Cognitive Dimension of Learning Using Garden-Based Education towards Sustainability: A Meta-Synthesis

Jennifer D. Paño¹, Jeralden R. Jumao-as², and Marchee T. Picardal³*

¹,²,³Cebu Normal University, Cebu City, Philippines
¹https://orcid.org/0000-0001-6739-6386, ²https://orcid.org/0000-0002-0775-6519,
³https://orcid.org/0000-0002-7257-6776
*Email Correspondence: picardalm@cnu.edu.ph

Abstract

Garden-based education (GBE) is an innovative approach to enhancing learners’ academic performance. However, the mechanism of how it develops the cognitive domain of learning is unclear. This meta-synthesis of 22 published articles focusing on garden-based education integration in the educative process examined its impact on mental aspects of learning. Secondary data from each reviewed article were extracted and analyzed thematically. Five themes emerged describing the impact of GBE on the cognitive domain of learning, namely, 1) experiential learning, 2) meaningful learning, 3) explicit and implicit learning, 4) discovery learning, and 5) transmissible learning. GBE is a successful program in most of the basic education curriculum integration contributing to the improvement of academic performance. Albeit, there is no standard template for its implementation as it varies across context and educational system, adopting the general principle of school garden learning in the teaching and learning process is beneficial for sustainable learning outcomes.

Keywords: Garden-based education, curricular integration, Education for Sustainable Development (ESD), Meta-synthesis

1.0 Introduction

Garden-based education (GBE) is an innovative strategy to nurture the cognitive dimension of learning for sustainability. It highlights hands-on learning through plant cultivation and management. It is among the most effective ways to help learners achieve their development and connection with nature (Kim et al., 2020). The increasing interest in plants and gardening occurred at the onset of the pandemic, eventually coined the “plantdemic”. The global health crisis increased the demand for greenery among Filipinos to overcome stress and relieve the impacts of lockdown. This trend of using learning gardens strengthens experiential learning with nature and connects learners to the most challenging societal problem such as climate change or environmental-related issues (Dunkley, 2016). GBE promotes botanical literacies among early childhood students (Beasley et al., 2021). One of the intended outcomes of this experiential learning is the improved academic performance of secondary students with challenging behaviors (Ruiz-Gallardo et al., 2013) and promoting greater interest and participation among students (Burt et al., 2018) in general. At the tertiary level, Eugenio-Gozalbo, Aragon, and Ortega-Cubero (2020) examined the integration of GBE in Spain as part of the innovative learning context for Teacher Training Institutions. They concluded that GBE improved student learning outcomes. Similarly,
Eugenio-Gozalbo, Pérez-López, and Tójar-Hurtado (2020) affirmed positive science learning from basic education to the university stages. Cognizant of the role of GBE as a valuable educational resource offering cognitive benefits in most countries that integrated GBE into the basic education curriculum (Bailey & Falk, 2016; Cheang et al., 2017; Cross & Kahn, 2018; Fifolt & Morgan, 2019; Lehnerd et al., 2019; McMillen et al., 2019), synthesizing these articles offers insights on how this program can serve as a basis for the integration of GBE into the curriculum.

In the Philippine context, a DepEd Memorandum 293, Series of 2007 mandates the establishment of “Gulayan sa Paaralan Program” or school garden in public elementary and secondary schools nationwide to address malnutrition, food security, and promote healthy consumption of fruits and vegetables. Unfortunately, there is a paucity of data as to how this program is translated into the formal curriculum neither its integration into the discipline-based lessons such as science, mathematics, and the likes. Thus, the necessity of having GBE become a part of a larger educational plan/program or garden curriculum and the need to equip future teachers with gardening skills is deemed necessary. To support such a call for reform, there has to be evidence on how such integration promotes the cognitive domain of learning. This meta-synthesis intends to add depth and meaning to the results and interpretation of several studies (Brion & Cordeiro, 2018; Kim et al., 2020) examining the integration of GBE in different parts of the world.

Moreover, it has been a dominant observation among school garden programs that they concentrate more on improving learners’ behaviour and knowledge towards food, inadvertently missing other opportunities to support learners’ development (Murukami et al., 2017). Considering that gardening is part of the basic education program, teachers are expected to possess the knowledge and skills to teach it to the learners. However, several studies revealed that teachers participating in this school-garden learning lacked the technical knowledge to design effective learning activities using the school garden (Burt et al., 2018; Laaksoharju et al., 2012). This scenario necessitates the need to gather empirical evidence from current literature on the extent and benefits of implementation of GBE in the curriculum, at least at the cognitive level, to make an informed recommendation on possible curricular enhancement across educational levels.

