The Superheroes of Nature: A Seven-Step Model for Transforming Biophobia

Mika Leon-Beck
David Yellin College of Education
Israel

Abstract

Biophobia, the fear or aversion to living organisms, particularly insects, limits opportunities for biodiversity appreciation, environmental education, and sustainable practices. This study presents a seven-step educational framework designed to transform adult learners' emotional responses to insects from fear and disgust to curiosity and admiration. Grounded in principles of Social and Emotional Learning (SEL), sustainability education, and experiential learning, the framework integrates emotional awareness, knowledge-building, and hands-on activities to promote curiosity and reduce emotional barriers. Implemented within the course The Superheroes of Nature: Insects, as part of an animal-assisted therapy program, the framework utilized local biodiversity and accessible resources to create impactful and cost-effective learning experiences. The study involved 45 participants who engaged in reflective practices, ecological observations, and the development of insect-inspired therapeutic activities. Results revealed a 39% reduction in negative emotions (from 63% pre-course to 24% post-course) and a 32.7% increase in positive emotions (from 53% pre-course to 85.7% post-course). Additionally, 96.8% of participants who desired emotional change achieved their goals, while 63.4% of those not initially seeking change experienced unexpected positive emotional shifts. This research highlights the transformative potential of integrating emotional and cognitive strategies to address biophobia and foster ecological empathy. The framework's scalable design and principles extend beyond insects, offering applications for addressing other stigmatized subjects and promoting resilience in diverse educational and therapeutic settings. This study integrates experiential and emotional learning into educational practices to promote inclusive, empathetic, and sustainable approaches to both learning and therapy.

Keywords: Biophobia, Social and Emotional Learning (SEL), Environmental Education, Animal-Assisted Therapy, Sustainability Education, Experiential Learning

1. Introduction

Curiosity is the cornerstone of intellectual growth and a vital driver of learning. It propels individuals to seek knowledge, ask questions, and develop a deeper understanding of the world around them. Yet, curiosity often contends with significant barriers when negative emotions, such as fear, disgust, or stress, dominate the learning environment. These emotions are particularly potent when dealing with topics that evoke discomfort or aversion. Insects serve as a prime example of this conflict. Despite their critical ecological importance and fascinating biological adaptations, insects frequently evoke fear and aversion in humans. These responses stem from a complex interplay of psychological, cultural, and evolutionary factors, posing challenges to biodiversity appreciation, environmental education, and sustainability practices [1-3].

The fear of insects, often categorized under the broader phenomenon of biophobia, is both deeply ingrained and multifaceted. Biophobia refers to the fear or aversion toward living organisms, and it is particularly pronounced in urbanized societies. Insects, being one of the most visible and diverse groups of organisms, are common targets of this fear. Humans have evolved to avoid organisms perceived as harmful, such as venomous or disease-carrying insects, reinforcing an evolutionary bias against them [1,2,4,5]. However, this evolutionary predisposition is compounded by urbanization, which limits meaningful interactions with insects and intensifies feelings of disgust or fear. The "urbanization-disgust hypothesis" posits that modern lifestyles, characterized by minimal contact with nature, exacerbate negative perceptions of insects [6]. As a result, insects are often misunderstood, feared, or dismissed despite their ecological significance.

Cultural narratives and societal stigmas further amplify this aversion. From childhood, many individuals are conditioned to associate insects with danger, disease, or nuisance. These perceptions are perpetuated through media portrayals, language, and even familial interactions. For instance, parental reactions of fear or disgust during encounters with insects can transfer negative emotional responses to

 | DOI: 10.20533/jitll.2633.7681.2024.0037

children, fostering long-term aversion. This cultural stigmatization not only limits curiosity but also hampers efforts to educate the public about the critical roles insects play in ecosystems [4,5,6]. Insects are indispensable contributors to ecological stability, performing essential services such as pollination, nutrient cycling, pest control, and soil aeration [7,8]. However, the lack of awareness about these roles perpetuates the perception of insects as threats rather than vital allies.

Addressing biophobia is not just a challenge for entomologists; it is a key component of broader sustainability efforts that integrate societal and educational perspectives. Overcoming these fears requires a shift in perspective, where insects are not merely tolerated but appreciated for their ecological and biological significance.

