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Connecting the Botanical Principles and Practical Laboratory Botanical Gardening: The Experience of BS Biology Students

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Abstract

Genuine botany education extends beyond the four walls of the classroom, requiring students to apply learned knowledge and skills to real-life contexts. However, limited attention has been given by the Botany instructors to the application of botanical concepts in gardening activities. Thus, this study examined how the Central Philippine University (CPU) BS Biology students connect their classroom learning in Botany to botanical gardening practices. The current study is grounded in constructionism, where students actively build knowledge of plant growth by integrating lecture concepts with hands-on experiences in the botanical garden. It is further supported by experiential learning theories of David A. Kolb and John Dewey, emphasizing that learning develops through experience, reflection, and interaction with the environment. The present study employed an interpretative phenomenological analysis (IPA) design. Twenty students were randomly selected as participants, and data were collected through a qualitative survey using validated guide questions. Instrument validation was conducted through peer and parallel evaluation, and the data were analyzed using thematic analysis. Findings revealed that students acquired key concepts from general Botany, including molecular and cellular processes, plant physiology, reproduction and genetics, development, environmental interactions, evolution, and plant' uses. These concepts guided them in maintaining plant growth and health through proper identification of plant needs and understanding of physiological processes. Students also developed practical skills such as taxonomy, plant maintenance, resource management, landscaping, social interaction, use of gardening tools, laboratory reporting, and soil preparation. These skills were applied in assessing plant conditions, controlling diseases, creating suitable environments, and monitoring plant growth. Students were able to revive plant health through consistent monitoring, pest management, application of farm technology, and reinforcement of physiological knowledge. Their experiences evoked both positive and negative emotions during plant deterioration. In this light, the participation in botanical gardening fostered positive attitudes toward plant care, environmental awareness, and collaboration. The study concludes that integrating botanical gardening into the Botany curriculum is highly recommended.

Keywords: *Botany, botanical principles, botanical garden, laboratory, gardening*
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Introduction

Science education does only occur within the four walls of the classroom and laboratory buildings. There are pieces of scientific information which can be found beyond the four corners of the educational institutions. Principles and concepts taught via the lecture and discussion which are mainly derived from the books will be easily gone by the wind unless supported by the scientific practices which are properly experienced by the learners. Proper scientific knowledge can be acquired once experienced by the students personally in proper context and perspective. In Botany, one of the best ways to introduce experiential learning is through maximum students' engagement in botanical gardening.

A botanical garden refers to the garden with a documented collection of living plants for the purpose of scientific research, conservation, display, and education. This type of garden is mostly found in the different universities and scientific organizations around the world. Botanical gardens are commonly run and managed by universities or other scientific research organizations, and often have associated herbaria and research programs in plant taxonomy or some other aspect of botanical science because this is associated with the scientific education and various research endeavors related to botanical studies. In principle, the role of the staff of the botanical garden is to maintain documented collections of living plants for the purposes of scientific research, conservation, display, and education, although this will depend on the resources available and the special interests pursued at each particular garden.

There have been various research activities related to urban botanical gardening. Most of the research activities found that urban green areas and natural areas have therapeutic effects on human health (Bertram and

Rehdanz, 2015; Coppel and Wüstemann, 2017). Interaction with green spaces is especially important for the healthy development of children (Sachs et al., 2020). However, both natural areas and urban green areas are under the threat of reduction and destruction. The United Nations underlines that urban residential areas will spread about 1.5 million square kilometers on a global scale by 2030 and this will negatively affect the already-limited green areas (Coppel and Wüstemann, 2017). While most of the studies on natural and urban green areas are based on surveys and observations, there are still few experimental studies. Most of the studies on the contributions of natural and cultural landscape are related to adults (Fleming et al., 2016; Gidlow et al., 2016; Coppel and Wüstemann, 2017; Sarkar and Webster, 2017; Vujcic et al., 2017). The number of studies on students is quite limited (Bogenç, 2021; Hodson and Sander, 2017). However, the natural environment and landscape offer a learning space for students (Yilmaz, 2022). Students witness direct interaction of events and phenomena with natural elements in nature (Koseoglu et al., 2021).

In the Philippines, almost all universities have botanical gardens. A botanical garden is one of the requirements under the physical plants and facilities aspect for accreditation of various government and private accrediting agencies. In spite of this requirement and popularity of the university botanical garden; few studies on this area have been published recently like the works of Castillo et al. (2023a) and Castillo et al. (2023b). Castillo et al. (2023a) studied the seismic-induced landslide hazard analysis of the recreational area of the Makiling Botanic Gardens, Los Baños, Philippines while Castillo et al. (2023b) assessed the threatened Philippine plants in the Makiling Botanic Gardens.

In Iloilo City, there are several existing universities with botanical gardens; however, no studies have been published at the moment concerning any aspects of university botanical gardens. With this established research gap, it is imperative to study the Central Philippine University Botanical Garden. Hence, the present study would like to determine the connection of CPU BS Biology students' learning from Botany lecture and laboratory classes to botanical gardening to ensure the growth and development of their plants. Specifically, this study aimed to 1.) identify key General Botany concepts that enhance understanding of plant growth and development, 2.) determine how General Botany knowledge influences students' approaches to maintaining plant growth and health, 3.) describe practical skills acquired from General Botany laboratory sessions relevant to plant management in a botanical garden, 4.) examine the application of laboratory-acquired skills in maintaining plant health in the botanical garden, 5.) assess students' emotional responses and coping strategies when plants show signs of deterioration, 6.) identify strategies and interventions used to restore plant growth and ensure survival, 7.) determine key lessons gained from engagement with the botanical garden and 8.) evaluate how these lessons are applied to sustain long-term plant health and growth.

Research Methodology

Research Design

The current study utilized an interpretative phenomenological analysis (IPA) because this involves the lived-experiences of the BS Biology students in the laboratory and botanical garden. This study tackled the phenomena pertaining to the experiences of the BS Biology students in Botany laboratory class and botanical gardening. According to Creswell and Poth (2016) and Creswell (2013), IPA approach will investigate the experiences of human beings while suspending the researchers' preconceived assumptions about the phenomenon. The main objective and essence of the IPA approach in a qualitative research study are to explore the 'lived experiences' of the research participants and allow them to narrate the research findings through these 'lived experiences' (Alase, 2017).

IPA allows for multiple individuals (participants) who have experienced similar events to tell their stories without any distortions and/or prosecutions (Alase, 2017). This approach investigates how individuals make sense of their experiences. It is assumed that people are "self-interpreting beings" which means that they are actively engaged in interpreting the events, objects, and people. This design draws upon the fundamental principles of phenomenology, hermeneutics, and idiography (Boadu, 2021).

The IPA approach assumes that people use a universal structure or essence to make sense of their experience. In this type of design, the participants' feelings, perceptions, and beliefs will be interpreted to clarify the essence of the phenomenon under investigation. This design is essential to bracket whatever a priori assumptions about the experience or phenomena to come up with the robust data for interpretation.

Epistemological and Theoretical Perspective

The epistemological stance of this study is anchored in constructionism. This view states that knowledge is something learners actively build through engagement with real-world contexts and experiences rather than simply receiving information (Creswell and Poth, 2016).). Within this framework, BS Biology students construct their understanding of plant growth and development by integrating theoretical knowledge from lectures with practical experiences in the botanical garden, allowing meaning to emerge through action and reflection. This perspective is consistent with interpretative phenomenological analysis, which focuses on how individuals interpret and make sense of their lived experiences within specific social and environmental contexts (Creswell, 2013). Consequently, knowledge in this study is understood as a co-constructed, context-sensitive process shaped by learners' interactions, prior understandings, and reflective practices in botanical gardening.

The theoretical framework of this study is anchored in experiential learning, emphasizing that knowledge is developed through direct experience, reflection, and active engagement in real-world contexts. First, David A. Kolb's Experiential Learning Theory explains that learning occurs through a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation, which is evident as students apply botany concepts in the botanical garden and refine their understanding through practice (Kolb, 2014). Second, John Dewey's Theory of Experience highlights that meaningful learning arises from the interaction between learners and their environment, where continuity and interaction shape educational experiences, aligning with students' hands-on engagement in plant cultivation and environmental interaction (Dewey, 1986). Together, these theories support the idea that botanical gardening serves as a dynamic learning environment where students integrate theory and practice, leading to deeper and more sustained scientific understanding.

Research Locale

The study was conducted at Central Philippine University, Lopez Jaena Street, Jaro, Iloilo City, Philippines. Central Philippine University is one of the largest universities in Panay Island, Philippines.

Participants of the Study

This study involved 20 BS Biology students. It was ensured that the participants should fit in the following inclusion criteria: (1) have studied at CPU, (2) took botany class in school 2022-2023, (3) submitted botany laboratory reports, and actively involved in the various activities in the botanical garden.

