthma, malaria, wound healing, peptic ulcer disease, weak bones, weak bones (osteoporosis) and as body building supplements as an alternative to anabolic steroids.
13	*Clitoria ternatea* Linn. - Fabaceae	Memory enhancer, nootropic, antistress, anxiolytic, antidepressant, anticonvulsant, tranquilizing and sedative agent.
14	*Coleus aromaticus* Benth. - Lamiaceae	treat malarial fever, hepatopathy, renal and vesical calculi, cough, chronic asthma, hiccough, bronchitis, helminthiasis, colic, convulsions, and epilepsy
15	*Costus pictus* D. Don. – Costaceae	anti-diabetic, anti-microbial, anti-cancer, antioxidant, anti-fertility, anti-helminthic, diuretic, anti-inflammatory
16	*Curcuma caesia* Roxb. – Zingiberaceae	used in piles, leprosy asthma, cancer, wounds, impotency, fertility, tooth ache, vomiting, and allergies
17	*Cymbopogon citratus* Stapf - Poaceae	antispasmodic, hypotensive, anticonvulsant, analgesic, antiemetic, antitussive, antirheumatic, antiseptic and treatment for nervous and gastrointestinal disorders and fevers
18	*Enicostemma axillare* (Lam.) Rayanal - Gentianaceae	Laxative, helps in curing fever, rheumatism, skin diseases, abdominal disorders, snake bite, obesity and helps to regulate blood sugar levels.
19	*Erythrina indica* Lam. - Fabaceae	nervine sedative, collyrium in ophthalmia, antiasthma, antiepileptic, antiseptic, and as an astringent.
20	*Eugenia jambolana* Lam. - Myrtaceae	astringent, sweet, sour, acrid, refrigerant, carminative, diuretic, digestive in diabetes, leucorrhea, gastric disorder, fever, skin diseases and wounds.
21	*Euphorbia hirta* Linn. - Euphorbiaceae	antibacterial, anthelmintic, anti-asthmatic, sedative, antispasmodic, antifertility, antifungal, and antimalarial properties.
22	*Ficus racemosa* Linn. - Moraceae	Cures diabetes, liver disorders, diarrhea, inflammatory conditions, hemorrhoids, respiratory, and urinary diseases.
23	*Hemidesmus indicus* Linn. Schult. - Asclepiadaceae	It is used as tonic, diuretic and aphrodisiac. Whole root and root-bark are useful in syphilis, leukoderma, hemicrania, rheumatism and in several liver and kidney

		disorders. Powdered root mixed with cow's milk treats scanty and highly colored urine and is used as a popular folk medicine.
24	*Hydrocotyle verticillata* Thunb. - Araliaceae	The raw immature leaves are eaten as a salad, used as a garnish, or steamed–sautéed if in need of a cooked green. Raw, the leaves have a refreshing hint–of–celery taste. The older leaves may be a little tough and slightly bitter.
25	*Jasminum sambac* Linn. - Oleaceae	used to treat dysmenorrhea, amenorrhea, ringworm, leprosy, skin diseases and as an analgesic, antidepressant, anti-inflammatory, antiseptic, aphrodisiac, sedative, expectorant
26	*Justicia gendarussa* Burm.f. - Acanthaceae	It is used as a tribal medicine for various ailments such as bronchitis, inflammations, vaginal discharges, dyspepsia, eye diseases and fevers, etc.
27	*Kalanchoe pinnata* (Lam)Pers. - Crassulaceae	Kalanchoe is a medicinal plant largely used in folk medicine for the treatment of kidney stones, gastric ulcer, pulmonary infection, rheumatoid arthritis
28	*Limonia acidissima* Linn. - Rutaceae	It is used as tonic for heart and lungs, the unripe fruit is used as anti-diarrheal, leaves of wood apple are anti-diabetic, fruit pulp is used in the treatment of sore throat
29	*Madhuca longifolia* (J.Konig) J.F.Macbr. - Sapotaceae	It is used as Anti diabetic, antiulcer, hepatoprotective, anti-pyretic, anti-fertility, analgesic, anti-oxidant, swelling, inflammation, piles, emetic, dermatological, laxative, tonic, anti-burn, anti-earth worm, wound healing
30	*Mangifera indica* Linn. - Anacardiaceae	Various parts of plant are used as a dentifrice, antiseptic, astringent, diaphoretic, stomachic, vermifuge, tonic, laxative and diuretic and to treat diarrhea, dysentery, anemia, asthma, bronchitis, cough, hypertension, insomnia, rheumatism, toothache, leucorrhea, hemorrhage and piles
31	*Melia dubia* Cav. - Meliaceae	Antioxidant, anticancer, antimicrobial, antidiabetic, antifeedant, and biopesticide
32	*Melothria maderaspatana* Linn. Cogn – Cucurbitaceae	antibacterial, antioxidant, larvicidal, antiulcerogenic, antidiabetic, hypolipidemic, antihypertensive, immunomodulatory properties and antihepatotoxic
33	*Merremia emarginata* Burm.F. Hall.F. - Convolvulaceae	Heals internal wounds and ulcers diuretic, for cough, headache, neuralgia, and rheumatism.
34	*Mimosa pudica* Linn. - Mimosaceae	urogenital disorders, piles, dysentery, sinus, and applied on wounds.
35	*Moringa oleifera* Lam. - Moringaceae	antitumor, antipyretic, antiepileptic, anti-inflammatory, antiulcer, antispasmodic, diuretic, antihypertensive, cholesterol lowering, antioxidant, antidiabetic, hepatoprotective, antibacterial and antifungal activities, and are being employed for the treatment of different ailments in the indigenous system of medicine, particularly in South Asia.
36	*Ocimum basilicum*	headaches, coughs, diarrhea, constipation, warts, worms,