Educational frameworks that aim to transform attitudes toward insects must leverage both cognitive and emotional strategies. The combination of knowledge and empathy has proven to be a powerful tool for reshaping perceptions. Studies show that using insects as part of animal-assisted therapy helps improve children's self-esteem, as demonstrated in research that found a significant positive change in participants' self-esteem scores following their involvement in such a therapeutic program [9]. Insects possess unique traits that inspire creativity and curiosity, as seen in their use in various forms of educational and therapeutic contexts. Their diverse characteristics, such as adaptability, resilience, and complex behaviors, hold significant potential for fostering learning and emotional connections [10].

In recent years, the integration of Social and Emotional Learning (SEL) principles into educational practices has gained traction as an effective way to address emotional barriers in learning. SEL emphasizes the development of self-awareness, empathy, and emotional resilience [11], making it an ideal framework for tackling biophobia. By encouraging learners to reflect on their emotions, confront biases, and engage with challenging topics, SEL fosters both emotional and intellectual growth. For instance, participants who initially fear insects can be guided to appreciate their ecological roles through hands-on activities and reflective practices. This approach not only reduces fear but also promotes skills such as critical thinking, emotional regulation, and empathy—skills that are transferable to other areas of life and learning.

The seven-step educational framework presented in this study builds on these principles to transform adult learners' fear and disgust of insects into curiosity and appreciation. Designed for a course on animal-assisted therapy, the framework emphasizes emotional awareness, knowledge building, and practical application. Participants begin by reflecting on their initial feelings toward insects, exploring the psychological and cultural roots of their aversion. They are then introduced to the ecological importance of insects through engaging lessons that highlight their "superhero-like" qualities. Hands-on activities, such as observations on insects, provide opportunities for direct interaction, fostering familiarity and reducing aversion. Finally, participants apply their newfound knowledge by designing therapy plans that incorporate insects, reinforcing their learning in a practical and creative context.

One of the most compelling aspects of this framework is its accessibility and scalability. By leveraging local biodiversity as a learning resource, the framework eliminates the need for specialized materials or facilities, making it a cost-effective solution for educators [7,8]. This aligns with principles of sustainability education, which emphasize the importance of utilizing immediate surroundings to foster environmental awareness and responsibility. Encouraging participants to explore insects in their natural habitats not only deepens their understanding of biodiversity but also instills a sense of connection to their local environment [12,13].

The findings of this study underscore the transformative potential of combining emotional and cognitive strategies in education. Nearly 86% of participants reported a positive emotional shift, with many expressing newfound curiosity and admiration for insects. Even among those initially skeptical about change, 65% experienced emotional growth, demonstrating the framework's efficacy. Beyond its application to insects, the principles underlying this model hold promise for addressing other stigmatized or challenging topics in education. Whether it is overcoming the fear of reptiles, developing empathy for marginalized groups, or fostering resilience in the face of complex societal issues, this framework offers a replicable process for emotional and intellectual transformation.

In addressing biophobia, this study contributes to the growing body of literature on the intersection of education, sustainability, and emotional learning. It highlights the potential for education to not only impart knowledge but also foster empathy, resilience, and deeper connection to nature. By transforming negative emotions into curiosity and appreciation, educators can empower learners to engage more deeply with the natural world and their own emotional landscapes. In doing so, they pave the way for a more inclusive, empathetic, and sustainable approach to education.

2. Methodology

Study Context and Participants

This study was conducted in 2022 at one of the academic colleges in Israel. All participants provided informed consent to participate in the study, which adhered to ethical guidelines for educational research

 | DOI: 10.20533/jitll.2633.7681.2024.0037

as approved by the institutional review board. The intervention was based on the course The Superheroes of Nature: Insects, which was attended by 45 students as part of an animal-assisted therapy program. Due to COVID-19 restrictions, most sessions were conducted online via Zoom, with the course concluding in a face-to-face peer teaching session.

Basis for the Educational Model

The educational model implemented in this study was designed to address participants' emotional and cognitive attitudes toward insects, enabling them to confidently use insects as therapeutic tools. The model was grounded using three interrelated theoretical frameworks: social and emotional learning (SEL), sustainability education, and experiential learning. These frameworks supported the integration of emotional, social, and ecological dimensions into a cohesive learning process.

