THE EFFECTS OF USING NATURE JOURNALING WITH MIDDLE SCHOOL SCIENCE STUDENTS

by

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DEDICATION

To my current and future students, may you always find curiosity in the world around you, wonder in the smallest details and joy in the act of discovery. I hope that through nature journaling, you see science not just as a subject but to connect with and understand the world. To my children, Ian, and Eli, may you grow up with the same sense of adventure, love for nature and endless questions that make learning an ongoing journey. You are my greatest inspiration and my most important students. This work is for all of you; may it spark a lifelong love of learning.

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To all of you—thank you for being part of this journey.

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ABSTRACT

This study examined whether integrating nature journaling into a middle school science curriculum could improve student engagement and strengthen observation and inquiry skills. Nature journaling was selected as a tool to encourage detailed observation, questioning, and personal connection with natural phenomena through a blend of science, art, and reflection. Over six weeks, seventh-grade students participated in weekly 45-minute to one-hour journaling sessions that incorporated both outdoor and indoor observation activities. Outdoor sessions took place in natural areas around the school, including a wooded area, a pond, and an open field. Indoors, students observed class pets, indoor plants, and live animal webcams, allowing consistent engagement with nature regardless of weather or accessibility. Each session included observation prompts, sketching, descriptive writing, and reflective questioning designed to promote curiosity and scientific thinking. A mixed-methods approach was used to evaluate the impact of the treatment. Pre- and post-surveys measured changes in students' confidence in observation skills, engagement with science, and enjoyment of nature. Open-ended survey responses captured shifts in attitudes, interests, and self-perception as scientific thinkers. Observation checklists, completed during journaling sessions, tracked physical, emotional, and behavioral engagement. Student journals were analyzed using a detailed rubric that assessed inquiry depth, question quality, drawing detail, use of scientific vocabulary, and level of reflection. Journal content was evaluated using descriptive statistics to identify growth patterns and thematic coding to uncover trends in student thinking and curiosity. Results showed significant improvements in students' ability to make detailed observations, ask meaningful scientific questions, and apply vocabulary. Survey responses indicated increased confidence and interest in science. Observation checklists revealed high levels of behavioral and emotional engagement, while journal analysis demonstrated growth in scientific inquiry, reflection, and personal connection to nature. Students progressed from simple sketches to more complex, inquiry-driven entries. In conclusion, integrating indoor and outdoor nature journaling enhanced middle school students' engagement and scientific habits of mind. This flexible and accessible approach supported curiosity and deeper observation while helping students form meaningful connections with science and the natural world. Nature journaling proved to be a powerful tool for enriching science education.

CHAPTER ONE

INTRODUCTION & BACKGROUND

Context of the Study

In the tranquil landscapes of Wolfeboro, New Hampshire, lies Kingswood Regional Middle School, a school set in a distant rural setting with about 2,000 people (City-data. com, 2023). The school caters to 7th and 8th graders from various communities including Brookfield, Effingham, Middleton, New Durham, Ossipee, Tuftonboro, and Wolfeboro, as part of the Governor Wentworth Regional School District no period here (Governor Wentworth Regional School District, 2023). The student population ranges from 350 to 400, with 44% female and 56% male students. Approximately 96% identify as Caucasian, and around 33% are classified as economically disadvantaged (U. S. News Education, 2023).

As a devoted educator on one of the two 7th grade teams teaching Earth and life science, I have been passionate about fostering a deep-rooted appreciation for science. Before venturing into the realm of education, I immersed myself in field research studying saw-whet owls along the coast of the Great Lakes, in New York. While out in the field, every subtle shift in the environment held significance. In those moments, I learned firsthand the importance of meticulous observation, gaining the essential role that observation plays in the realm of science. Whether studying the behavior of wildlife or the intricate ecosystems of our planet, the ability to keenly perceive one's surroundings is paramount. Yet, as I ventured into the classroom, I discovered that many students lacked this essential skill. In a world where noses are often buried

in screens, the art of attentive observation has become a lost skill. The ability to notice subtle changes has been replaced by the fleeting distractions of technology.