	Linn. - Lamiaceae	and kidney malfunctions
37	*Ocimum tenuiflorum* var mint. Linn. - Lamiaceae	recommended for the treatment of bronchitis, bronchial asthma, malaria, diarrhea, dysentery, skin diseases, arthritis, painful eye diseases, chronic fever, insect bite
38	*Ocimum tenuiflorum* Linn. - Lamiaceae	antifertility, anticancer, antidiabetic, antifungal, antimicrobial, hepatoprotective, cardioprotective, antiemetic, antispasmodic, analgesic, adapt genic and diaphoretic actions. Eugenol (1-hydroxy-2-methoxy-4-allylbenzene), the active constituent present in *Ocimum sanctum* L., has been found to be largely responsible for the therapeutic potentials of Tulsi.
39	*Ormocarpum cochinchinense* Auct. non (Lour.)Merr. - Fabaceae	traditionally used for curing bone fracture in the villages of Tamil Nadu, India. Significant healing of bone fractures was observed in experiments with the albino Wistar rats.
40	*Orthosiphon aristatus* (Blume) Miq. - Lamiaceae	urinary tract infections, nephritis, kidney stones, gout, rheumatism, jaundice and diabetes. considered to be anti-hypertensive, diuretic, anti-fungal, anti-bacterial, and anti-inflammatory.
41	*Phyllanthus emblica* Linn. Phyllanthaceae	antidiabetic, hypolipidemic, antibacterial, antioxidant, antiulcerogenic, hepatoprotective, gastroprotective, and chemo preventive properties. Important dietary source of vitamin C, amino acids, and minerals. traditional medicine for the treatment of diarrhea, jaundice, and inflammation.
42	*Phyllanthus niruri* Linn - Phyllanthaceae	antimicrobial, antiviral, hepatoprotective, antioxidant, anticancer, anti-inflammatory, anti-plasmodial and diuretic.
43	*Physalis minima* Linn. – Solanaceae	anti-cancerous, anti-diabetic, analgesic, anti-inflammatory, anti-pyretic potentials
44	*Piper longum* Linn. - Piperaceae	used to treat chronic bronchitis, asthma, constipation, gonorrhea, paralysis of the tongue, diarrhea, cholera, chronic malaria, viral hepatitis, respiratory infections, stomachache, bronchitis, diseases of the spleen, cough, and tumors.
45	*Prosopis cineraria* Linn. Druce - Mimosaceae	Rheumatism, cough, common cold, anthelmintic properties, dysentery, bronchitis, asthma, leukoderma, piles and tremors of the muscles.
46	*Prunus americana* Marsh. - Rosaceae	Bark is astringent, diuretic and pectoral. It has been used to make a cough syrup by native Americans. The fruit is edible.
47	*Psidium guajava* Linn. - Myrtaceae	found to be effective in diarrhea, dysentery, gastroenteritis, hypertension, diabetes, caries, pain relief, cough, oral ulcers and to improve locomotors coordination and liver damage inflammation.
48	*Punica granatum* Linn. - Lytharaceae	used in natural and holistic medicine to treat sore throats, coughs, urinary infections, digestive disorders, skin disorders, arthritis, and to expel tapeworms.
49	*Sansevieria*	used as a cardiotonic, expectorant, febrifuge, purgative,