Social and Emotional Learning (SEL). SEL principles emphasize the cultivation of self-awareness, emotional regulation, and empathy [11, 14]. These skills were integrated into the model to help participants confront emotional barriers associated with insects, such as fear or aversion. By promoting reflective discussions and emotional exploration, the course supported participants in developing positive emotional connections with the subject matter and in preparing to evoke similar responses in their patients.

Sustainability Education. Sustainability education highlights the role of ecological literacy and emotional connection in fostering responsibility toward biodiversity [7,12,15]. By framing insects as "superheroes of nature," the model aimed to transform participants' perceptions of insects from sources of fear or disgust to symbols of inspiration and ecological importance. This approach linked participants' personal growth with a broader understanding of the ecological and therapeutic potential of insects.

Experiential Learning. The course structure was further guided by Kolb's Experiential Learning Theory [16], which emphasizes learning through direct experience and reflection. The model engaged participants in activities that aligned with Kolb's four-stage cycle:

- Concrete Experience: Observing insects and interacting with them directly.
- Reflective Observation: Reflecting on personal emotions and cognitive responses to these interactions.
- Abstract Conceptualization: Connecting these reflections to broader ecological and therapeutic principles.
- Active Experimentation: Applying these insights to therapeutic practices and designing interventions for future use with patients.

Together, these frameworks supported the design of a model that guided participants through a structured process of emotional transformation and practical application.

The Seven-Step Framework

The intervention employed a seven-step framework, guiding participants through a structured progression from emotional reflection to practical application and reflective practice. A summary of the framework is presented in Table 1.

Table 1. Overview of the Seven-Step Educational Framework

Step	**Activity**	**Implementation**
1	Recognizing Emotional Attitudes Toward Insects	Pre-course survey (Appendix A)
2	Reflecting on the Desire for Emotional Change	Pre-course survey (Appendix A)
3	Finding Inspiration in Insect Superpowers	Collaborative presentations
4	Building Connections to Insect Traits	Zoom sessions
5	Exploring Insect Success	Zoom sessions and Ecological observations
6	Developing Therapeutic Activities	In-person session of peer teaching and feedback
7	Reflecting on Growth	Post-course survey (Appendix B) and reflective essays (Appendix C)

Implementation Details

Pre-Course Activities (Steps 1–3): Participants completed a Google Forms survey (Appendix A) assessing their initial attitudes toward insects. They created collaborative presentations using Google

 | DOI: 10.20533/jitll.2633.7681.2024.0037

Slides, linking the unique traits of insects to human strengths.

- Online Sessions (Steps 4–5): Two 3-hour Zoom sessions combined with formal instruction, group discussions, and guided ecological observations.
- Practical Application (Step 6): Participants designed and implemented insect-themed therapeutic activities with their patients. Feedback was provided by peers and the instructor in a peer-teaching 3-hour session.
- Reflective Practice (Step 7): Participants were required to complete a post-course survey (Appendix B), which evaluated their emotional and cognitive changes and provided insights into their overall transformation throughout the course. Additionally, they were tasked with submitting reflective essays at the end of the course, following specific instructions to guide their reflections (Appendix C). These essays focused on their learning experience, the therapeutic activities they developed, and insights gained from peer teaching sessions.

Data Collection and Analysis

This study utilized a mixed-methods research approach, combining quantitative and qualitative methods.

Quantitative Methods: Binary pre- and post-course emotional responses (e.g., presence or absence of positive or negative emotions) were analysed using Chi-Square Tests of Independence to evaluate statistically significant associations between pre- and post-course emotional states. Aggregate scores for positive emotions (curiosity, happiness, calm) and negative emotions (fear, disgust, stress) were calculated based on binary responses. Paired t-tests were used to examine mean differences in emotional states before and after the intervention.

To examine the effects of time (pre- vs. post-course) and emotion type (positive vs. negative) on emotional scores, a two-way repeated measures ANOVA was conducted using the Python Pingouin library. The dependent variable was an emotional score, and two within-subject factors were included: Time and Emotion_Type, as well as their interaction (Time × EmotionType). This analysis provided a detailed breakdown of the main and interaction effects, including F-statistics, p-values, and effect sizes.

All quantitative analyses were conducted using SPSS version 26.0 and the Pingouin library in Python, with statistical significance set at $p<0.05$. All visualizations were created using Python.

Qualitative Methods: The qualitative analysis included responses to open-ended questions in the pre- and post-course surveys, collaborative assignments (Google Slides presentations and therapeutic activity plans), and reflective essays.