Observation skills are the bedrock of scientific inquiry. This innate skill often lacks direction and focus, especially when it comes to science. Many students are accustomed to skimming the surface, their attention divided by the constant pull of electronic devices. It was only when I entered the field of education that I realized the extent to which observation was a skill that needed to be taught. Teaching students the art of scientific observation demands patience and ingenuity. It entails more than mere encouragement for them to glance at their surroundings; it necessitates a deliberate slowing down, a conscious effort to immerse oneself fully in the environment. It is about noticing the faint rustle of leaves, the subtle change in light, the delicate interplay of colors and shapes. This realization led me to understand that nature journaling is a practice that extends beyond simple documentation. Nature journaling, with its blend of artistic expression and scientific observation, offered the perfect conduit for students to connect with the natural world in a meaningful way. Through guided exercises and immersive experiences in the school's picturesque surroundings, students were encouraged to slow down, observe, and document their findings in intricate detail.

Students, venturing into the wilderness armed with sketchbooks and pencils, will have the chance to notice the subtle nuances of their environment such as the delicate hues of a flower petal, the intricate patterns of a spider's web, the rhythmic dance of leaves in the wind. With each stroke of their pencil and each word penned in their journals, students could embark on a journey of exploration, guided by their innate curiosity, and fueled by a newfound sense of wonder. Nature journaling becomes more than just an educational tool; it develops into a gateway to a

deeper understanding of the world around them and a lifelong appreciation for the beauty and complexity of nature.

Through nature journaling, students learn to discern patterns, make connections, and uncover hidden mysteries. They discover beauty in the seemingly mundane and develop a profound respect for the intricate web of life that surrounds them. It is a journey of self-discovery as much as it is a quest for knowledge, using natural curiosity to build scientific inquiry. As Richard Louv (2008) eloquently expressed, "Time in nature is not leisure time; it's an essential investment in our children's health" (p. 118). In a world increasingly dominated by screens and digital distractions, nature journaling offers a respite—an opportunity for students to unplug, reconnect with the natural world, and engage their senses in a profound way. Whether it's the graceful curvature of a fern frond, the labyrinthine intricacies of a snail's shell, or the hypnotic sway of branches in a breeze, every observation becomes a gateway to deeper understanding and wonder.

Beyond the confines of the classroom, nature journaling transcends disciplinary boundaries, bridging the realms of art and science. Through their journals, students become not just passive observers, but active participants in the process of scientific inquiry, asking questions, forming hypotheses, and seeking answers. Through nature journaling, students not only learn how to observe the world around them but also how to cultivate curiosity and ask meaningful questions. It is about instilling in them a lifelong love for exploration and discovery. Ultimately, nature journaling serves as a gateway to developing a scientific mindset—one that values curiosity, precision, and the pursuit of truth.

Focus Question

The purpose of this study was to explore how integrating nature journaling into a middle school science curriculum could enhance students' engagement and deepen their understanding of scientific concepts. By grounding scientific learning in direct observations of the natural world, this research is aimed to cultivate curiosity, foster critical thinking, and promote active exploration through a structured journaling process. Nature journaling was used as a tool to encourage students to make detailed observations, ask meaningful questions, and draw connections to broader ecological and scientific principles. This study sought to address the overarching question: does nature journaling enhance middle school students' engagement in science?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

What is Nature Journaling?

Nature journaling introduces an additional dimension to academic journaling by offering a pedagogical approach that enriches traditional education, promoting a comprehensive approach to learning. This educational strategy entails observation, reflection, and creativity in exploring the natural world. It begins with careful observation of the natural world. Next, students reflect on their experiences and connect them to their emotions or thoughts. Creativity plays a role through sketches and artistic expressions. All of this is captured in a structured journal format, allowing for a deeper exploration of nature (Leslie & Roth, 2000; Laws & Lygren, 2020). It encourages individuals to engage with their surroundings, deepen their understanding of nature, and cultivate a sense of connection to the environment.