	roxburghiana Schult. & Schult. f. - Agavaceae	tonic in glandular enlargement and rheumatism, juice of plant used to cure ear ache in folk medicine
50	*Solanum nigrum* Linn. - Solanaceae	Used to treat pneumonia, aching teeth, stomach ache, tonsillitis, wing worms, pain, inflammation and fever, tumor, inflammation, and also as hepaprotective, diuretic, antipyretic
51	*Solanum torvum* Swartz - Solanaceae	a range of medicinal properties, ranging from cardio-protection & treatment of heart related diseases, nephro-protection, to analgesic, anti-inflammatory, anti-ulcer, and anti-microbial activities.
52	*Terminalia catappa* Linn. - Combretaceae	Used to cure gastritis, contains vitamin E, essential unsaturated fatty acids, and minerals.
53	*Thespesia populnea* Linn. Sol.Ex. Correa	A decoction of the leaves is used in treating coughs, influenza, headache and relapses in illnesses
54	*Tridax procumbens* Linn. - Asteraceae	wound healing and as an anticoagulant, antifungal, and insect repellent. The juice extracted from the leaves is directly applied on wounds. Its leaf extracts were used for infectious skin diseases in folk medicines.
55	*Vitex negundo* Linn. - Lamiaceae	anti-inflammatory, expectorant, tranquilizer, antispasmodic, anti-convulsant, and rejuvenator.

RESULTS AND DISCUSSION

The pre-test score for the experimental group ranged from 20 to 39 and the mean score, whereas that of post-test score was 22 to 47. The corresponding means for the pre-test and post-test were 26.1 and 35.13 (Table 2; Fig 3 & 4).. Whereas the control group recorded a score range of 11 to 38 for the pre-test and 18 to 44 for the post-test with the corresponding means 19.26 and 26.33 (Table 3; Fig 5 & 6). This amply indicates increase in knowledge gain among the experimental group and the statistical significance of the values.

Table 2 - Experimental group score

S.No	Name	Pre-Test Score	Post-Test Score
1	Jayanthi L	27	40
2	Jeevitha V	25	37
3	Rathi J	26	35
4	Maheshwari T	23	29
5	Sudha Km	28	36
6	Poovazhagi P	26	33
7	Ushadevi M	22	29
8	Umarani G	24	35
9	Anbukarasi A	27	33
10	Josephine C	22	31

11	Murugappan K	20	29
12	Mohan V	23	22
13	Latha Mp	27	29
14	Ramalakshmi N	26	36
15	Balachandar Bt	21	33
16	Santhakumar M	23	31
17	Sudarsan Sk	24	29
18	Thangavel D	24	27
19	Senthilkumar M	22	27
20	Thirumalai G	21	41
21	Geetha B	33	46
22	Brindha Vp	22	38
23	Kumaran S	33	47
24	Shanthi E	26	44
25	Easter Jeba Rosy I	33	41
26	Subhashini M	39	47
27	Arul Jothi R	29	41
28	Saidha K	32	37
29	Karthikeyan T	19	27
30	Jayakumar	36	44
Mean		26.1	35.13
Median		25.5	35
Mode		20	25
Standard Deviation		4.9364	6.7145
Standard Error		0.9012	1.2259
Paired T-Test (One Tailed Between Pre-Test And Post-Test Score) – Significant At 0.0005 Level			5.2130