The thematic analysis followed Braun and Clarke's [17] six-phase framework was utilized:

- Familiarization with Data: Survey responses, assignments, and essays were read multiple times to gain a comprehensive understanding of the content.
- Generating Initial Codes: Data were coded inductively, focusing on recurring ideas and patterns related to emotional changes, cognitive shifts, and professional applications.
- Searching for Themes: Codes were grouped into broader themes reflecting transformations in participants' emotional attitudes, cognitive insights, and practical skills.
- Reviewing Themes: Themes were refined and reviewed across all data sources to ensure consistency and alignment with the original responses.
- Defining and Naming Themes: Themes were clearly defined to capture their essence, with sub-themes identified where necessary for greater depth.
- Producing the Report: Results were organized to highlight key emotional, cognitive, and professional changes observed in participants, supported by representative quotes from the various data sources.

Rigor in Analysis: Methodological rigor was ensured through:

- Triangulation of Data Sources: Combining survey responses, collaborative assignments, and reflective essays provided a comprehensive understanding of participants' experiences.
- Peer Debriefing: Findings and themes were reviewed with a colleague familiar with the course and study objectives to enhance consistency and credibility.
- Thick Description: Contextual details and illustrative quotes from diverse data sources enriched the analysis.
- Audit Trail: All steps of coding and theme development were documented to ensure transparency and replicability.

 | DOI: 10.20533/jitll.2633.7681.2024.0037

This comprehensive analysis revealed nuanced insights into participants' emotional, cognitive, and professional transformations, emphasizing the impact of the course on their attitudes toward insects and their readiness to integrate them into therapeutic contexts.

3. Results

Transforming Biophobia Through the Seven-Step Model

The findings from implementing the seven-step model highlight how participants overcame their initial biophobia and developed curiosity and admiration toward insects. These results are structured according to the model's steps, illustrating emotional, cognitive, and professional growth.

Step 1: Recognizing Emotional Attitudes Toward Insects

Participants began by identifying their baseline emotional responses to insects, reflecting on personal, societal, and intergenerational experiences that shaped their attitudes. Analysis revealed that 63% of participants initially expressed at least one negative emotion (i.e., fear, disgust, or stress), and 53% reported at least one positive emotion (i.e., curiosity, calm, or happiness).

Intergenerational transmission emerged as a significant theme, reflecting the societal and familial influences shaping perceptions. For example, one participant noted,

"My father's reaction to cockroaches made me associate them with panic and fear, even though I wasn't directly afraid of them."

Another reflected,

"Watching fireflies with my grandfather gave me a sense of wonder that I carried into adulthood."

Participants also highlighted societal influences that shaped their views. One participant shared:

"At school, we were taught that insects were pests, which shaped my view of them as something to avoid,"

This stage laid the groundwork for self-awareness, helping participants uncover the origins of their attitudes and reflect on how these influences contributed to their emotional responses.

Step 2: Reflecting on the Desire for Emotional Change

This stage encouraged participants to examine their relationship with insects and consider their desire for change. According to pre-course surveys, 65.3% of participants expressed a desire to feel different emotions toward insects. For example, one participant shared,

"I want to feel less disgusted to prevent projecting and passing it on to my children,"

While another stated that:

"I'd rather not fear insects. Fearing them is a weakness for me."

In contrast, 34.7% of participants reported no desire for change, often explaining that they already felt comfortable or neutral toward insects. However, some of those who did not seek change expressed skepticism about the possibility of altering their feelings, with one participant stating,

"There's no way my feelings will change because they're just disgusting."

The process also helped some participants view their emotions professionally. As one participant noted,

"Understanding that my fear of insects is something I can control helped me feel more equipped to guide patients through their own emotional transformations."

By prompting participants to reflect on their emotions and intentions, this stage established a foundation for personal and professional development, empowering them to approach the subsequent steps with curiosity and purpose.

Step 3: Finding Inspiration in Insect Superpowers

Participants explored the "superpowers" of insects, reframing them as extraordinary beings with traits worth admiration. This step not only sparked curiosity but also offered new ways to relate to insects. One participant shared:

"At first, I was unsure how to approach the assignment, but as I learned about the butterfly's transformation, I started to see insects as symbols of resilience and growth,"

Another observed,

"Learning about the black soldier fly's ability to turn waste into resources reminded me to look for opportunities in challenges."