2.0 Methods

Research Design

This study employed meta-synthesis for qualitative study. It is the systematic review and integration of findings from qualitative studies of a particular phenomenon of interest (Chrastina, 2018). The protocol adheres to the Combined Model containing the seven meta-synthetic stages by Chrastina (2018) as follows:

Step 1. - Deciding the phenomenon of interest
- This meta-synthesis contributed to the present state of knowledge by filling a research gap and developing a conceptual model for Garden-based education.

Step 2. Deciding what is relevant- A combination of narrow and large comprehensive search strategies was employed using numerous databases and meta-search engines. The manuscripts were obtained via reputable academic electronic repositories using several search engines such as Crossreference, Scopus, ScienceDirect, JSTOR, Google Scholar, ERIC, Pro-Quest, Research Gate, and Gale Academy. Hand searching was also used for Google Scholar and Research Gate to check on the abstract and possible retrieval of the full text. The following information for inclusion (e.g., the context of the investigation, the availability of full papers, and the total number of papers) was decided through data saturation. Keywords search used Boolean operators for four different clusters
of keywords, along with inclusion and exclusion criteria. There was no limit on how many studies might be included in order to make the results as saturated and transferable as feasible.

Step 3. Careful reading and re-reading - repeated reading of each journal was done to explore whether the inclusion and exclusion criteria were met and to assess the methodological and significant strengths and weaknesses. Key concepts were extracted from various journals to extract fundamental knowledge and compare their findings to establish a common understanding of GBE. Second-order constructs were recognized as the original writers’ primary themes, whereas first-order constructs were identified as the individual participants’ quotes. The master themes are the third-order constructions, and they represent the researchers’ perspective.

Step 4. Determining the relatedness of the study - Once themes have been established and organized, a rigorous process of searching for connections between them took place. Thematic analysis approach by Braun and Clarke (2006) was then applied (Figure 1). Identification of qualified research journals was based on the Critical Appraisal Skills Programme (CASP) checklist using a three-point scale (Lachal et al., 2017).

Figure 1. Thematic Analysis approach

The two authors used the Atlas.ti v7.0 software to conduct data analyses as suggested by Friese (2015). Data were then coded in the first stage, the descriptive phase, grouping the text into topic categories and allowing researchers to evaluate each statement independently and assess the possible contributions to the data meanings (Miles et al., 2014).

Open coding has been used, which entailed searching for content categories that had already been determined to be appropriate for the purpose of this research (Cohen et al., 2011). Inductive methods are common in qualitative research that gathers data to "rebuild" reality as depicted by the actors in a given social system. Researchers concurred on the concept of first-order codes (subcategories) and subsequently grouped them into a smaller number of second-constructs (categories). Finally, five categories emerged based on their numeric representation and substantial meaning for further analysis.

Relationships between individual themes were sought in the second stage, the interpretative phase, because they allow signals of contextual factors to be revealed and aid in understanding of the Garden-based education (Contreras, 2011). As a result, co-occurrence analyses were carried out on the five categories chosen, revealing the relationships between categories and subcategories. The relationships with the highest number of co-occurrences were deemed the most representative and were chosen to be displayed using explanatory visuals, as is customary (Miles et al., 2014).

Step 5. Translating studies into one another - the careful analysis of the themes employed the synthesis of argument lines wherein research identified several parts of an issue that can be combined into a new interpretation.

Step 6. Synthesizing the translation - In order to construct a conceptual model of the phenomena, all the themes that came up with the line of argument (synthesis) reflecting the entire category were mapped together.
Step 7. Communicating the results through publication.

Inclusion criteria: (1) the research design is qualitative; (2) the journal is academic and peer-reviewed; (3) the article is about garden-based education and its setting and/or similar experiences; (4) the study used primary data; (5) The study’s authors used a specified sample/ sampling; (6) qualitative data was collected using some well-known qualitative method(s); and (7) the paper was written in English.

Exclusion criteria: (1) studies with no research design and an entirely conceptual or theoretical background; (2) studies that use a quantitative method (quantitative-based research analysis); (3) studies that use closed-ended survey questions as the data collection tool; (4) qualitative data that is not organized into themes or study findings that do not reflect the GBE experience; (5) Mixed-method research in which qualitative and quantitative data could not be separated; and (6) qualitative studies on GBE that examines the effect or impact to the larger community or society as this study aimed to focus at the school level implementation only.