Purposive sampling was utilized in the selection of the participants. Purposive sampling refers to a group of non-probability sampling techniques in which units are selected because they have characteristics that the researcher needs in the sample (Bekele and Ago, 2022; Thomas, 2022).

Research Instrument

The researcher drafted the guide questions to be utilized in the actual survey. These guide questions were used as a research instrument in the study. The guide questions were drafted in order to address the objectives of the study. The contents of the guide questions were based on the works of Bacon et al., 2023; Faraji and Karimi et al., 2022; Klimenko et al., 2022; and Ren et al., 2022.Eight questions were considered in this study. The questions are given as follows.

1. What key concepts or principles did you learn from your General Botany lecture that you found particularly useful in understanding plant growth and development?
2. In what specific ways has the knowledge gained from your General Botany lecture influenced your approach to maintaining the growth and health of your plants? Please provide examples.
3. What practical skills did you acquire during your General Botany laboratory sessions that you believe have been valuable in your engagement with plants, especially within the botanical garden setting?
4. How did you apply the significant skills you obtained from the General Botany laboratory to ensure the good health of your plants in the botanical garden?
5. When faced with the prospect of your plants deteriorating in the botanical garden, what emotions or concerns did you experience? How did you respond to these challenges?
6. Reflecting on occasions when your plants were struggling, what strategies or interventions did you employ to revive their growth and to ensure their survival?
7. What important lessons have you gained from your engagement with the botanical garden?
8. Based on the important lessons you acquired during your botanical garden exposure, how did you ensure that your plants would grow healthier over a longer period of time?

The drafted research instrument (guide questions) was validated using self-validation, colleague validation, and parallel validation. In self-validation, the researcher reviewed the content thrice as to the construction of the questions, grammar, spelling, and other technical aspects. For the colleague's validation, three experts scrutinized the instrument (2 Science Teachers and 1 English language expert). Their suggestions were collated and incorporated for polishing the research instrument. Parallel validation was performed by involving ten General Physiology (Plants and Animals) students.

Data Gathering Procedure

The data gathering procedures are divided into three parts: before the survey, during the survey, and after the survey.

Before the survey proper, the researchers prepare the survey protocols and guide questions. In the survey protocols, the researchers introduce themselves to the participants with courtesy and kindness. Prior to survey proper the researchers explained the purpose and utilization of the data that were obtained from the survey and the methods on how the research data will be protected with confidentiality through a cover letter and informed consent. The things that should be done and the things that should be refrain from doing during the survey were clearly put in the protocols (Josselson, 2013). All ethical aspects were laid down in the protocols.

As part of the protocol informed consent was provided to the participants. In the consent, it was explained that the participation of the participants in the study is voluntary. Whatever pieces of information that were gathered should be treated with utmost confidentiality as a compliant to Republic Act 10173 or also known as "Data Privacy Act of 2012" (Republic of the Philippines, 2012).

The survey via messenger was done to gather the data needed to address the objectives of the study. This was accomplished by using the guide questions. During the survey, the researcher/interviewer was expected to adhere to the protocols described or agreed upon by the researchers and the participants as described above. The survey was done individually among the participants to protect their identities and to respect their privacy and the confidentiality of the data that was disclosed. While conducting the survey, the researchers practiced epoch or bracketing techniques. This technique eliminated the judgment of the participants and set aside their own experiences and/or assumptions regarding the phenomena involved in the survey. The researchers tried to describe those experiences with a fresh perspective by treating those experiences as if for the first time (Stahl and King, 2020).

After the conduct of the survey, the form was retrieved and the data were collated. After collation of the data, these were analyzed using thematic analysis. Thematic analysis is a method for analyzing qualitative data that involves reading through a set of data and looking for patterns in the meaning of the data to find themes (Mortari, 2017; Mortari, 2019). Its detailed processes will be described in the data analysis part. Major themes and sub themes will be generated after the analysis and they will be presented in diagram or concept map form. The diagrams and concept maps are described in detail in the results part.

Upon finalizing the surveyed data, the findings of the study were shared to all participants of the study in a process called member checking. Member checking is a qualitative technique used to establish the tenet of credibility in trustworthiness (Candela, 2019). Credibility involves establishing the truth of the research study's findings to show that the findings are accurate and honest.

Data Analyses

The data taken from twenty participants using survey form were transcribed properly. The answers to the guide questions were noted carefully. The written data were read by the researchers several times for familiarization. Once the data were not understood, the authors clarified the participants' answers via chat messaging or video call through the participant's messenger account. The details of the conversation were strictly observed.

The written data were analyzed using thematic analysis. Thematic analysis is a method for analyzing qualitative data that involves reading through a set of data and looking for patterns in the meaning of the data to find themes (Nowell et al., 2017). It is an active process of reflexivity in which the researcher's subjective experience is at the center of making sense of the data (Braun and Clarke, 2022).

To make the analysis more prolific and meaningful, six steps in the thematic analysis were strictly followed. These steps include (1) familiarizing the data intensively, (2) generating the initial codes, (3) searching for the themes, (4) reviewing the themes, (5) defining and naming the themes, and (6) producing the report (Dawadi, 2020).

In the first step of the analysis, the researchers read and re-read the transcripts to make themselves familiar with the collected data. The written extracts were examined meticulously (Dawadi, 2020; Maguire and Delahunt, 2017).

In the second step, the researchers initially observed the pattern that captures something significant or interesting about the data and/or research question. Coding was done by highlighting sections of the text – usually phrases or sentences – and coming up with shorthand labels or "codes" to describe their content. In the extracts, the researchers made highlights in various phrases in different colors corresponding to the different codes. Each code described the idea expressed in this part of the text (Dawadi, 2020; Maguire and Delahunt, 2017).

In the third step, the researcher looked over the codes that were created, identified patterns among them, and started coming up with themes. In this stage, since themes were generally broader than codes, the researchers combined several codes into a single theme (Dawadi, 2020; Caulfield, 2022).

In the fourth stage, the preliminary themes made in step 3 were reviewed, modified, and developed to make these themes more sensible. The researchers gathered together all the data that are relevant to each theme (Dawadi, 2020; Caulfield, 2022).

In the fifth step, the researchers named and defined each of them. Defining themes involves formulating exactly what is meant by each theme and figuring out how it helps us understand the data while naming themes involves coming up with a succinct and easily understandable name for each theme (Dawadi, 2020; Caulfield, 2022).

In the last step, the researchers made a manuscript for the themes defined and named. In this step, the themes were elaborated for better understanding of the readers.

Ethical Considerations

The conduct of this study adheres to the major provisions on the rights of the students on data privacy as stipulated in Republic Act 10173 or also known as the Data Privacy Act of 2012. Informed consent was given to the respondents explaining that their participation is voluntary. The researchers discouraged the involvement of any form of intimidation, threat or coercion. Any approval provided by a participant with sound mind and decision, was considered as voluntary. In any case that the participants found the interview disconcerting, they were given a freedom to skip the question or to withdraw from the research without any consequence such as penalty or sanction. In the event that the participant wished to withdraw from the study given that the survey has already finished, the information provided by him/her was not utilized as part of the research findings. There was no monetary compensation or reimbursement provided for participating in this study. Participation in this study did not involve any form of remuneration.

Results and Discussions

Concepts or Principles Learned by BS Biology Students from Botany Lecture

Findings of the study showed that the main concepts or principles that BS Biology students learned from their general Botany lecture that are useful in understanding plant growth and development include molecular and cellular processes, physiological processes, plant reproductive and genetic processes, plant development, plant environmental, interaction and evolution, and uses of plants (Figure 1). The key concepts or principles under the theme, "molecular and cellular processes are cell division, chemiosmosis, oxidation-reduction reaction, and enzymatic reaction. The key concepts or principles under the theme, "physiological processes" are composed of hormonal regulation, photosynthesis, respiration, and water and nutrient intake. Under the theme, "plant reproductive and genetic processes" the key concepts or principles include the processes of fertilization, genetic variability, and pollination.