These insights are carried over into therapeutic contexts. One participant noted, "The butterfly's confined to our sessions—it could reappear in

 | DOI: 10.20533/jitll.2633.7681.2024.0037

unexpected moments, reminding my patient of their inner strength."

Step 4: Building Connections to Insect Traits

Participants explored the origins of human fear of insects, identifying key factors such as ignorance, cultural stigmas, and the unpredictability of insects' movements. One participant observed,

"When I understood that my fear was connected to ignorance, I wanted to know more about insects so I could see them differently."

Another explained,

"Their sudden movements make them feel unpredictable and hard to control, which is unsettling."

The exploration helped participants shift from fear to curiosity, as understanding the roots of their discomfort created space for emotional connection.

In this stage, participants were also tasked with observing an insect of their choice, drawing it, and describing its behavior. This hands-on activity not only deepened their knowledge but also fostered an emotional bond with the insect. One participant shared,

"Drawing the insect helped me focus on its unique traits and see it in a new light,"

Another reflected,

"Spending time observing the insect allowed me to appreciate its role in the environment and feel a sense of connection to it."

The exercise provided an opportunity to view insects from a fresh perspective, encouraging curiosity and empathy.

Step 5: Exploring Insect Success

Participants explored the traits that contribute to insects' global success, including adaptability, diversity, and specialized ecological roles such as pollination and decomposition. Group discussions highlighted key factors like rapid reproduction, small size, and resilience, helping participants understand why insects dominate ecosystems worldwide. These discussions also provided a foundation for distinguishing between harmful, neutral, and beneficial insects, emphasizing that even harmful insects play essential roles in ecological balance. As one participant reflected,

"Understanding how important insects are made me rethink my initial fear. I started seeing them as crucial to the health of the planet."

This stage also highlighted the strong connection between cognitive and emotional development. As participants gained more knowledge about insect behavior and ecological roles, many reported a reduction in fear. One participant explained,

"More knowledge will help to know what to expect. […] When there is a lack of knowledge, fear is usually the consequence."

This growing understanding empowered participants to feel a greater sense of control during encounters with insects, replacing fear with curiosity and confidence. Another participant noted,

"Knowing what to do made me feel more in control and less scared. It shifted my entire perspective on insects."

By integrating cognitive insights with emotional growth, participants experienced a significant transformation in how they viewed and interacted with insects. This newfound perspective bridged their intellectual and emotional development, enabling them to appreciate insects as contributors to ecosystems and sources of inspiration. By the end of this step, participants reported feeling more confident and curious, which prepared them for applying these insights into therapeutic contexts in the next stage.

Step 6: Developing Therapeutic Activities

Participants designed and implemented insect-inspired therapeutic activities, choosing insects based on personal relevance or patients' needs. One participant described a breakthrough with an autistic child who had not spoken in 16 prior sessions. Using ants to emphasize teamwork and family dynamics, the child observed, drew, and reflected, remarking,

"This ant is crying because her twin sister hit her, and their mother is angry at the sister."

This mirrored his own family dynamics, as he also has a twin sister, and marked his first communication, showcasing the profound potential of insect-inspired therapy to facilitate emotional expression and connection. Another participant reflected,

"Insects provide endless opportunities to address themes like fear, rejection, and resilience while opening pathways for emotional growth."

This highlights how the inherent adaptability and resilience of insects can serve as powerful metaphors

 | DOI: 10.20533/jitll.2633.7681.2024.0037

in therapy, inspiring emotional development and fostering meaningful therapeutic progress.

Step 7: Reflecting on Growth

As shown in Figure 1, Participants reflected on their transformation, with 85.7% reporting positive attitudes toward insects by the end of the course, compared to 53% at the start. In contrast, only 24.5% of participants reported negative emotions compared to 63% reported pre-course. Among those who initially expressed a desire for change, 96.8% achieved their goal, while 63.4% of those who did not actively seek change still experienced unexpected emotional growth. This highlights the power of intentional learning processes to foster meaningful transformations (see Figure 1).

Figure 1. Word Cloud Visualisation

Figure 1 shows the Word Cloud visualisation communicates the relative size of each evoked emotion as reported by participants pre- and post-intervention

One participant shared,

"I used to panic at the thought of insects, but now I feel comfortable observing them and even using them in therapy."