Search Result

There were eight search engines utilized in this study that were either through database search or through hand search (Figure 1). The original number of articles was 181,272; however, titles were vetted for the inclusion of terms in the search parameters, and this resulted to 476. The duplicated studies were deleted through continuous examination, resulting in 355. The abstracts of each publication were reviewed for the key points sought in this study, decreasing the number of journals to 194. All qualified abstracts were then examined to see if the entire manuscript was available in English, yielding to 177 journals. Each article’s methodology must be accurate and rigorous, to be qualified; this resulted in 35 studies. Finally, journals were evaluated using a three-point scale on the Critical Appraisal Skills Programme (CASP) checklist, yielding 20 qualified journals (Lachal et al, 2017).

Figure 2. PRISMA Flow Diagram for selecting studies
3.0 Results and Discussion

The breakdown of the origins of the 20 studies included research journal publications from Asia (3), North America (14), Africa (1), and Europe (2), sourced from eight search engines. This meta-synthesis yielded five (5) key themes describing the cognitive skills learned by the students using garden-based learning. Table 1 provides an overview and characterization of the final themes.

For co-occurrence analysis, first-order codes were grouped together to their respective categories taking into consideration their quantitative weight (number of quotes) and contribution to the study goals. There were a total of 292 quotes or text fragments categorized as units, with 22 subcategories. Table 2 shows the reorganized subcategories.

Table 1. Summary Table of First-order codes and quotation count

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Author of the Paper</th>
<th>First-order Codes (subcategories)</th>
<th>Quotation Count</th>
</tr>
</thead>
</table>
| 2          | (Laaksoharju et al., 2012) | Learning Work ethics  
Equality in the share of harvest  
Fun-play relationship  
Ability to read the environment  
Solve problems together | 7               |
| 3          | (Kangas et al., 2014) | Individual and Mutual Accountability  
Ownership of Learning  
Equality in the share of harvest  
Shared responsibility  
understanding of content knowledge  
Solve problems together  
Transmissible learning  
Connects Content and Context  
Learning Work ethics  
Meaningful engagements | 23              |
| 5          | (Kim et al., 2020) | Multi-sensory engagement  
Meaningful engagements  
Ownership of Learning  
Solve problems together  
Connects Content and Context  
Ability to read the environment  
Garden as site for inquisitiveness  
Tested knowledge of seed growing and transplanting  
Learning Work ethics  
Fun-play relationship | 20              |
| 6          | (Eugenio-Gozalbo, Aragon, & Ortega-Cubero, 2020) | Food-systems knowledge  
Agro-ecological experiences  
Connects Content and Context  
Transformational education  
Individual and Mutual Accountability  
Shared responsibility  
Solve problems together  
Learning Work ethics  
Transmissible learning | 21              |

Continued on next page
Table 1. Summary Table of First-order codes and quotation count (Continued)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Author of the Paper</th>
<th>First-order Codes (subcategories)</th>
<th>Quotation Count</th>
</tr>
</thead>
</table>
| 7          | (Cramer et al., 2019) | Agro-ecological experiences  
Food-systems knowledge  
Fun-play relationship  
Garden as site for inquisitiveness  
Transformational education  
Transmissible learning  
Learning Work ethics  
Connects Content and Context  
Understanding of content knowledge  
Ability to read the environment  
Meaningful engagements | 35              |
| 8          | (Greer et al., 2019)  | Tested knowledge of seed growing and transplanting  
Agro-ecological experiences  
Fun-play relationship  
Garden as site for inquisitiveness  
Equality in the share of harvest  
Connects Content and Context  
Transformational education  
Food-systems knowledge  
Transmissible learning  
Community-building  
Complex level of Comprehension  
Understanding of content knowledge | 25              |
| 9          | (Murakami et al., 2017) | Meaningful engagements  
Multi-sensory engagement  
Community-building  
Ability to read the environment  
Garden as site for inquisitiveness  
Transmissible learning  
Fun-play relationship  
Agro-ecological experiences  
Connects Content and Context  
Understanding of content knowledge | 22              |
| 10         | (Cheang et al., 2017)  | Agro-ecological experiences  
Ability to read the environment  
Transformational education  
Garden as site for inquisitiveness  | 12              |
| 11         | (Schneller et al., 2015) | Connects Content and Context  
Ability to read the environment  
Transformational education  
Transmissible learning  
Meaningful engagements  
Food-systems knowledge  
Garden as site for inquisitiveness  
Collateral learning | 26              |
| 12         | (Cross & Kahn, 2018)   | Ability to read the environment  
Agro-ecological experiences | 2               |