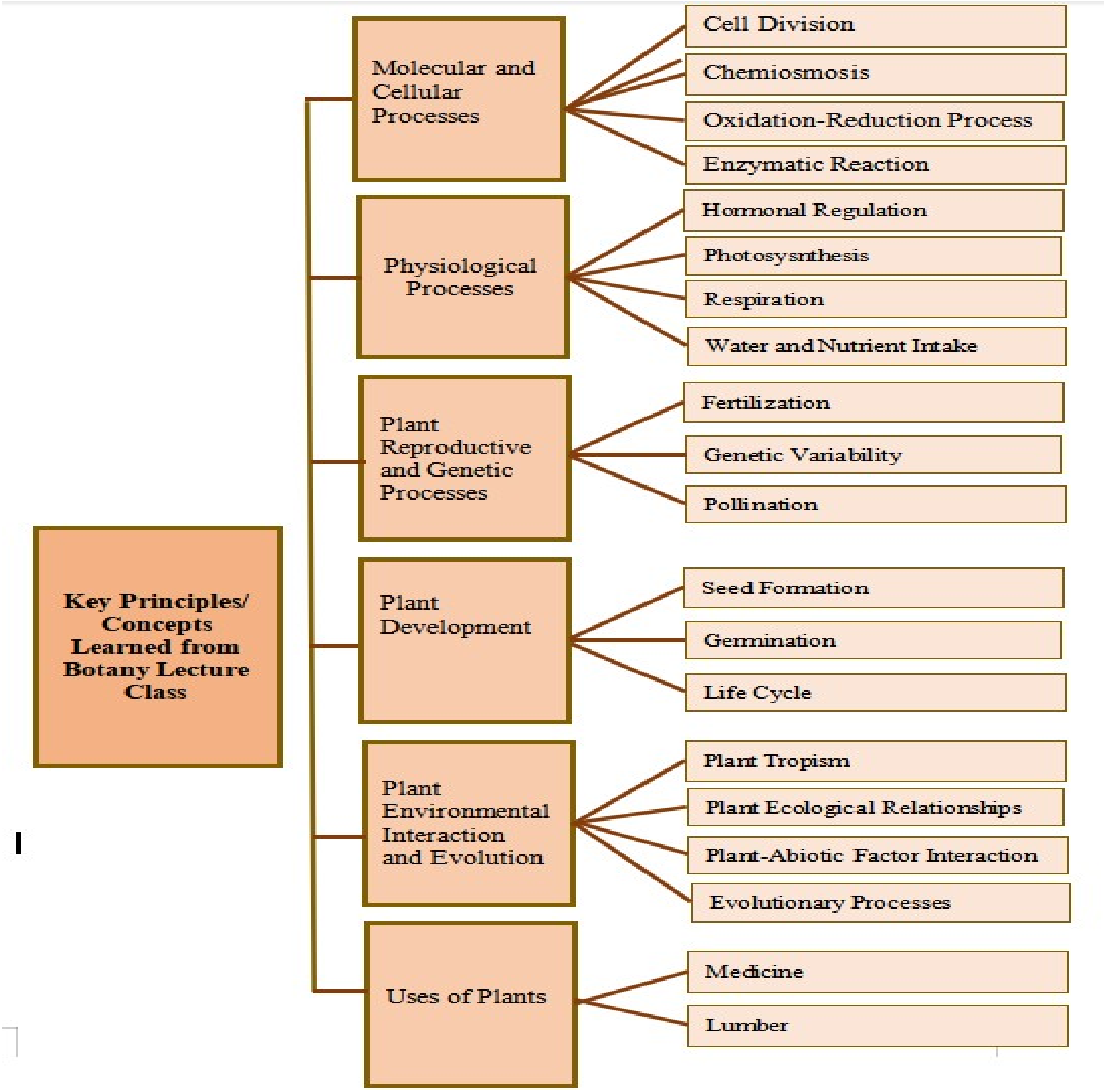

Figure 1. Key Concepts or Principles that BS Biology Students Learned from their General Botany Lecture that are Useful in Understanding Plant Growth and Development.

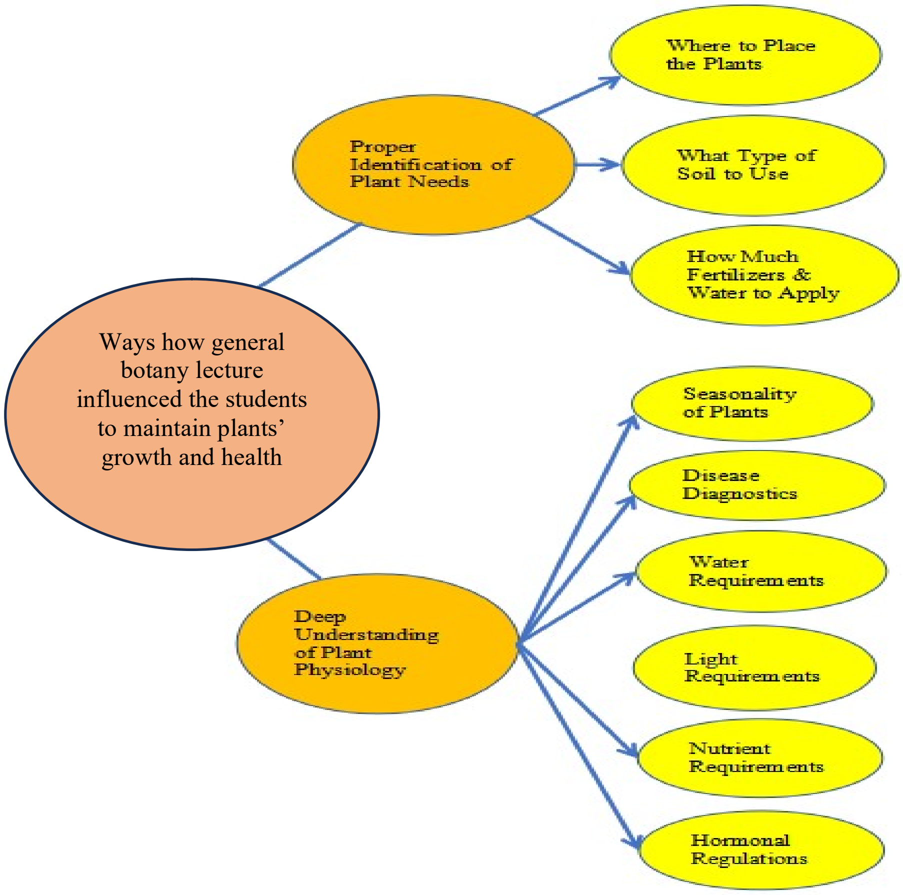

Figure 2. Ways how General Botany lecture influenced the students to maintain plants' growth and health

As far as the theme, "plant development" the key concepts or principles learned by the BS Biology students are composed of seed formation, germination, and life cycle. In terms of the theme, "plant environmental interaction and evolution" the key concepts or principles learned by the students include plant tropism, plant ecological relationships, plant-abiotic factor interaction, and evolutionary process. Finally, under the theme, "uses of plants" students were able to learn lumber and medicine.

Influence of the Knowledge Gained from General Botany Lecture to the Approaches in Maintaining the Growth and Health of their Plants

Results of the investigation (Figure 2) revealed that the specific ways on how the knowledge gained by the BS Biology students from general Botany lecture have influenced their approaches to maintain their plants' growth and health. There are two major themes generated which include proper identification of plant needs and deep understanding of plant physiology (Figure 2). Under the theme, "proper identification of plant needs", the following sub-themes were generated such as where to place the plants, what type of soil to use, and how much fertilizers and water to apply. For the theme, "deep understanding of plant physiology", the following sub-themes were identified such as seasonality of plants, disease diagnostics, water requirements, light requirements, nutrient requirements, and hormonal regulations.

Practical Skills Acquired by BS Biology Students During Botany Laboratory Sessions

The BS Biology students were able to acquire the practical skills during the General Botany laboratory sessions that have been valuable in their engagement with plants, particularly in the botanical garden setting. These skills include skills in taxonomy, plant maintenance, management of resources, landscape designing, socialization, proper use of gardening tools, laboratory reporting, and soil preparation and cultivation (Figure 3).

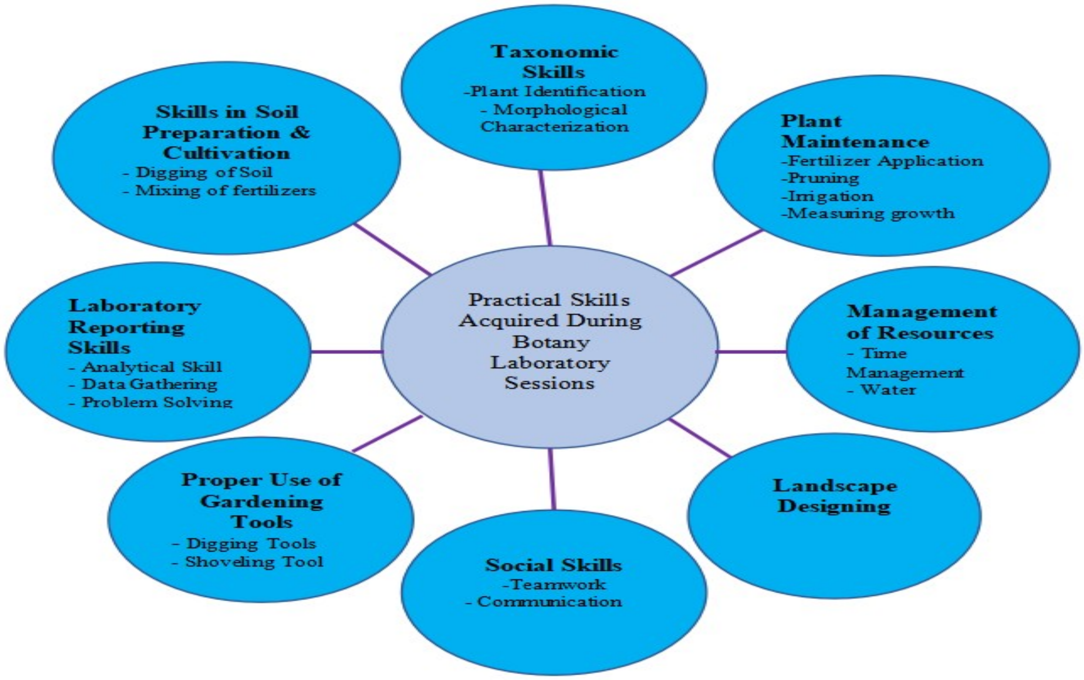

Figure 3. Practical Skills Acquired by BS Biology Students from General Botany Laboratory Sessions Have Been Valuable in their Engagement with Plants in the botanical garden setting.