Another emphasized,

"Understanding insects helped me develop curiosity and empathy, which I can use in therapy and in life."

Participants also reflected on the therapeutic potential of insects, noting how their small size and unique traits can inspire patients. One participant observed,

"I never thought of insects as useful creatures before, but now I see their therapeutic potential. Despite their small size, insects demonstrate strength and resilience, which resonate deeply with patients who feel insignificant or powerless. Helping patients relate to these traits fosters insights into their own inner strengths. The simple act of giving attention to something small teaches patients—and us as therapists—that no one is ever too small to be seen."

These reflections illustrate how the structured model fostered both emotional growth and professional insights. Participants moved beyond initial fear and aversion to develop curiosity, admiration, and a deeper commitment to promoting ecological awareness and empathy in both personal and professional contexts.

Main ANOVA Effects and Post-Hoc Analysis

I used repeated measures ANOVA to test the interaction between total reported negative and positive emotions and pre- and post-intervention. The analysis revealed that time did not significantly impact the total reported emotions, $F(1,44)=0.404$, $p=0.528$, with a negligible effect size ($\eta 2=0.0009$). This suggests that total evoked emotions did not differ significantly before and after intervention independently of emotion type.

In contrast, a significant main effect of emotion type was observed, $F(1,44)=4.574$, $p=0.038$, with a small effect size ($\eta 2=0.0369$). These findings indicate that the dependent variable varied meaningfully between positive and negative emotion types, highlighting the importance of accounting for these differences.

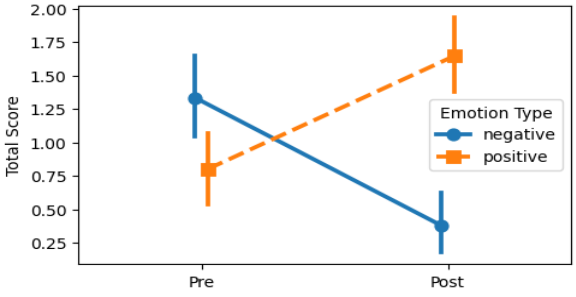

Figure 2. Interaction plot showing emotion type * time effect

A highly significant interaction (see figure 2) between time and emotion type emerged, $F(1,44)=23.311$, $p<0.001$, with a medium to large effect size ($\eta 2=0.187$). This interaction indicates that the effect of time on the dependent variable differs substantially depending on the emotion type, reflecting a complex interplay between these factors.

Post-hoc analysis provided detailed insights into the observed interaction effects:

Main Effect of Emotion Type: A significant difference was found between negative and positive emotion types, $t(44)=-2.139$, $p=0.038$, with a medium effect size (Hedges' $g=-0.560$). Indicating that overall, participants reported more positive emotions than negative ones.

Main Effect of Time: No significant difference was observed between the baseline and end time points, $t(44)=0.636$, $p=0.528$, with a negligible effect size (Hedges' $g=0.131$).

 | DOI: 10.20533/jitll.2633.7681.2024.0037

Interaction Effects: For negative emotions, a significant decrease was observed from pre to post, $t(44)=-4.257$, $p<0.001$ (Bonferroni corrected), with a large effect size (Hedges' $g=-0.892$). For positive emotions, a significant increase was observed from pre to post, $t(44)=4.484$, $p<0.001$ (Bonferroni corrected), with a large effect size (Hedges' $g=0.990$). These post-hoc results confirm the significant interaction effect, demonstrating that the direction of change over time was opposite for the two emotion types.

Implications for Environmental Advocacy

The emotional and cognitive transformations observed in this study extend beyond individual growth, highlighting significant implications for environmental advocacy. As participants developed a deeper appreciation for insects, they also reported increased ecological awareness and a commitment to sustainability. One participant shared,

"Learning about insects' roles in ecosystems made me want to protect them and teach others to do the same."

These shifts in perception translated into concrete actions, such as reducing pesticide use, planting pollinator-friendly gardens, and educating others about the importance of biodiversity. Another participant reflected,

"After learning about pollination, I planted flowers in my garden to support bees."

This demonstrates the potential for education to inspire sustainable practices and ecological responsibility.