Continued on next page
### Table 1. Summary Table of First-order codes and quotation count (Continued)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Author of the Paper</th>
<th>First-order Codes (subcategories)</th>
<th>Quotation Count</th>
</tr>
</thead>
</table>
| 13         | (McMillen et al., 2019) | Ability to read the environment  
                      Tested knowledge of seed growing and transplanting  
                      Agro-ecological experiences  
                      Shared responsibility  
                      Complex level of Comprehension  
                      Food-systems knowledge  
                      Learning Work ethics  
                      Fun-play relationship | 14               |
| 14         | (Christodoulou & Korfiatis, 2018) | Transformational education  
                      Solve problems together  
                      Community-building  
                      Fun-play relationship  
                      Agro-ecological experiences  
                      Ability to read the environment  
                      Food-systems knowledge  
                      Transmissible learning | 8                |
| 15         | (Bailey & Falk, 2016) | Agro-ecological experiences  
                      Ability to read the environment  
                      Tested knowledge of seed growing and transplanting  
                      Community-building | 8                |
| 16         | (Davis & Brann, 2017) | Food-systems knowledge  
                      Agro-ecological experiences  
                      Connects Content and Context  
                      Transformational education | 8                |
| 17         | (Dickey et al., 2020) | Agro-ecological experiences  
                      Community-building  
                      Transmissible learning  
                      Transformational education | 7                |
| 18         | (Carlsson et al., 2016) | Agro-ecological experiences  
                      Food-systems knowledge  
                      Transformational education  
                      Complex level of Comprehension  
                      Garden as site for inquisitiveness  
                      Community-building | 9                |
| 31         | (Rich & Ardoin, 2014) | Agro-ecological experiences  
                      Transmissible learning  
                      Complex level of Comprehension  
                      Connects Content and Context  
                      Ability to read the environment  
                      Garden as site for inquisitiveness  
                      Transformational education  
                      Shared responsibility  
                      Food-systems knowledge | 18               |
| 32         | (Jorgenson, 2013) | Complex level of comprehension  
                      Ability to read the environment  
                      Garden as site for inquisitiveness | 8                |

*Continued on next page*
Table 1. Summary Table of First-order codes and quotation count (Continued)

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Author of the Paper</th>
<th>First-order Codes (subcategories)</th>
<th>Quotation Count</th>
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</thead>
<tbody>
<tr>
<td>33</td>
<td>(Jones et al., 2012)</td>
<td>Meaningful engagements, Connects Content and Context, Agro-ecological experiences, Transformational education, Individual and Mutual Accountability, Complex level of Comprehension, Transmissible learning, Ownership of Learning</td>
<td>16</td>
</tr>
<tr>
<td>34</td>
<td>(Acharya, 2019)</td>
<td>Garden as site for inquisitiveness, Fun-play relationship</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Quotes 292

Table 2. List of Themes, sub-themes, and number of codes

<table>
<thead>
<tr>
<th>Categories/ Sub-themes</th>
<th>Grounded Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theme 1: Experiential Learning</strong></td>
<td></td>
</tr>
<tr>
<td>1. Concrete idea of the lesson</td>
<td>11</td>
</tr>
<tr>
<td>2. Complex level of Comprehension</td>
<td>8</td>
</tr>
<tr>
<td>3. Active engagement in problem solving</td>
<td>9</td>
</tr>
<tr>
<td>4. Support learning on nature</td>
<td>6</td>
</tr>
<tr>
<td><strong>Theme 2: Meaningful Learning</strong></td>
<td></td>
</tr>
<tr>
<td>5. Multi-sensory engagement</td>
<td>6</td>
</tr>
<tr>
<td>6. Students’ meaningful engagement in planting</td>
<td>8</td>
</tr>
<tr>
<td>7. Ability to adapt to changing situations</td>
<td>2</td>
</tr>
<tr>
<td>8. Fun-play relationships</td>
<td>14</td>
</tr>
<tr>
<td><strong>Theme 3: Explicit and implicit learning</strong></td>
<td></td>
</tr>
<tr>
<td>9. Food-systems knowledge</td>
<td>22</td>
</tr>
<tr>
<td>10. Sustainable food processes</td>
<td>10</td>
</tr>
<tr>
<td>11. Creative food production</td>
<td>5</td>
</tr>
<tr>
<td>12. Engagement on food production</td>
<td>6</td>
</tr>
<tr>
<td><strong>Theme 4: Discovery learning</strong></td>
<td></td>
</tr>
<tr>
<td>13. Equality in the share of harvest</td>
<td>3</td>
</tr>
<tr>
<td>14. Garden as a site for inquisitiveness</td>
<td>17</td>
</tr>
<tr>
<td>15. Solve problems together</td>
<td>9</td>
</tr>
<tr>
<td>16. Ownership of Learning</td>
<td>5</td>
</tr>
<tr>
<td>17. Learning work Ethics</td>
<td>6</td>
</tr>
</tbody>
</table>