Figure 3- The test scores of the experimental group

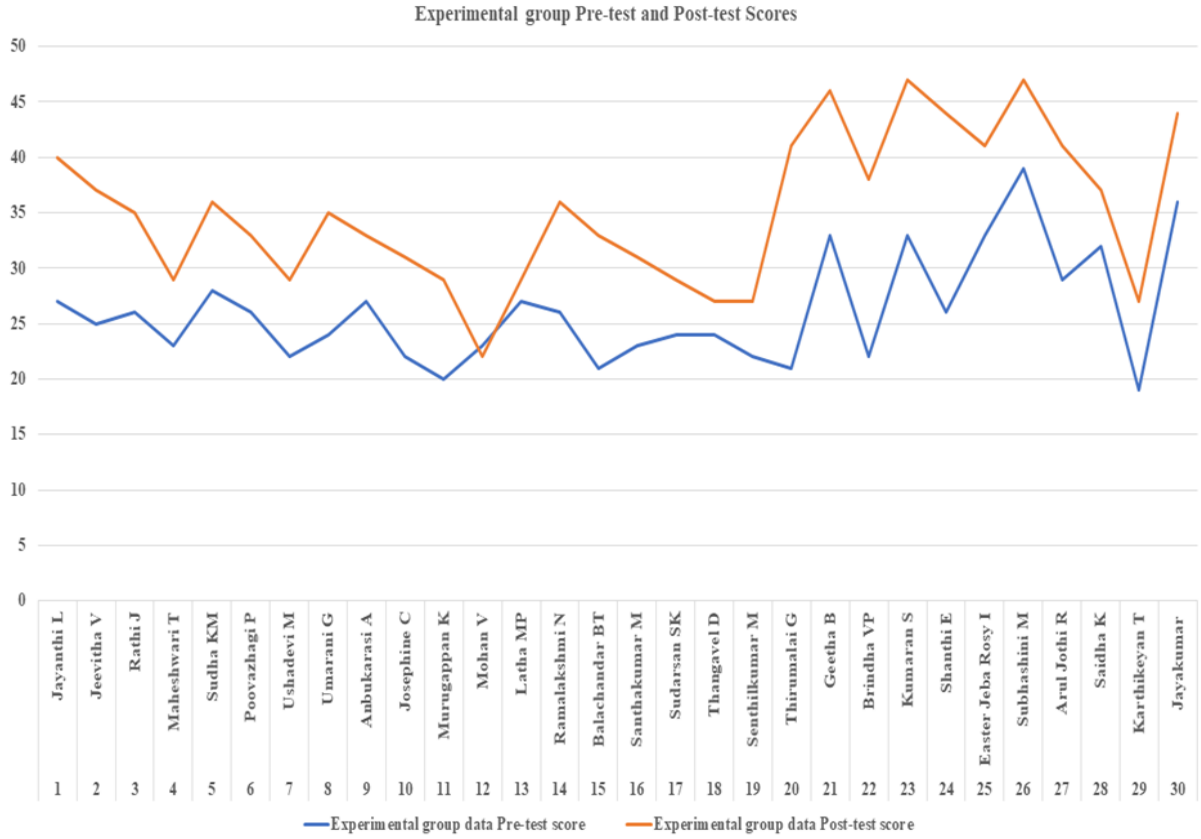


Figure 4 - The central tendency for the scores of the experimental group

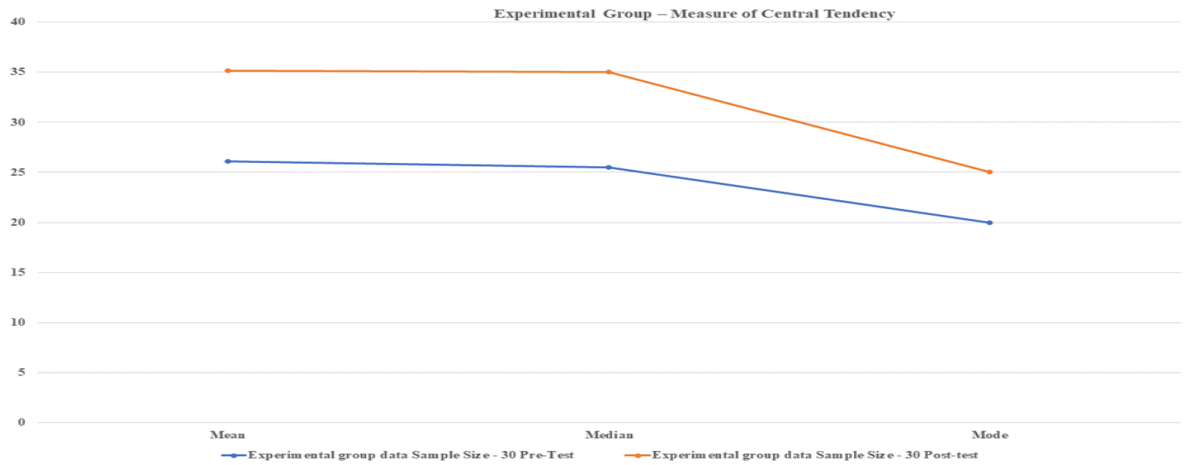


Table 3 - Control group score

S. No.	Name	Pre-Test Score	Post-Test Score
1	Anusuya Pushpalatha G	19	26
2	Adeeswari D	24	32
3	Babu C	11	19
4	Chinnasamy K	15	24
5	Deepa Bt	17	24
6	Dharmasamvarthini K	13	22
7	Gajendiran M	11	21
8	Goutham	35	40
9	Gowthamraj V	12	14
10	Grace Nayagi	21	28
11	Jayanthi	19	26
12	Jesita	20	28
13	Kalpana	18	25
14	Kumaran N	12	26
15	Lakshmi K	15	24
16	Monisha	21	29
17	Nachimuthu	24	31
18	Nobal Golda J	31	39
19	Nevetha Selvaraj	28	32
20	Premline Anita R	22	30