Nature journaling is not a new concept. Aristotle, Charles Darwin, Rachel Carson, and Jane Goodall all meticulously documented their observations and studies of the natural world. Rooted in the tradition of natural history studies, nature journaling serves as a means of comprehending, experiencing, and appreciating the wonders of nature (Bell, 1997). Nature journaling can take various forms, ranging from personal diaries kept by individuals to structured activities facilitated in educational settings (Leslie & Roth, 2000; Laws & Lygren, 2020).

Nature journaling activities in educational settings commonly start with a prompt, providing students with dedicated time for observation and sketching. The degree of structure

can be tailored to accommodate various age groups and subject matters, while the format can be customized to the preferences of either the teacher or the students. The ease and flexibility of this activity are highlighted by the few materials needed, allowing participation in various outdoor settings, not just limited to wilderness areas (Colbert 2020; Leslie & Roth 2000).

Key Components of Nature Journaling

Nature journaling offers a wide range of benefits for learners of all ages by fostering a growth mindset, particularly among budding scientists, naturalists, writers, and thinkers (Leslie & Roth, 2000; Laws & Lygren, 2020). The key components of nature journaling encompass honing observation skills, fostering a deep connection to nature, and integrating disciplines such as science, art, and literature to create multifaceted representations of the natural world (Figure 1).

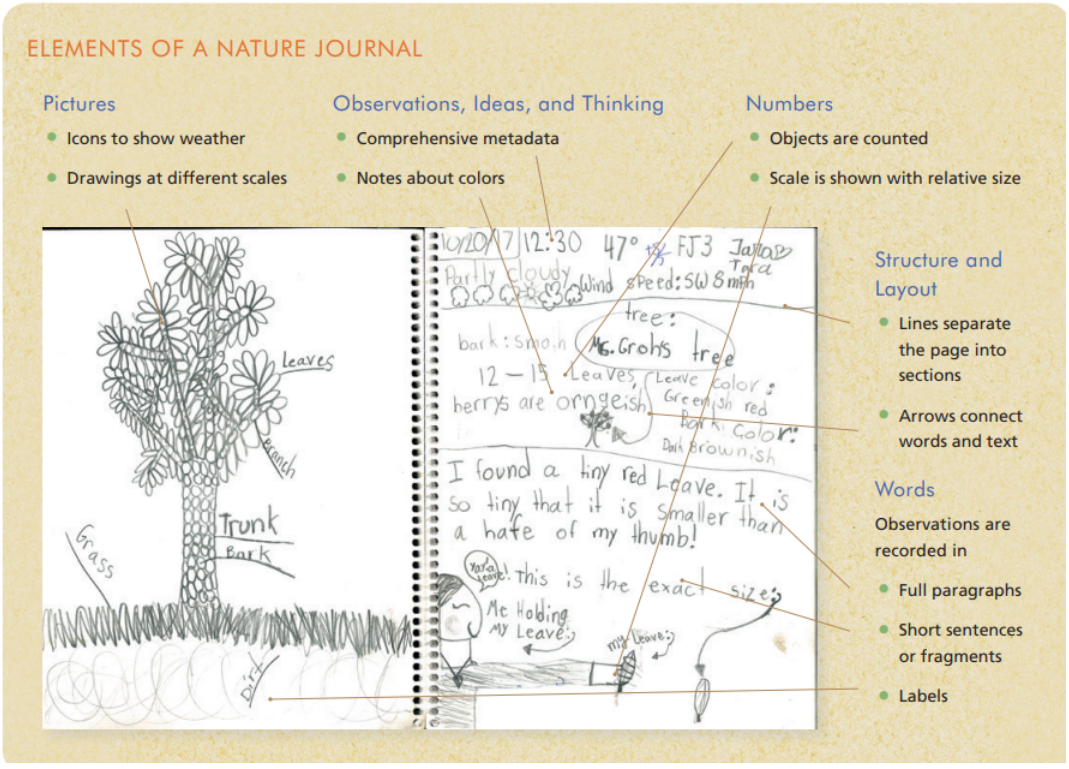

Figure 1. Example of a Nature Journaling Page, (Laws & Lygren, 2020).