Continued on next page
Table 2. List of Themes, sub-themes, and number of codes (Continued)

<table>
<thead>
<tr>
<th>Categories/ Sub-themes</th>
<th>Grounded Code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theme 5: Transmissible learning</strong></td>
<td></td>
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<tr>
<td>18. Intergenerational learning</td>
<td>5</td>
</tr>
<tr>
<td>19. Collateral Learning</td>
<td>20</td>
</tr>
<tr>
<td>20. Shared responsibility</td>
<td>10</td>
</tr>
<tr>
<td>21. Individual and Mutual Accountability</td>
<td>10</td>
</tr>
<tr>
<td>22. Transformational Education</td>
<td>27</td>
</tr>
</tbody>
</table>

After co-occurrence analysis, five themes emerged. These include the following: experiential learning, meaningful learning, explicit and implicit learning, discovery learning, and transmissible learning.

Cognitive Learning in Garden-Based Education

Cognitive learning is the springboard for higher-order thinking, which helps students to remember, reason, solve problems, think, and learn, judge and reason. Five themes were presented to highlight the kinds of the cognitive impact of GBE, gleaned from the synthesized articles.

**Theme 1: Experiential learning**

Experiential learning is acquired when students are engaged in multisensory, cooperative, and collaborative engagement. Students perceive their lessons as tangible as they explore in the garden. It is where they learned the value of involvement in gardening as they plant and eat their grown food. The garden also enhanced their learning experience as they played the roles of problem solvers and community members while growing and caring for plants. The majority of the participants expressed their experiences in the following vignettes:

**The concrete idea of the lesson**

"Being able to participate in managing a garden, planting it and then harvesting it, will give them a better idea of things when they learn about photosynthesis, plant growth, life cycles, and things like that" (Article 8, Principal).

**Complex level of Comprehension**

One teacher commented that [the students] plant [the food] and they watch it grow and they look after it and they see that …they are not putting things on it that are not friendly to the things that grow (i.e., pesticides). I think that is important, and I think that is going to get way more and more and more important too (Article 18, SEF 91).

**Active engagement in problem solving**

“The children made inferences about the reasons for some seeds not sprouting and the ideal conditions for germination” (Article 5, teacher’s observation).

**Support Learning on Nature**

“We take the children to the garden and let them experience firsthand what is healthy food” (First-grade teacher (5FG), Article 29).

The vignettes are evidence of how learned theories are connected to the real-life scenario as personally witnessed by the students. Their experiences in the garden stimulate critical thinking, nurture responsibility, evoke ecological provocations, and concretize knowledge about plants. Mohamed and Othman (2018) affirm these
observations that School gardens cover a plethora of learning possibilities, as well as a natural laboratory for honing cognitive skills while gaining a greater understanding of nature.

**Theme 2: Meaningful learning**

A theory of cognition and learning states that a combination of previous organized cognitive structure and new learning experience results in meaningful learning (Ertmer & Newby, 2013). When students' recently acquired knowledge is combined with existing experiences and knowledge that generates a unique and personal comprehension that encourages meaningful learning (Acharya, 2019). These are concepts that are fully understood by learners and are of high value to their lives. Example vignettes that follow these findings are listed below.

**Multi-sensory engagement**

“Okay, I picked that one because I like how the children can touch smell, see the plants can notice the different heights of them as they grow; one child looks like they found a seed or some type of little critter, so that’s why I picked it and they’re all working together and also looking at things individually.” —Terri, Year 1 (Article 9)

First-grader who ate a peppermint leaf said, “This leaf tastes like Cinnamon Toast Crunch,” (Student, Article 7).