Application of Botanical Skills for Ensuring Plant Health

Findings of the study depicted that the BS Biology students were able to apply their significant skills obtained from General Botany laboratory to ensure the good health of their plants in the botanical garden in the following aspects- assessing plant needs, controlling plant disease, creating good environment for plants, and monitoring and maintaining plant growth and development (Figure 4). Students were able to assess the plant needs by considering the plants' light needs, nutrients needs and water needs. BS Biology students were able to control the plant diseases by removal of the insects, pesticides application, and identification of disease symptoms.

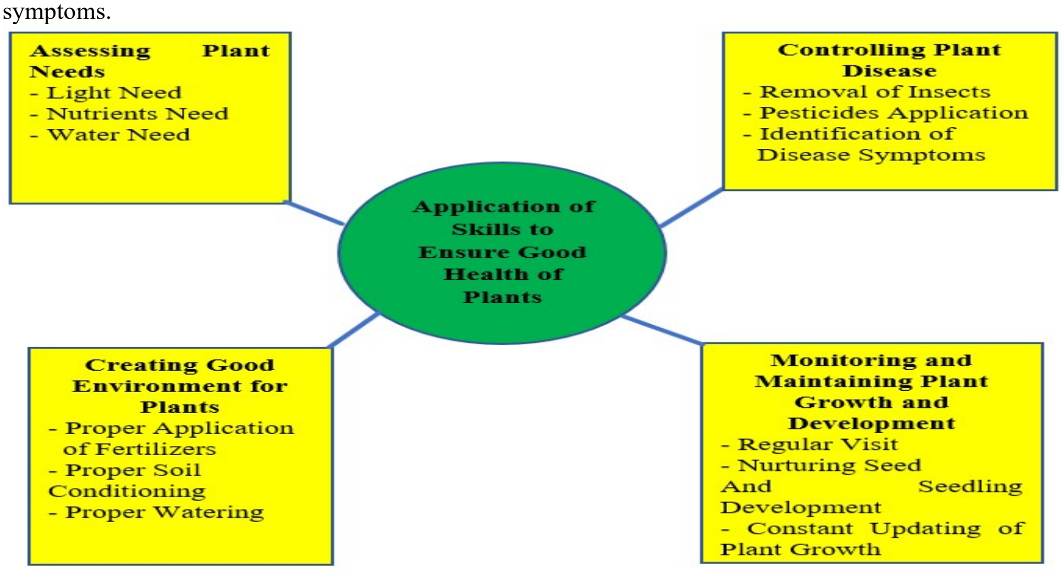

Figure 4. Application of the Significant Skills Obtained by BS Biology Students from General Botany Laboratory to Ensure the Good Health of their Plants in the Botanical Garden

BS Biology students had created good environment for plants by proper application of fertilizers, proper soil conditioning, and proper watering. These students could monitor and maintain plant growth and development by visiting the plants regularly, nurturing the seed and seedling development, and constant updating of plant growth.

Emotions Experienced by BS Biology Students During Plant Growth Deterioration

Findings of the study demonstrated the emotions experienced by the BS Biology students during their plant growth deterioration are divided into two types: positive and negative emotions (Table 1). Positive emotions are composed of calm, concerned, challenged, developed sense of responsibility, and optimism. Negative emotions include the feeling of anxiety, depression, disappointment, dissatisfaction, distraught, regrets, frustration and pessimism. Some students felt heart broken, mad, sad, upset, and worried. Other students tend to blame themselves for the negative fate of their plants.

Table 1. Two Types of Emotions Experienced by the BS Biology Students during Their Plant Growth Deterioration

Emotions During Plant Deterioration	
Positive	**Negative**
Calm Concerned Challenged Developed sense of responsibility Optimism	Anxiety Depressing Disappointed Dissatisfied Distraught Feeling of Regrets Frustrated Heart broken Mad Pessimism Sad Self-blaming Upset Worried

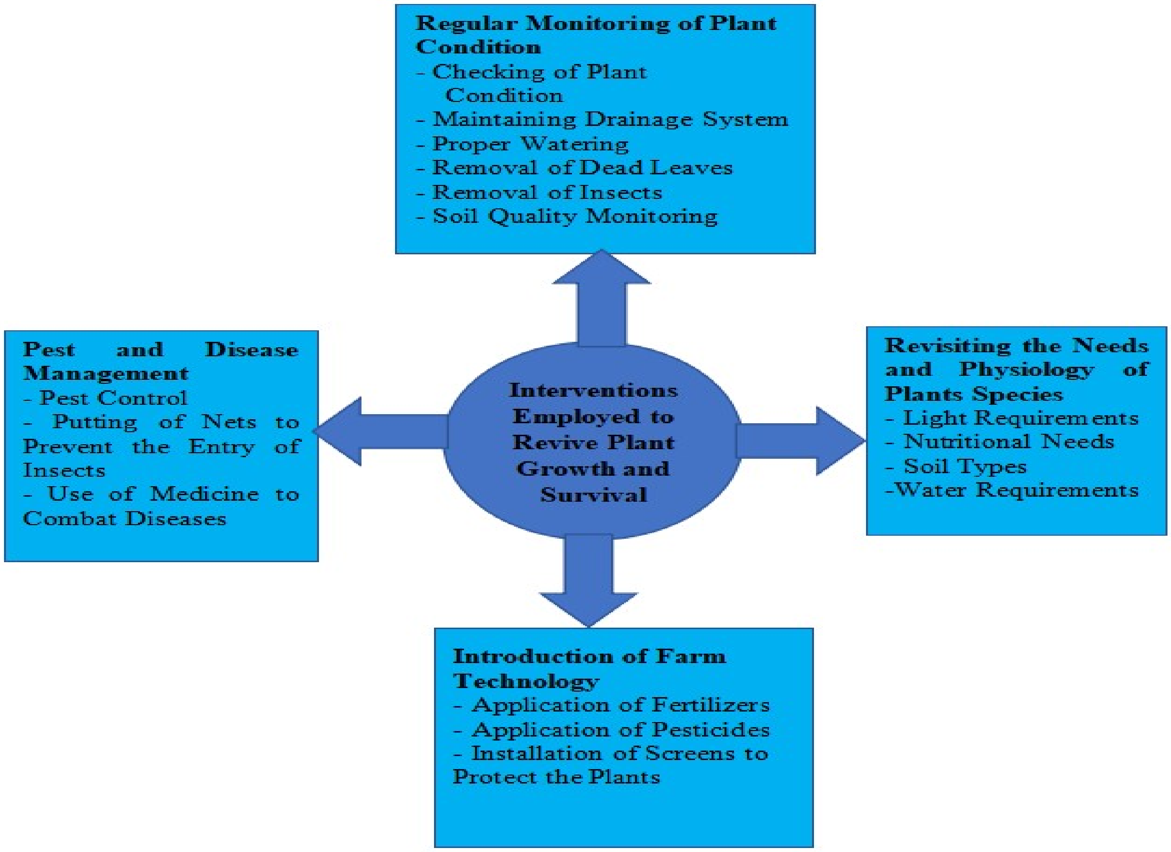

Figure 5. Strategies or Interventions Employed by BS Biology Students to Revive Plant Growth and Survival

Interventions Employed by BS Biology Student for Revival of Plant Growth and Survival

Outcome of the investigation revealed that the BS Biology students were able to employ strategies or interventions in order to revive the plant growth and survival. These strategies or interventions include regular monitoring of plant condition, pest and disease management, introduction of the farm technology, and revisiting the needs and physiology of plant species (Figure 5). Regular monitoring of plant condition includes checking of plant condition, maintaining drainage system, proper watering, removal of dead leaves, removal of insects, soil quality monitoring. Pest and disease management consists of pest control, putting of nets to prevent the entry of insects and use of medicine to combat diseases. Introduction of the farm technology includes application of fertilizers, application of pesticides, and installation of screens to protect the plants. Revisiting the needs and physiology of plant species are composed of reviewing the light requirements, nutritional needs, soil types, and water requirements.