Observation skill development stands at the core of nature journaling, where practitioners meticulously scrutinize the intricacies of plants, animals, and landscapes. Nature journaling encourages students to closely observe their surroundings, leading to improved attention to detail. This skill is crucial for scientific observation and research. This focused observation not only enhances perception but also cultivates essential skills for scientific inquiry. Through activities such as drawing, sketching, and writing about their observations, individuals deepen their understanding of the natural world (Leslie & Roth, 2000; Laws & Lygren, 2020). Sobel (2004) found that regular engagement with nature fosters critical thinking, observation skills, and creative expression. Additionally, research emphasizes that nature journaling fosters the development of observation skills by encouraging focused attention to detail (Laws & Lygren, 2020; Shipp, 2017).

Not only does nature journaling develop observational skills, but it yields significant educational benefits for adolescents, encompassing both cognitive and emotional dimensions. Through hands-on learning experiences, students delve into ecological concepts and processes, fostering a deeper comprehension of the natural world (Louv, 2008). This engagement also nurtures a profound connection to nature, instilling a sense of belonging and empathy towards the environment (Chawla, 1998; Mayer, 2004).

Empirical studies underscore the transformative effects of nature journaling on adolescents' environmental awareness and attitudes. Nisbet (2009) and Kals (1999) note that participation in nature journaling correlates with increased environmental awareness, empathy, and a heightened sense of responsibility towards conservation efforts. Additionally, there are

studies highlighting how nature journaling of ecosystems inspires students to become stewards of the environment, leading to tangible changes in behavior and attitudes towards sustainability (Ballantyne et al., 2019).

Nature journaling serves as a gateway for students to familiarize themselves with the flora and fauna in their local environment (McMillan, 2007; Cornell, 2012). As students document their observations, their knowledge of the natural world expands, deepening their understanding of ecological principles (Cornell, 2012). Additionally, journaling fosters empathy for the natural world, reinforcing the connection between individuals and their surroundings (Warkentin, 2011). Through these multifaceted experiences, nature journaling cultivates a holistic approach to environmental education, nurturing not only ecological literacy but also a sense of responsibility and stewardship towards the planet.

Finally, nature journaling serves as a dynamic platform for integrating various disciplines, facilitating a holistic understanding of the natural world. This interdisciplinary approach draws upon insights from science, art, literature, and writing, enabling practitioners to craft rich and multidimensional representations of their surroundings (Palmer, 1998). This integration of discipline enhances educational outcomes by providing hands-on learning experiences and fostering critical thinking skills (Lieberman, 1998). For instance, McMillan (2007) illustrated how nature journaling activities intertwined with language arts can deepen adolescents' connection with nature and enhance their reading abilities, thus highlighting the potential for integrating nature journaling with literary analysis. McMillan found that incorporating activities such as composing haikus inspired by natural surroundings can foster a deeper appreciation for both the environment and the nuances of poetic expression. Additionally,

McMillan found that encouraging more interactive engagements found in nature journaling or group discussions on ecological themes found in literature further enriched students' comprehension and critical thinking skills.