The findings emphasize that addressing biophobia can serve as a gateway to broader environmental engagement. By transforming fear and disgust into curiosity and admiration, the seven-step model not only fosters personal and professional growth but also promotes a more inclusive and empathetic approach to nature. These changes align with global efforts to enhance public understanding of biodiversity and encourage proactive sustainability behaviors, making the model a valuable tool for advancing sustainability education and advocacy.

4. Conclusion

This study demonstrated the effectiveness of a structured seven-step educational framework in transforming adult learners' negative emotions, such as fear and disgust, into positive feelings like curiosity and happiness toward insects. By integrating principles of Social and Emotional Learning (SEL) [11], [14], experiential learning [16], and sustainability education [12], [15], the framework successfully fostered emotional and cognitive growth, paving the way for a deeper appreciation of insects and their ecological significance.

The findings revealed a 39% reduction in negative emotions (from 63% pre-course to 24% post-course) and a 32.7% increase in positive emotions (from 53% pre-course to 85.7% post-course). These results highlight the framework's ability to reframe insects as fascinating and valuable rather than sources of fear or aversion, aligning with research on biophobia reduction through targeted education [3], [6].

Participants noted that gaining knowledge about insects' ecological roles not only reduced their fears but also fostered curiosity and admiration, bridging cognitive and emotional transformation [4], [5], [7].

The framework's application extended to therapeutic contexts, where participants utilized insect traits, such as resilience and teamwork, to address themes of personal growth and emotional regulation in their patients [9], [18]. By leveraging local biodiversity and minimal resources, the framework provided an accessible, inclusive, and cost-effective educational approach, fostering ecological awareness and a sense of connection to the environment [12], [15].

Beyond individual growth, the study's implications for environmental advocacy are significant. Participants reported increased ecological awareness and a commitment to pro-environmental behaviors, such as reducing pesticide use and planting pollinator-friendly gardens, demonstrating the potential of addressing biophobia as a gateway to sustainability practices [6], [13].

Despite its promising findings, the study's small sample size and single-institution context limit generalizability. Future research should explore diverse cultural and educational settings, apply the framework to other stigmatized species, and assess the long-term sustainability of the observed changes [16].

This scalable, replicable model offers an inclusive, empathetic, and sustainable approach to education and therapy, with potential for broader applications in fostering curiosity, empathy, and resilience.

5. References

[1] Jose, V. (2019). Why are Humans so Afraid of Insects?. International Journal of Trend in Scientific Research and Development, vol. 3, no. 2, 2019, p. 1027. Retrieved from www.ijtsrd.com (Access Date: 9 May 2025).

[2] Azil, A. H., Yakub, M. A., Hassan, N., and Sharip, S. (2021). Fear towards insects and other arthropods: A cross-sectional study in a Malaysian university. Geografia: Malaysian Journal of Society and Space, vol. 17, no. 1, pp. 69-80.DOI: 10.17576/geo-2021-1701-06.

[3] Y. Cho and D. Lee, (2018). Love honey, hate honeybees: reviving biophilia of elementary school participants through an environmental education program. Environmental

 | DOI: 10.20533/jitll.2633.7681.2024.0037

Education Research, vol. 24, no. 3, pp. 445-460. DOI: 10.1080/13504622.2017.1279277.

[4] Soga, M., Gaston, K. J., Fukano, Y., and M.J. Evans, (2023). The vicious cycle of biophobia. Trends in Ecology and Evolution, vol. 38, no. 6. DOI: 10.1016/j.tree.2022.12.012.

[5] Sumner, S., Law, G., and Cini, A. (2018). Why we love bees and hate wasps. Ecological Entomology, vol. 43, no. 6, pp. 836-845. DOI: 10.1111/een.12676.

[6] Fukano, Y. and Soga, M. (2021). Why do so many modern people hate insects? The urbanization-disgust hypothesis. Science of the Total Environment, vol. 777, p. 146229. DOI: 10.1016/j.scitotenv.2021.146229.

[7] Weeks, F. J., and Oseto, C. Y. (2018). nterest in Insects: The Role of Entomology in Environmental Education. Insects, vol. 9, no. 26. DOI: 10.3390/insects9010026.

[8] Ingram, E., and Golick, D. (2018). The Six-Legged Subject: A Survey of Secondary Science Teachers' Incorporation of Insects into U.S. Life Science Instruction. Insects, vol. 9, no. 32. DOI: 10.3390/insects9010032.