**Students’ meaningful engagement in planting**

“Being able to participate in managing a garden, planting it, and then harvesting it, will give them a better idea of things when they learn about photosynthesis, plant growth, life cycles, and things like that” (Article 8, Principal).

**Ability to adapt to changing situations**

“And I don’t know whether that’s simply knowing where it came from. It is less mysterious maybe? […] where did this come from when it appears on their plan, vs in the garden, […] this is where it came from. This is what it is. […] Just how willing they are to try new things in the garden” (Article 9, Cheryl, Year 2).

**Fun-Play Relationships**

“The kids right now just don’t get a chance to play outside. When you use the outdoor classroom, they are not only getting their learning, but they’re also getting that opportunity to play outside and get fresh air” (Article 23).

Students were delighted to learn about garden realities. For instance, underground potatoes and flowers require pollination to develop fruit. School garden learning bridges abstract concepts and real-life examples. This is exemplified when students' prior experiences and their lessons become relevant making any classroom dynamic and interesting. Similar to the findings of Cheang et al. (2017), a garden invigorates engagement by highlighting authentic and real-life organisms. The student's ability to perceive phenomena, analyze their observations, and creatively inquire about the experience is enhanced by direct interaction with natural growth processes and development in a garden. Hence, activities using multi-sensorial approaches, hands-on experiences, and a garden as a living laboratory may enhance students' focus and ability to learn and develop inquisitive minds and critical thinking.

**Theme 3: Explicit and implicit learning**

Explicit learning is the information acquired by the learners directly while implicit learning is the
complex information acquired incidentally. Explicit learning includes identifying what to plant and the elements needed to make a garden grow. It also includes where food comes from and how it grows. Implicit learning is manifested by food-system knowledge, pea growing and counting while in the garden. It also pertains to the family knowledge of gardening and cooking, allotting space for self-exploration, and a deeper understanding of scientific processes to make better choices, seed cultivation, and follow-up. Some of the respondents affirmed implicit and explicit learning in the following vignettes:

**Food-systems knowledge**
“Okay, I picked that one because I like how the children can touch smell, see the plants can notice the different heights of them as they grow and one child looks like they found a seed or some type of little critter, so that’s why I picked it and they’re all working together and also looking at things individually.” —Terri, Year 1 (Article 9)

**Sustainable Food Processes**
"My whole life we’ve gotten local or organic foods, but I never knew really why. I didn’t know about the conventional and organic and local food, and the differences between them ... that was a helpful lesson for later in life" (Student, Article 10).

**Creative Food Production**
“Another teacher added that in her visits to the garden, she is teaching the students to recognize the connection between the health of the soil to that of the plants and then ‘how we’re going to benefit from this plant” (Teacher, SEF 9, Article 28).

**Engagement on food production**
"We had several children… their parents said that they refused to eat broccoli. And when… they helped us harvest the broccoli. And when we cut it up and had it for snack … they all tried it. And some of the children … went home and told their parents that they like it … I think that the reason why they tried it was because … they put in so much hard work in gardening and weeding and taking care of them” (Article 23).

The school garden is considered a valuable avenue for teacher training institutions since it has a wide array of knowledge sources. Eugenio-Gozalbo, Aragon, and Ortega-Cubero (2020) supports this contention in their observation that gardening provides better context for science instruction as it stimulates interest and motivation to learn.

**Theme 4: Discovery learning**
Discovery learning encourages students to learn at their own phase by motivating students to ask their questions and formulate tentative answers. Based on the nuances of participants in the study, discovery learning is exhibited in students’ interest in eco-garden management and hands-on activities. Some accounts from the participants revealed that:

**Equality in the share of harvest**
“Children were very precise in sharing the harvest fairly” (Teacher’s observation, Article 1).

**The garden as a site for inquisitiveness**
“And I’m really into inquiry-based science and labs and hands-on things, and the garden gives me that chance. And I feel like they won’t take that away from me” (Article 32, Meredith).

**Solve problems together**
Haim: Teacher, the seeds might be sleeping! They don’t wake up!
Jisub: Maybe, didn’t it die by drowning?
Ownership of learning

“I think it’s good that everyone comes together and shares ideas: children have very different ideas compared to the adults. It gives the children part ownership in what’s going on” (Teacher PEO3, Article 31).