Lessons Learned by BS Biology Students from Botanical Garden Engagement

The BS Biology students were able to gain important lessons from their engagement in botanical garden. These lessons include positive attitudes in planting, proper maintenance of plants, environmental concerns, understanding plant physiology, and productive social engagement (Figure 6).

BS Biology students' positive attitudes in planting include appreciation of nature, calmness in dealing with challenges, patience, persistence, perseverance, and resilience. Proper maintenance of the plants consists of taking good care of the plants and putting in the proper amount of fertilizers. Environmental concerns include biodiversity conservation, environmental protection, stewardship of nature and ecosystem interconnectedness. The sub-themes for the theme, "understanding of plant physiology" include habitat quality, demand for sunlight, nutritional need, and water requirement. Under the theme, "productive social engagement" students were able to develop cooperation, enjoyment in group activity, and teamwork.

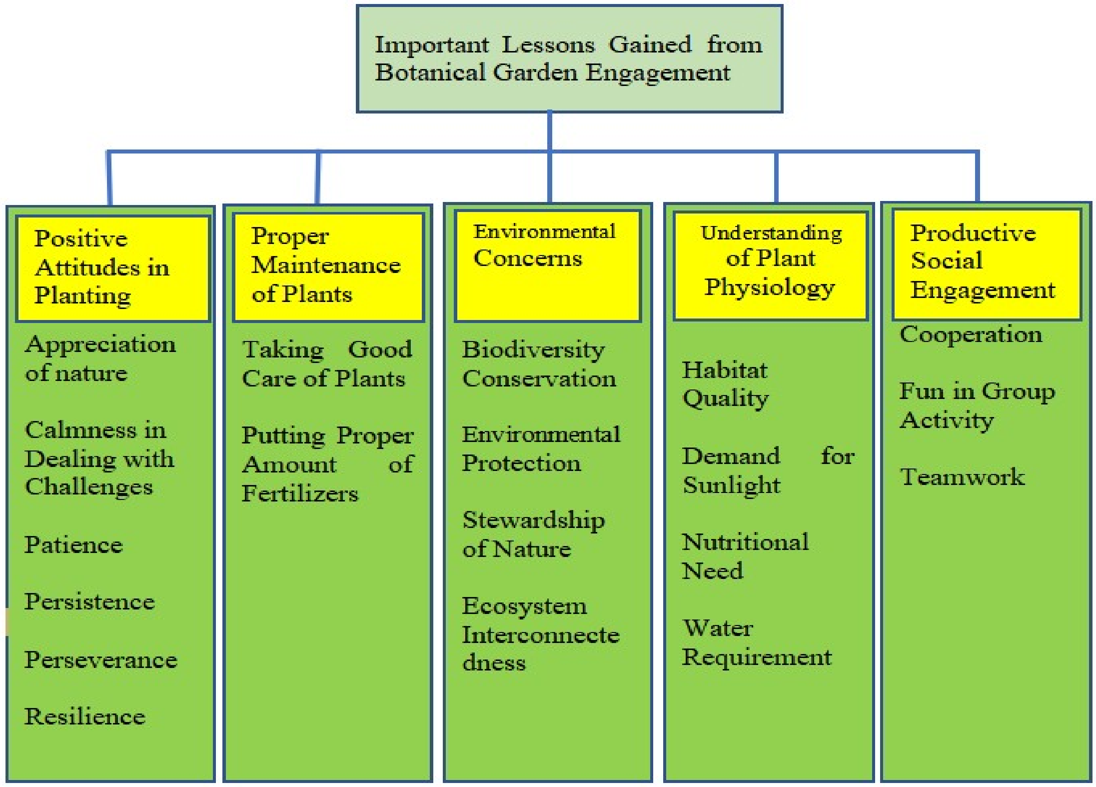

Figure 6. Important Lessons that BS Biology Students Gained from their Engagement with the Botanical Garden

BS Biology Students' Ways of Ensuring Long Term Health of Plants

Based from the important lessons acquired by BS Biology students during their botanical garden exposure, they were able to ensure that their plants would grow healthier over a longer period of time by proper checking and monitoring, routine maintenance, knowing plant physiology, performing horticultural practices, and developing teamwork and cooperation (Figure 7).

In the study, proper checking and monitoring are composed of disease monitoring, pest monitoring, and soil testing. Routine maintenance consists of the application of fertilizers, trimming of leaves, routine pruning, and watering of plants. Knowing plant physiology includes the sub themes such as need for sunlight, soil requirement, and water and nutrient requirements. Knowledge on horticultural practices include irrigation techniques, integrated pest management, management of plant diseases, and soil preparation strategies. Developing teamwork and cooperation are composed of sub themes sharing responsibilities, scheduling of tasks, and effective communication.

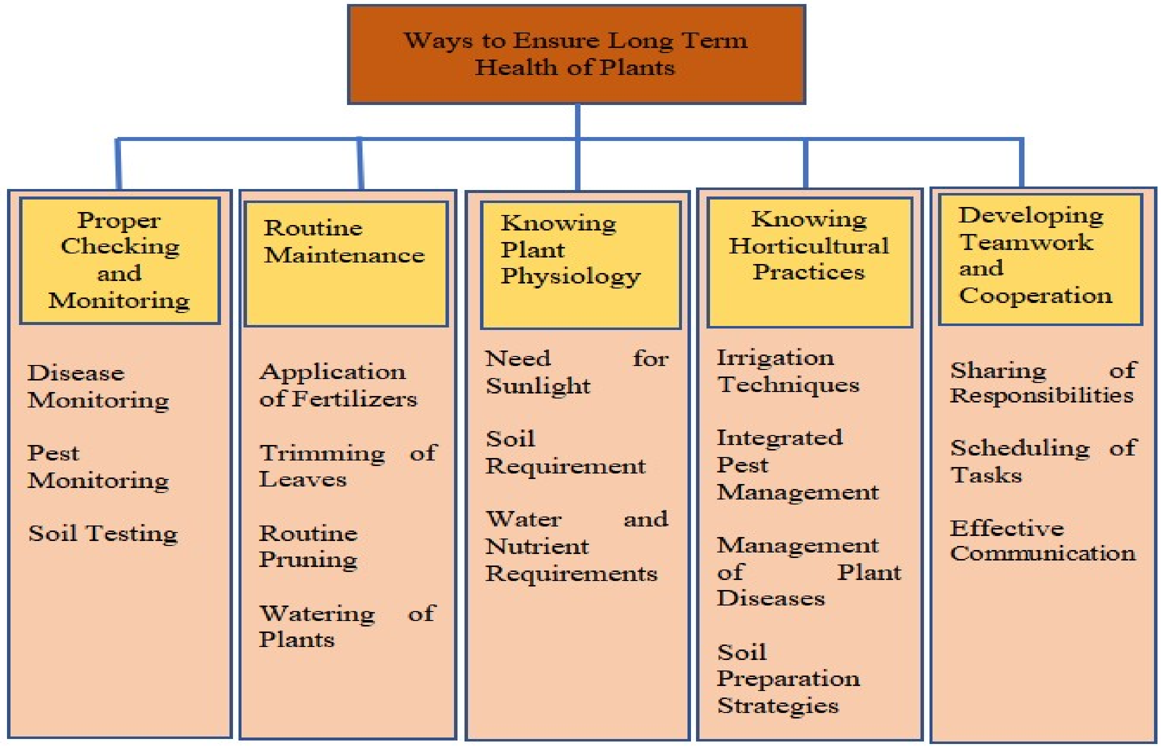

Figure 7. Ways Employed by BS Biology Students to Ensure Plants' Long-term Growth and Health

Discussions

The principles and concepts of experiential learning were evidently applied in the current study. BS Biology students were not only confined within the four walls of the lecture room for discussion of the topics found in the syllabus. Moreover, they were not only allowed to refer to the laboratory manual and textbooks for the detailed illustrations of the morphology and anatomy of the roots, stems, leaves, fruits, and flowers in the Botany class. The instructor went beyond what the classroom discussion and laboratory sessions could offer.

Experiential learning in Botany class at the Department of Life Sciences of College of Arts and Sciences, Central Philippine University has been manifested in the involvement of the BS Biology students in the University's Botanical Garden. Students in Botany class were allowed to prepare and condition soil, plant their favorite vegetables, flowering plants, and ornamental plants, and maintain these species of plants by watering them regularly, applying appropriate amounts of fertilizers on soil, and preventing the occurrence of diseases to the plants themselves by removing the parasites and implementing proper crop management practices. These skills can be allowed to flourish and sharpen once applied in botanical gardening. Their hands-on activities could provide them the opportunities to apply what they have learned from the lecture classes and laboratory sessions.