21	Priya P	24	26
22	Radhamani J	38	44
23	Raja Prabhu	11	19
24	Rajesh G	15	21
25	Rajkumar S	17	23
26	Siva Chandran	13	18
27	Sivagami	11	18
28	Venkatesan C	20	25
29	Venkatesh S	18	27
30	Boominathan P	23	29
Mean		19.26	26.33
Median		18.5	26
Mode		11	26
Standard Deviation		7.0316	6.6557
Standard Error		1.2837	1.2151
Unpaired T-Test (One Tailed Between Pre-Test Scores Of Experimental Group And Control Group) – Significant At 0.005 Level		3.1207	
Unpaired T-Test (One Tailed Between Post-Test Scores Of Experimental Group And Control Group) – Significant At 0.05 Level		1.9670	

Figure 5 - The test scores of the control group

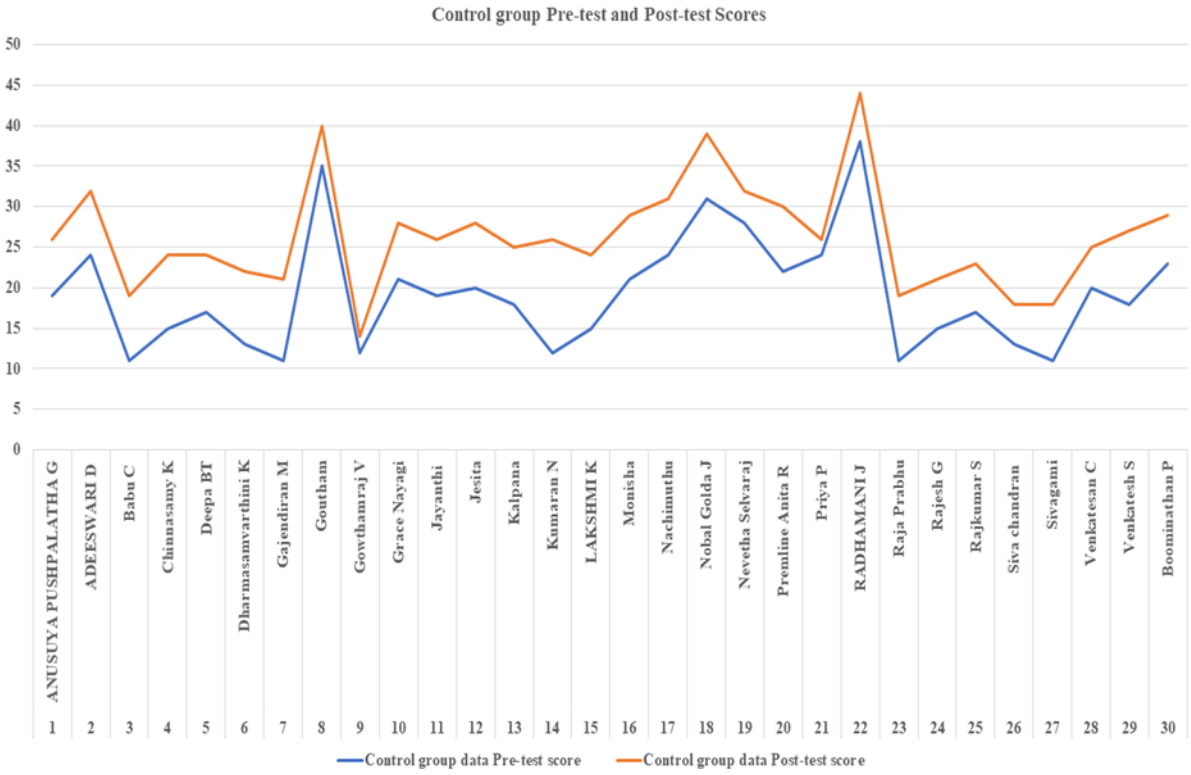
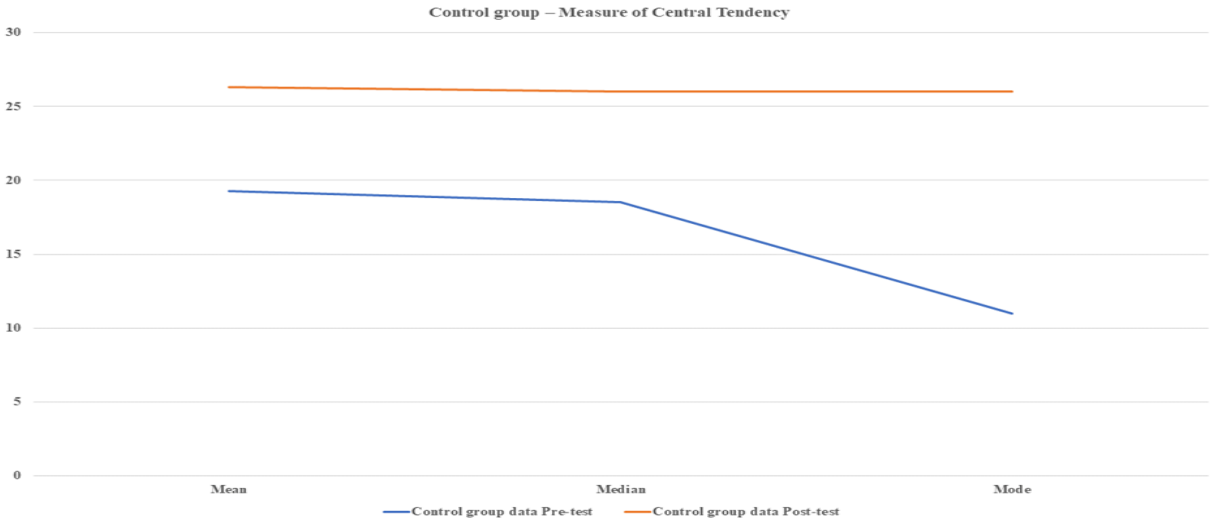