Learning work ethics

“We are devoting time to what we really want and we own our own time (…) we celebrate a kind of leisure time which is creative and constructive and is not taken up by consumption” (P8:110, Article 5).

School gardens offer place-based learning opportunities and promote students to discuss the content knowledge they learned and the experiences that actively engaged them (Burt et al., 2018; McMillen et al., 2019). It is an appropriate tool for discovery learning as it makes the students engrossed in their activities. Their curiosity can be a springboard for analytical and innovative participation. The impact on the cognitive domain in this scenario is exhibited by their curiosity and wonder that Cross and Kahn (2018), and Davis and Brann (2017) consider as reconciling curricular linkages and learning opportunities.

Theme 5: Transmissible learning

Schools as educational institutions continuously develop reforms from the numerous salient findings from scientific research. These circumstances suggest that learning should never stop and that it should be shared with others through natural progression, community building, and various development scaffolding (Dunkley, 2016; Eugenio-Go zalbo, Pérez-López, & Tójar-Hurtado, 2020; Fifolt & Morgan, 2019). The transactional nature of garden-based education brought about by the interaction of learners with the community to build knowledge aligns with the constructivism theory (Xie et al., 2018). In this context, students’ manifest progression of learning as they share functional knowledge with the family. Similarly, there is evidence of knowledge transfer from the community to the learners or from other stakeholders that characterizes intergenerational learning (Schneller et al., 2015). Engaging students in gardening provides opportunities and a sense of achievement when students share information through different models of learning. Some of the respondents affirmed transmissible learning from the following vignettes:

Intergenerational learning

“I told my parents about the aquaponics system, about how it circles and what’s good for the plants and fish. They thought it was a cool idea” (Student, Article 11).

Shared responsibility

“They all take care of each other and remind each other, give each other encouragement … [they show] teamwork, working together, rule-following” (Article 23).

Transformational Education

Moreover, OLGs both embrace living processes and provide ways to engage students with food production, which was considered transformative: “Truly, gardens are a key for educational transformation” (P5:23, Article 5).

There are science lessons wherein students spontaneously or consciously tell others about what they have learned in school. This may be done through formal, non-formal, or informal settings.
across generations (i.e., children to their parents or older relatives, or to other people groups) in order to gain or share knowledge or skills. This finding is similar to the results of Brion and Cordeiro (2018) who pointed out that there is a transfer of learning when learners are self-motivated and willing to engage in conversation and collaboration.

From the 22 subcategories synthesized from the articles, five themes describing cognitive learning emerged. These themes characterized the different ways that the cognitive dimension of learning can be facilitated through the implementation of garden-based education (Williams, 2018). Integrating such curricular enhancement at the tertiary level particularly in the context of environmental science, in the science education program will be beneficial, as these preservice teachers will become implementers of GBE when they teach (Eugenio-Gozalbo, Aragon, & Ortega-Cubero, 2020). The use of school gardens enables the curriculum to come alive as students see the "real-life" lessons they learn. The GBE can encourage students to engage in experiential learning, discover new things, and develop skills such as responsibility, teamwork, accountability, and environmental stewardship (Burt et al., 2018). The synthesized findings revealed a preponderance of beneficial impacts on the cognitive dimensions of learning using garden-based education. The adoption of instructional gardens has become more popular as a means to address the wellness and hunger issues of the sustainable development goals, and more so, it creates an impact on the learner's cognition of becoming a productive citizen.

![Thematic map of the impact of garden-based education on cognitive domain of learning](image)

**Figure 3.** Thematic map of the impact of garden-based education on cognitive domain of learning
4.0 Conclusion and Recommendations

This metasynthesis elucidated the different ways that the integration of garden-based education program in the curriculum supported the development of cognitive domain of learning. School administrators and teachers should provide learning opportunities through school garden to support the learner by exposing them to different mechanism and aspects of garden-based instruction not only for enhanced academic outcome but also for other areas of development. In order to maximize the successful and sustainable implementation of GBE in promoting holistic development of learners, this study recommends that the integration have to be mandated in the discipline where the teacher can formally integrate school garden learning in their lesson to bridge the concepts and real-life application. Moreover, in order to achieve a sustainable garden-based learning, integration should be extended up to the higher education courses such as in the environmental science and in the teacher education program. Preservice teachers in general and science teachers in particular are most likely be the one to utilize garden-based learning in the interdisciplinary approach of instruction.

References


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