In the process of quest for effective pedagogic approaches in Biology education, experiential learning has been found as one of the best strategies to allow learners to maximize the acquisition of knowledge from the subject matter. It has been familiar to most educators that experiential learning is the process of learning by doing. By engaging students in hands-on experiences and reflection, they are better able to connect theories and knowledge learned in the classroom to real-world situations. As some educators said, most of the principles and theories taught in the classroom setting can be easily gone by the wind once they are not applied in the actual activities and practices.

When students participate in experiential education opportunities, they can obtain many benefits in contrast to the usual traditional lecture and discussion strategies. First and foremost, experiential learning can lead students to a better understanding of course materials. It was also found that a broader view of the world and an appreciation of community can take place among the students once experiential learning is applied. Through this type of learning insights of the students can be genuinely applied into their own skills, interests, passions, and values. Furthermore, this type of learning can provide opportunities to collaborate with diverse organizations and people. Moreover, positive professional practices and skill sets can be manifested among the students once they have beem allowed to perform things so that they can learn well. They are bodies of knowledge claiming that experiential learning can boost self-confidence and leadership skills of the students.

According to the recent development in the scholarly works on experiential learning, the majority of research articles about outdoor science education focused on informal or extraordinary educational contexts, such as single-day field trips once a year (Ayotte-Beaudet et al., 2017). In formal settings, many articles have focused on the main challenges of conducting science activities outdoors (Ayotte-Beaudet et al., 2023). Recently, an increasing number of articles have been publishing empirical research results on outdoor science learning initiatives at the K–12 level in schools' immediate surroundings like the scholarly works of King and Henderson et al 2018; Mygind et al., 2018. Limited studies are directly linked to the direct effects of experiential learning to biology education.

In spite of the limited studies of biology education and experiential learning, research in science education has increasingly documented the benefits of outdoor education for how students learn in school-based settings. Particular attention has been given to motivational dimensions, which have been recognized to increase academic achievement (Taylor et al., 2014). Recent articles have highlighted a link between outdoor education and positive achievement emotions (Fägerstam, 2014), higher levels of interest (Ayotte-Beaudet et al., 2019), and deeper engagement (Skinner and Chi, 2012). Some studies have even shown that outdoor science education can provide students with a sense of autonomy (Ayotte-Beaudet, et al., 2019; Dettweiler et al., 2017), which can encourage them to exhibit self-determined behaviors.

Recent research has also shown that outdoor science learning is often positively correlated with what or how much content knowledge students learn in school. In an integrative review, Kuo et al. (2019) showed that outdoor environments offer a 'supportive context for learning', especially when learning experiences in natural environments provide calmer contexts, enhance cooperative relations among students, and increase their autonomy during activities. Kuo et al. (2019) noted that the 'relationship between nature and learning holds up across different research designs and that early studies 'have begun comparing outcomes for nature-based instruction (NBI) versus traditional instruction (TI) showing that incorporating nature adds value to the instruction.

Remaining in the classroom to learn about nature may help students in their surface learning, but it may be insufficient 'to develop in-depth conceptual understanding' (James and Williams, 2017). Researchers suggest that outdoor environments offer concrete opportunities for students to learn about ecology topics that 'they cannot see or sense in other ways' (Hayes et al., 2017). To support using the outdoors, Giamellaro (2017) offers the expression 'learning in context', which means connecting the content to the context of use through direct experience. Giamellaro (2014) found a significant association between learning outcomes and learning in context during ecology classes. According to other researchers, outdoor places can also give students an opportunity to 'develop the ability to transfer science knowledge to different contexts' (Glackin, 2016) and make more fluid transitions when it comes to using scientific learning across contexts (Bellocchi et al., 2016). Fluid transitions, a metaphor used 'to describe students' toing and froing between concepts and context' (King and Henderson, 2018), are of particular importance in helping students better interpret the environments in which they live their daily lives.

Interesting to mention that not all the times the knowledge gained by the BS Biology students in General Botany lecture and skills acquired from the laboratory experiments could be converted into successful survival and growth of the plants. In some cases, negative emotions were experienced by the students (like anxiety and self-blaming) during plant deterioration. The occurrence of the productive failure has significant pedagogical implications. Productive failure serves as an eye opener to the botany teachers to not blame the students for the uncontrollable poor survival and health of the plants. They should help the students to investigate the factors which had potentially affected the poor health of the plants and assist them in how to revive the growth based on the principles of plant physiology and ecology. Teachers should teach the students to learn from their mistakes in planting and to gain lessons from their negative experiences so that they can deepen their learning process towards building resilience.

The results reveal that while BS Biology majors could utilize concepts learned in General Botany within the context of the botanical garden, such did not always lead to the plants' survival success, hence leading to productive failures along with feelings like anxiety and self-reproach during the plants' deterioration. With regards to Jean-Philippe Ayotte-Beaudet et al.'s findings in 2017, 2019, and 2023, the current study validates their claim that contextualized science learning is more engaging and leads to better conceptual understanding and situational interest but, at the same time, deviates in part from their conclusions in showing how such authentic contexts can also be sources of emotional stress for unsuccessful biological outcomes. In the same vein, while Michael P. Kuo et al. (2019) focus on the therapeutic psychological impacts of nature-based activities through their emphasis on restoration and stress reduction, the results of the current research somewhat challenge their assertions by suggesting that the stress levels of students engaged in nature-based learning settings are not necessarily decreased, since they might feel anxious and blame themselves for failing to control the growth of plants. However, both studies share the idea that exposure to nature triggers significant psychological responses.

The findings indicate that the BS Biology students were able to use several Botany lecture concepts related to molecular and cellular process, physiology, reproduction, plant development, and ecologic relationships in comprehending plant growth and development. Contrary to Kolb's theory, wherein the process involves a smooth progression from experiencing to reflecting and experimenting, the findings suggest that using the lecture concepts did not ensure the success of the plant growth process because interruptions occurred along the way as influenced by the realities of biology. Moreover, unlike the emphasis on productive learning through constant interaction with the environment in Dewey's Theory of Experience, the current findings demonstrate that interactions may produce unfavorable situations and emotions, which include feeling anxious and blaming oneself when the plants deteriorated. Therefore, it can be inferred that the results help develop further Kolb's and Dewey's Theories by demonstrating that while experiential and environmental learning greatly assist concept comprehension and application, the realities of botany bring about uncertainties and emotions that the theoretical foundations do not consider.

Conclusions and Recommendations

Considering the major results of the study, eight conclusions were made:

1. The main concepts or principles that BS Biology students learned from their general Botany lecture that have become useful in understanding plant growth and development are composed of molecular and cellular processes, physiological processes, plant reproductive and genetic processes, plant development, plant environmental, interaction and evolution, and uses of plants.
2. The specific ways on how the knowledge gained by BS Biology students from general Botany lecture have influenced the approach to maintain the growth and health of their plants include proper identification of plant needs and deep understanding of plant physiology.
3. The practical skills that the BS Biology students were able to acquire during the General Botany laboratory sessions have been valuable in their engagement with plants include skills in taxonomy, plant maintenance, management of resources, landscape designing, socialization, proper use of gardening tools, laboratory reporting, and soil preparation and cultivation.
4. The BS Biology students were able to apply their significant skills obtained from the General Botany laboratory to ensure the good health of their plants in the botanical garden in the following aspects- assessing plant needs, controlling plant disease, creating a good environment for plants, and monitoring and maintaining plant growth and development.
5. The BS Biology students were able to employ strategies or interventions in order to revive the plant growth and survival such as regular monitoring of plant condition, pest and disease management, introduction of farm technology, and revisiting the needs and physiology of plant species.
6. The emotions experienced by the BS Biology students during their plant growth deterioration are divided into two types: positive and negative emotions.
7. The BS Biology students were able to gain important lessons from their engagement in the botanical garden. These lessons include positive attitudes in planting, proper maintenance of plants, environmental concerns, understanding plant physiology, and productive social engagement.
8. Based on the important lessons acquired by BS Biology students during their botanical garden exposure, they were able to ensure that their plants would grow healthier over a longer period of time by proper checking and monitoring, routine maintenance, knowing plant physiology, performing horticultural practices, and developing teamwork and cooperation.

Given the conclusions of the study, the following recommendations are suggested in the future research endeavors.