Figure 6 - The central tendency for the scores of the control group



RESEARCH HYPOTHESIS – 1

- Hypothesis – There is a significance difference about the attitude towards herbal gardening between the control and experimental group
- Inference – Unpaired T-test (one tailed between pre-test scores of experimental group and control group) score obtained was 3.1207 and its significant at 0.005 level so this hypothesis is accepted

RESEARCH HYPOTHESIS – 2

- Hypothesis – There is a significance difference in the practice of herbal gardening among test group before and after experiment.
- Inference – Paired T-test (one tailed between pre-test and post-test score of experimental group) score obtained was 5.2130 and its significant at 0.0005 level so this hypothesis is accepted

NULL HYPOTHESIS

- Hypothesis – There is no significance difference among test and control group in herbal gardening practices.
- Inference – Unpaired T-test (one tailed between post-test scores of experimental group and control group) score obtained was 1.9670 and its significant at 0.05 level so this null hypothesis is rejected.

The descriptive statistical analysis and inferential T-test statistical analysis exhibited significant difference between the experimental group and control group of science teachers revealed that institutional herbal garden shall be utilized to promote outdoor science education among class VI – XII students facilitated by science teachers. The researcher and the participant high school science teachers observed that institutional herbal garden acts as a hub for learning about gardening and agriculture concepts. It facilitates integrated learning of math, science, art, health, physical education and social studies.

Teachers could train students to learn focus and patience, cooperation, teamwork and social skills. Gardening could help them in attaining self-confidence and capability with new skills in agricultural practices. Achievement scores will improve by garden-based teaching, gardening made students fit and healthy and started choosing healthy foods over junk food, the schoolyard will be diversified and beautified.