[9] Kim, A. S., Ko, H. J., Choi, H. I., Moon, H., and Kim, S. H. (2018). Effects of rearing pet insects for improving mental health and salivary diurnal cortisol profile of elementary school children: A Pilot study. Current Pediatric Research, vol. 22, no. 1, pp. 23-29. www.currentpediatrics.com (Access Date: 20 May 2025).

[10] Da-Silva, E. R., Coelho, L. B. N., Rodas, T., and de Miranda, G. S. (2014). Marvel and DC characters inspired by insects. Journal of Interdisciplinary and Multidisciplinary Research, vol. 1, no. 1,mpp. 23–34. https://www.researchgate.net/publication/266559807 (Acc -ess Date: 23 May 2025).

[11] Weissberg, R. P., Durlak, J. A., Domitrovich, C. E., and Gullotta, T. P. (2015). Social and Emotional Learning: Past, Present, and Future. in Handbook of Social and Emotional Learning: Research and Practice, Guilford Press, 2015.

[12] Jankielsohn, A. (2018). The Importance of Insects in Agricultural Ecosystems. Advances in Entomology, vol. 6, 2018, pp. 62-73. DOI: 10.4236/ae.2018.62006.

[13] Wagler, R. and Wagler, A. (2011). Arthropods: Attitude and incorporation in preservice elementary teachers. International Journal of Environmental and Science Education, vol. 6, no. 3, pp. 229-250.

[14] Zins, J. E. and Elias, M. J. (2007). Social and emotional learning: Promoting the development of all students. Journal of Educational and Psychological Consultation 17, no. 2–3, 233–255. DOI:10.1080/104744107014131 52.

[15] UNESCO. (2022). Education for Sustainable Development: A Roadmap. Paris: UNESCO. https://unesco.org (Access Date: 4 June 2025).

[16] Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

[17] Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, vol. 3, no. 2, pp. 77–101. DOI:10.1191/1478088706qp063 oa.

[18] Parbery-Clark, C., Lubamba, M., Tanner, L., and McColl, E., (2021). Animal-Assisted Interventions for the Improvement of Mental Health Outcomes in Higher Education Participants: A Systematic Review of Randomized Controlled Trials. International Journal of Environmental Research and Public Health, vol. 18, no. 10768. DOI: 10.3390/ijerph182010768.

Acknowledgements

The author thanks David Yellin Academic College for supporting this research and the participants for their engagement. Special appreciation goes to Dr. Arni Zacks for her support in integrating this course into the therapy curriculum and to Dr. Eyal Soreq for his feedback on the manuscript.

Appendices

Appendix A: Pre-Course Survey

1. Describe a meaningful encounter you had with an insect. Include: When it occurred, where it occurred, who you were with, which type of insect you encountered, how you felt and why this event was meaningful.

2. What emotions did you feel during this event? (Select all that apply): Fear, Curiosity, Anxiety, happiness, Disgust, Calmness, Other (specify).

3. Would you like to experience different emotions when encountering insects? If yes, what emotions and why?

Appendix B: Post-Course Survey

1. Describe a meaningful encounter you had with an insect during the course. Include: When it occurred, where it occurred, who you were with, which type of insect you encountered, how you felt and why this event was meaningful.

2. What emotions did you feel during this event? (Select all that apply): Fear, Curiosity, Anxiety, happiness, Disgust, Calmness, Other (specify).

3. Did your emotions toward insects change during the course? What contributed to this change?

Appendix C: Reflective Essay Instructions

Instructions for the Reflective Assignment:

With the conclusion of the course, please submit a reflective essay addressing the following questions:

1. Learning and Implementation: What have you learned from the course, and what do you intend to implement as a therapist?

2. Insights from Therapeutic Activity Development and Implementation:

- Provide insights from planning and implementing the therapeutic activity inspired by insects.
- Did you experience challenges? How did you address them?
- What opportunities does insect-inspired therapy provide? Were these opportunities realized?
- *How could the therapeutic activity be improved?*

3. Peer Teaching Reflection:

- Reflect on a significant activity conducted by your peers during the peer teaching session.
- What insights did you gain from this activity, and how can you apply them in your therapeutic practice or other professional settings?

Good luck and enjoy the reflective process!

 | DOI: 10.20533/jitll.2633.7681.2024.0037