1. The engagement of the Botany students in the botanical garden should be maximized so that they can appreciate the science of studying plants and the arts of planting. Field exposure can widen the perspectives of the students on plants and their interactions with the natural environment.
2. Before allowing the students to propagate various plant species in the botanical garden they should be properly taught with the different abiotic factors affecting the growth, survival, and development of the plants in the lecture component of the subject. It should be made clear to the students that how each plant species interacts with the abiotic factors in the environment is an essential part of their development.
3. Occurrence of the diseases is one of the major reasons for the deterioration of growth and is one of the causes of death of the plants. BS Biology students should be taught how to investigate the signs and symptoms of the diseases so that they can properly manage them.
4. Each university should maintain a botanical garden so that the instructors can maximize the learning opportunities for the students. Botanical gardens can be sources of the specimens for study in the laboratory setting.
5. The quantitative version of this study can be explored in future research activities.

6. Other aspects of botanical gardens which were not investigated here can also be explored in the next research endeavors.

References

Alase, A. (2017). The interpretative phenomenological analysis (IPA): A guide to a good qualitative research approach. *International Journal of Education and Literacy Studies, 5*(2), 9–19.

Ayotte-Beaudet, J. P., Chastenay, P., Beaudry, M. C., L'Heureux, K., Giamellaro, M., Smith, J., & Paquette, A. (2023). Exploring the impacts of contextualised outdoor science education on learning: The case of primary school students learning about ecosystem relationships. *Journal of Biological Education, 57*(2), 277–294.

Ayotte-Beaudet, J.P., Potvin, P., Lapierre, H. G., & Glackin, M. (2017). Teaching and learning science outdoors in schools' immediate surroundings at K–12 levels: A meta-synthesis. *EURASIA Journal of Mathematics, Science and Technology Education, 13*(9), 5343–5363. https://doi.org/10.12973/eurasia.2017.00833a

Ayotte-Beaudet, J.P., Potvin, P., & Riopel, M. (2019). Factors related to middle-school students' situational interest in science in outdoor lessons in their schools' immediate surroundings. *International Journal of Environmental and Science Education, 14*(1), 13–32.

Bacon, K. L. (2023). Investigating student experiences of botanical field work using a semi-immersive virtual botanical fieldtrip. *Journal of Biological Education*. Advance online publication.

Bekele, W. B., & Ago, F. Y. (2022). Sample size for interview in qualitative research in social sciences: A guide to novice researchers. *Research in Educational Policy and Management, 4*(1), 42–50.

Bellocchi, A., King, D. T., & Ritchie, S. M. (2016). Context-based assessment: Creating opportunities for resonance between classroom fields and societal fields. *International Journal of Science Education, 38*(8), 1304–1342. https://doi.org/10.1080/09500693.2016.1189107

Bennett, B. (2014). Learning in paradise: The role of botanic gardens in university education. In C. Quave (Ed.), *Innovative strategies for teaching in the plant sciences* (pp. xx–xx). Springer. https://doi.org/10.1007/978-1-4939-0422-8_13

Blackmore, S. (2017). The future role of botanical gardens. *Scientia Danica, Series B, Biologica, 6*, 285–297.

Botanical Garden. (2024). Retrieved June 28, 2024, from https://depts.washington.edu/open2100/pdf/2_OpenSpaceTypes/Open_Space_Types/botanical_gardens.pdf

Bertram, C., & Rehdanz, K. (2015). The role of urban green space for human well-being. *Ecological Economics, 120*, 139–152.

Boadu, G. (2021). Giving voice to teachers through interpretative phenomenological research: A methodological consideration. *Qualitative Research Journal, 21*(4), 408–423.

Bogenç, C. (2021). The role of environmental education in the development of nature awareness in individuals. *Journal of Humanities and Tourism Research, 11*(2), 408–419.

Braun, V., & Clarke, V. (2022). Conceptual and design thinking for thematic analysis. *Qualitative Psychology, 9*(1), 3–26.

Candela, A. (2019). Exploring the function of member checking. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2019.3726

Castillo, A. M. A., Aguirre, J. J. C., Borja, C. B., & Cruz, A. C. (2023a). Seismic-induced landslide hazard analysis of the recreational area of the Makiling Botanic Gardens, Los Baños, Laguna, Philippines.

Castillo, L., Castillo, M., Barua, L., Canceran, M., Guab, M. R., Caña, M., & Fernando, E. (2023b). Threatened Philippine plants in the Makiling Botanic Gardens: A preliminary assessment. *Ecosystems and Development Journal, 13*(1), 69–78.

Catahan, N., Hopwood, M., & Suraweera, P. (2024). Botanic garden tourism, social value, health, and well-being. *Journal of Zoological and Botanical Gardens, 5*(2), 187–199.

Cuadra, V. P., Verolo, M., & Cambi, V. (2024). Plant species in recreational spaces of initial education establishments of Bahía Blanca District (Buenos Aires, Argentina): Analysis of its diversity and educational role. *Boletín de la Sociedad Argentina de Botánica, 59*(2).

Caulfield, J. (2022). *How to do thematic analysis: Step-by-step guide & examples*. Retrieved July 2, 2024, from https://www.scribbr.com/methodology/thematic-analysis/

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). SAGE Publications.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. SAGE Publications.

Coppel, G., & Wüstemann, H. (2017). The impact of urban green space on health in Berlin, Germany: Empirical findings and implications for urban planning. *Landscape and Urban Planning, 167*, 410–418.

Dawadi, S. (2020). Thematic analysis approach: A step-by-step guide for ELT research practitioners. *Journal of NELTA, 25*(1–2), 62–71.

Dettweiler, U., Lauterbach, G., Becker, C., & Simon, P. (2017). A Bayesian mixed-methods analysis of basic psychological needs satisfaction through outdoor learning and its influence on motivational behavior in science class. *Frontiers in Psychology, 8*. https://doi.org/10.3389/fpsyg.2017.02235

Dewey, J. (1986). Experience and education. *The Educational Forum, 50*(3), 241–252.

Díaz-Meneses, G., & Amador-Marrero, M. (2024). Visitor experience at Viera y Clavijo Botanic Garden: Satisfaction and loyalty antecedents. *Journal of Outdoor Recreation and Tourism, 47*, 100778.

Fägerstam, E. (2014). High school teachers' experience of the educational potential of outdoor teaching and learning. *Journal of Adventure Education and Outdoor Learning, 14*(1), 56–81. https://doi.org/10.1080/14729679.2013.769887

Faraji, L., & Karimi, M. (2022). Botanical gardens as valuable resources in plant sciences. *Biodiversity and Conservation, 31*(12), 2905–2926.

Fleming, C. M., Manning, M., & Ambrey, C. L. (2016). Crime, greenspace and life satisfaction: An evaluation of the New Zealand experience. *Landscape and Urban Planning, 149*, 1–10.

Gao, C., & Weibang, S. (2018). The role of botanical gardens in scientific research, conservation, and citizen science. *Plant Diversity, 40*(4), 181–188. https://doi.org/10.1016/j.pld.2018.07.006

Giamellaro, M. (2017). Dewey's yardstick: Contextualization as a crosscutting measure of experience in education and learning. *SAGE Open, 7*(1), 1–11. https://doi.org/10.1177/2158244017700463

Gidlow, C. J., Jones, M. V., Hurst, G., Masterson, D., Clark-Carter, D., Tarvainen, M. P., & Nieuwenhuijsen, M. (2016). Where to put your best foot forward: Psycho-physiological responses to walking in natural and urban environments. *Journal of Environmental Psychology, 45*, 22–29.

Glackin, M. (2016). 'Risky fun' or 'authentic science'? How teachers' beliefs influence their practice during a professional development programme on outdoor learning. *International Journal of Science Education, 38*(3), 409–433. https://doi.org/10.1080/09500693.2016.1145368

Golding, J., Güsewell, S., Kreft, H., Kuzevanov, V. Y., Lehvävirta, S., Parmentier, I., & Pautasso, M. (2010). Species-richness patterns of the living collections of the world's botanic gardens: A matter of socio-economics? *Annals of Botany, 105*(5), 689–696. https://doi.org/10.1093/aob/mcq043

Greenupside. (2024). *What is a botanical garden? Why they're important*. Retrieved June 20, 2024, from https://greenupside.com/what-is-a-botanical-garden-why-theyre-important/

Gubo, V., & Schiffl, S. (2022). The development of students' interest in and knowledge of botany by means of a workshop on pollination and floral ecology. *International Journal of Research in Education and Science, 8*(2), 262–273. https://doi.org/10.46328/ijres.2220

Hardwick, K. A., Fiedler, P., Lee, L. C., Pavlik, B., Hobbs, R. J., Aronson, J., & Hopper, S. D. (2011). The role of botanic gardens in the science and practice of ecological restoration. *Conservation Biology, 25*(2), 265–275.

Hayes, M. L., Plumley, C. L., Smith, P. S., & Esch, R. K. (2017). A review of the research literature on teaching about interdependent relationships in ecosystems to elementary students.

Hodson, C. B., & Sander, H. A. (2017). Green urban landscapes and school-level academic performance. *Landscape and Urban Planning, 160*, 16–27.