RECOMMENDATIONS

- A mother bed to grow seedlings may be developed in all the DIETs across India. Wherever more space is available with the coordination of (interested) faculty through their gardeners & the saplings may be given to nearby schools and a free field trip to visit DIET's Herbal/Medicinal/Roof Garden.
- *Melia dubia*, *Bassia latifolia*, *Bassia longifolia*, *Thespesia populenia* and *Borassus flabelifer* are drought resistant and shall be used for bio-fencing.
- Every year on 5th June world environment day is celebrated across the globe, hence in India the pre-service students of DIETs, and all teacher training institutes (TTIs) must be indulged in biodiversity conservation with special focus to *in-situ* conservation of medicinal plants depending upon the soil type, altitude, water availability etc.
- Every year 1st week of July is Vanamahotsav celebration occurs in India, in this juncture the SCERT must observe a one-week celebration of this programme to initiate propagation of medicinal plants in all TTIs and further extended to schools across

Tamil Nadu in a phased manner through the district NGC coordinators and NGC in charge of each school.

TANGIBLE OUTCOME/BENEFITS

- Science teachers across the state will get hands on training as well as guidance to establish school herbal garden, conservation, propagation and utilization of medicinal herbals will be achieved.

INTANGIBLE OUTCOME/BENEFITS

- The institutional herbal garden and school herbal garden will serve as an out-door science education center, and inculcate better understanding about ecology, morphology, physiology and ethnomedicinal uses of medicinal herbals by experimental studies and field activities.

The researcher suggests that NGO's, state government and central government must promote entrepreneur skills among rural communities to identify appropriate medicinal plants that could be cultivated based on agroclimatic factor. Wild populations of several medicinal plant species are in great demand due to unlawful harvesting, to overcome this issue a policy decision on conservation, propagation and utilisation of medicinal plants is crucial.

The current market scenario is at Rs. 4.2 billion (US$ 56.6 million) in 2019 and the compound annual growth rate is expected to be 38.5% to Rs. 14 billion (US$ 188.6 million) by 2026. Thus, its evident that the central government of India and the state governments must play a pivotal role in the promotion of medicinal herbs export with special focus on species of high demand such as *Berberis aristata*, *Glycyrrihza glabra*, *Aegle marmelos*, *Plantago ovata*, *Annona muricata*, *Commiphora wightii*, *Santalum album*, *Senna alexandrina*, *Pepper longum*, *Bacopa monniera*, *Nardostachys jatamansi*, *Withinia somnifera*, *Saraca asoca*.

The organically cultivated medicinal herbs free of pesticides and other chemicals are under great demand for its extracts is gradually increasing in foreign countries, especially in Europe and other developed countries. The huge gap in between the supply(26%) and demand(50%) of medicinal herbs is due to naive agricultural and quality control procedures, lack of processing, research & development, standardization in products and regulatory framework in trade of medicinal plants. This could be overcome by reforestation of the habitat and decrease levels of over-exploitation by granting permission to cultivate medicinal plants in villages of Western Ghats, Eastern Ghats and river delta basins across India by engaging rural unemployed youths under central government sponsorship to meet the global demand of herbal trade which is currently assessed at US$ 120 billion. Every year an awareness program must be conducted by the district institute of education and training (DIET) across the Indian sub-continent on world environment day and vanamahotsav week. Government school science teachers and district eco-club coordinators must be indulged as representatives to promote such outdoor science education in government school campus and it should be monitored by the district educational officers across India.

The state bio-diversity authority and national bio-diversity authority shall frame guidelines to engage in conservation, cultivation, and research & development of medicinal plants. Further extension of research on extraction and utilization of phytochemicals by CIMAP, CSIR may lead to production of novel Phytodrugs to combat dreadful diseases.

Organic cultivation of medicinal herbs free of pesticides and herbicides in a commercial mode is a boon to farmers of below poverty line. Unemployed youths of villages must be trained to form societies and avail startup small scale industry loans. A district level training center in all DIETs must be established across India to promote good manufacturing practices (GMP) for the benefit of marginalized people.

CONCLUSION

As the initiatives taken up, over the years, by the Union Government of India and the State Governments have not yet fully reached the grassroots, the researchers believe that success can easily be achieved by creating awareness through participatory mass programs of people and the authorities of school education department in all the villages across India. A national level high committee, state level sub-committee can be formed under the aegis of the authorities of Governments of India and the States, for efficient planning and execution of conservation, propagation and utilization of medicinal plants. The researchers believe that a well-equipped supply chain management and establishment of farmer associations will provide a healthy life-style and employment in rural India for the financial progress of farmers to come out of below poverty line.

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