Jabar, M. A., Jabar, S. A., & Jabar, M. S. A. (2024). Exploring visitors' satisfaction towards conservation activities at botanical gardens. *Gading Journal for Social Sciences*, 109–117.

James, J. K., & Williams, T. (2017). School-based experiential outdoor education: A neglected necessity. *Journal of Experiential Education, 40*(1), 58–71. https://doi.org/10.1177/1053825916676190

Jidesjö, A. (2008). Different content orientations in science and technology among primary and secondary boys and girls in Sweden: Implications for the transition from primary to secondary school. *Nordina, 4*(2), 192–208.

Josselson, R. (2013). *Interviewing for qualitative inquiry: A relational approach*. Guilford Press.

King, D., & Henderson, S. (2018). Context-based learning in the middle years: Achieving resonance between the real-world field and environmental science concepts. *International Journal of Science Education, 40*(10), 1221–1238. https://doi.org/10.1080/09500693.2018.1470352

Klimenko, M., Tarasovskaya, N., Khamzina, S., Zhumadilov, B., & Zhumabekova, B. (2023). Creating environment for students to make interdisciplinary competences in botany. In *E3S Web of Conferences* (Vol. 460, p. 05009). EDP Sciences.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT Press.

Kónya, E. P., & Táborská, J. (2023). The role of botanical gardens in education and plant conservation toward the new biodiversity and plant conservation strategy. In *Botanical gardens and their role in plant conservation* (pp. 107–119). CRC Press.

Koseoglu, P., Mercan, G., Gokbulut, Ö. Ö., & Pehlivanoglu, E. (2021). STRCT-inquiry-based science schools in nature: Effect on environmental awareness on preschool teachers and preschool children. *Kastamonu Eğitim Dergisi, 29*(3), 54–69.

Kuo, M., Barnes, M., & Jordan, C. (2019). Do experiences with nature promote learning? Converging evidence of a cause-and-effect relationship. *Frontiers in Psychology, 10*, 305. https://doi.org/10.3389/fpsyg.2019.00305

Lekhak, M. M., & Yadav, S. R. (2024). Botanical gardens and their role in education, research, conservation, and bioprospecting of plant diversity: Lead Botanical Garden (LBG), Shivaji University, Kolhapur—A case study. In *Botanical gardens and their role in plant conservation* (pp. 149–171). CRC Press.

Li, Y., Li, S., & Wang, C. (2022). Spatiotemporal evolution of Chinese botanical gardens over the last 5000 years. *Sustainability, 14*(23), 15806. https://doi.org/10.3390/su142315806

Maguire, M., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *AISHE-J, 3*(3), 33501–33513.

Mortari, L. (2017). Reflectivity in research practice: An overview of different perspectives. *International Journal of Qualitative Methods, 15*(5), 1–9.

Marbach-Ad, G. (2004). Expectations and difficulties of first-year college students in biology. *Journal of College Science Teaching, 33*, 18–23.

Miller, A. J., Novy, A., Glover, J., Kellogg, E. A., Maul, J. E., Raven, P., & Jackson, P. W. (2015). Expanding the role of botanical gardens in the future of food. *Nature Plants, 1*(6), 1–4.

Mortari, L. (2019). Writing reflections: A phenomenological approach. *International Journal of University Teaching and Faculty Development, 4*(4), 205–221.

Moskwa, E. C., & Crilley, G. (2012). Recreation, education, conservation: The multiple roles of botanical gardens in Australia. *Annals of Leisure Research, 15*(4), 404–421. https://doi.org/10.1080/11745398.2012.744276

Mu, L. (2022). *The botanical gardens that changes the world*. Retrieved from http://www.forestry.gov.cn/main/5462/20220330/101825785363086.html

Mygind, E., Bølling, M., & Barfod, K. S. (2018). Primary teachers' experiences with weekly education outside the classroom during a year. *Education 3–13, 47*(5), 599–611. https://doi.org/10.1080/03004279.2018.1513544

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods, 16*, 1–13.

O'Donnell, K., & Sharrock, S. (2017). The contribution of botanic gardens to ex situ conservation through seed banking. *Plant Diversity, 39*(6), 373–378. https://doi.org/10.1016/j.pld.2017.11.005

Oruç, N. E., & Çahantimur, A. I. (2024). Beyond a garden: Alignment of sustainable development goals with botanic gardens. *Environmental Science & Policy, 152*, 103639.

Pany, P. (2014). Students' interest in useful plants: A potential key to counteract plant blindness. *Plant Science Bulletin, 60*(1), 18–27.

Ren, H., Wen, X., Liao, J., Zheng, X., Yang, M., & Zhou, J. (2022). The view on functional changes of botanical gardens and the establishment of China's national botanical garden system. *Biodiversity Science, 30*(4), 22113.

Republic of the Philippines. (2012). *Republic Act No. 10173: Data Privacy Act of 2012*. Official Gazette of the Republic of the Philippines.

Sachs, N. A., Rakow, D. A., Shepley, M. M., & Peditto, K. (2020). The potential correlation between nature engagement in middle childhood years and college undergraduates' nature engagement, proenvironmental attitudes, and stress. *Frontiers in Psychology, 11*, 2919.

Sagor, I. (2017). *Jardin botanique de Montreal (Montreal Botanical Garden) in Canada*. Retrieved from https://steemit.com/travel/@sagor24/jardin-botanique-de-montreal-montreal-botanical-garden-in-canada

SANBI Biodiversity for Life. (2024). *Kirstenbosch awarded level 4 accreditation by ArbNet accreditation programme*. Retrieved from https://www.sanbi.org/media/kirstenbosch-awarded-level-4-accreditation-by-arbnet-accreditation-programme/

Sanders, D. L., Ryken, A. E., & Stewart, K. (2018). Navigating nature, culture and education in contemporary botanic gardens. *Environmental Education Research, 24*(8), 1077–1084. https://doi.org/10.1080/13504622.2018.1477122

Sarkar, C., & Webster, C. (2017). Urban environments and human health: Current trends and future directions. *Current Opinion in Environmental Sustainability, 25*, 33–44.

Skinner, E. A., Chi, U., & The Learning-Gardens Educational Assessment Group. (2012). Intrinsic motivation and engagement as "active ingredients" in garden-based education: Examining models and measures derived from self-determination theory. *The Journal of Environmental Education, 43*(1), 16–36. https://doi.org/10.1080/00958964.2011.596856

Stahl, N., & King, J. (2020). Expanding approaches for research: Understanding and using trustworthiness in qualitative research. *Journal of Developmental Education, 44*(1), 26–28.

Stanja, J., Gritz, W., Krugel, J., Hoppe, A., & Dannemann, S. (2023). Formative assessment strategies for students' conceptions—The potential of learning analytics. *British Journal of Educational Technology, 54*(1), 58–75.

Thomas, F. B. (2022). The role of purposive sampling technique as a tool for informal choices in social sciences in research methods. *Just Agriculture, 2*(5), 1–8.

Timeout. (2024). *The 13 best botanical gardens in the world*. Retrieved from https://www.timeout.com/things-to-do/best-botanical-gardens-in-the-world

Taylor, G., Jungert, T., Mageau, G. A., Schattke, K., Dedic, H., Rosenfield, S., & Koestner, R. (2014). A self-determination theory approach to predicting school achievement over time: The unique role of intrinsic motivation. *Contemporary Educational Psychology, 39*(4), 342–358. https://doi.org/10.1016/j.cedpsych.2014.08.002

Unacademy. (2024). *Features of a good botanical garden*. Retrieved June 30, 2024, from https://unacademy.com/content/neet-ug/study-material/biology/features-of-a-good-botanical-garden/

Uno, G. E. (2009). Botanical literacy: What and how should students learn about plants? *American Journal of Botany, 96*, 1753–1759. https://doi.org/10.3732/ajb.0900025

Vujcic, M., Tomicevic-Dubljevic, J., Grbic, M., Lecic-Tosevski, D., Vukovic, O., & Toskovic, O. (2017). Nature-based solution for improving mental health and well-being in urban areas. *Environmental Research, 158*, 385–392.

Washburn, C. E. (2024). Conservation of water resources in a botanic garden. *Journal of Zoological and Botanical Gardens, 5*(2), 131–142.

Xie, Y., Jiao, Y., Shi, L., Liu, D., Liu, Y., Tang, Z., & Ma, Y. (2024). A study on the influencing factors of mental health of Chinese garden workers: A cross-sectional study. *BMC Public Health, 24*(1), 765.

Yorek, N., Sahin, M., & Aydin, H. (2009). Are animals "more alive" than plants? Animistic-anthropocentric construction of life concept. *Eurasia Journal of Mathematics, Science and Technology Education, 5*(4), 369–378.

Yilmaz, S. (2022). Effects of visual environment on students' adjustment to stress. *ICONARP International Journal of Architecture and Planning, 10*(1), 43–69.