Nature journaling also serves as a valuable tool for environmental and geographic education, as demonstrated by Warkentin's exploration in 2011. By engaging with the natural world through journaling, students not only develop a deeper understanding of figurative language and natural imagery found in literature but also reconnect with their local environments and cultural landscapes (Laws & Lygren, 2020; McMillan & Wilhelm, 2007; Louv, 2008). Journaling assignments have been shown to enhance student learning and application of concepts across various disciplines (Connor-Greene, 2000). Johnson (2014) suggests that nature journals are used as a tool for developing ecological literacy and nurturing connections with the natural world through drawing. This approach stimulates children's intelligence and academic engagement.

Significance of Journaling

When the word journaling is heard, the image that often comes to mind is that of a personal diary, a space for private reflection. However, it is important to recognize that journaling can serve as much more than just a repository for personal thoughts. In fact, it can be a powerful tool for idea development and the cultivation of metacognitive skills (Osteneck, 2020). In academic contexts, journaling plays a multifaceted role. It not only helps students derive meaning from course content but also facilitates the connection of theoretical concepts to real-world applications. Beyond that, it sharpens attention to detail, encourages inquiry, and prompts deeper exploration of answers. (Ramadhanti et al., 2020). Drawing on principles of

metacognition and critical thinking, journaling prompts students to reflect on their learning experiences, bridging the gap between theory and practice. This reflective process not only enhances writing proficiency but also provides a creative outlet for self-expression (Cole, 1994; Connor-Greene, 2000).

Research indicates that integrating journaling into K-12 curriculum can noticeably improve students' literacy abilities and writing fluency. Regular writing practice refines composition skills, strengthens grasp of grammar and syntax, and expands vocabulary (Applebee, 1984). Moreover, journaling empowers students by promoting ownership of their learning journey. By documenting their academic progress and setting goals for improvement, students gain insight into their strengths and areas for growth. Setting specific, fosterable, and achievable goals promotes motivation and a sense of responsibility for one's own learning. (Black et al., 2000; Connor-Greene, 2000; Lepore & Smyth, 2002).

Summary

In essence, nature journaling embodies a versatile educational approach, encouraging interdisciplinary comprehension, critical thinking, and a profound bond with the natural world within varied educational settings. Although there is a large body of research surrounding nature journaling, there is a lack of research examining its impact on middle school science engagement. Most existing studies focus on early childhood education or high school populations, leaving a critical gap at the middle level. Middle school represents a pivotal developmental stage, where students often begin to form lasting attitudes toward science and either deepen their curiosity or disengage from the subject entirely. At this age, students are developmentally ready to handle more abstract scientific thinking, yet many struggle with

maintaining interest in traditional classroom instruction. Nature journaling offers a hands-on, reflective, and exploratory practice that encourages personal connection, sustained observation, and curiosity-driven learning. Investigating its effectiveness at the middle school level is essential, as it may provide a meaningful strategy to address declining engagement and foster a stronger connection to science during this formative period. As nature journaling continues to grow as a valuable educational tool, research centered on its implementation in middle school settings could significantly contribute to both science education and student engagement literature.

CHAPTER THREE

METHODOLOGY

Demographics

This action research-based study examined the effects of implementing nature journaling with middle school science students. The study was conducted at Kingswood Middle School, a public school serving approximately 350-400 students in grades seven and eight. The school's student body is divided into four instructional teams, with two teams dedicated to each grade level. In a middle school setting, a team is an organizational structure designed to create a smaller, more connected learning community within a larger grade level. Typically, a team consists of a group of students who share the same set of core subject teachers, such as those for math, science, language arts, and social studies. This approach allows teachers to collaborate closely on curriculum planning, student support, and interdisciplinary projects, fostering a more cohesive learning experience. By working with the same group of students, teachers can build stronger relationships, provide personalized support, and address individual learning needs more effectively. Teams help cultivate a sense of belonging and community among students, as they learn and grow together with familiar peers and educators. This model supports both academic and social development, making the transition through middle school smoother and more engaging for students. For the purposes of this research, the study focused on Team Quest, one of the seventh-grade teams, which included five sections of science, totaling 74 students ranging in age from 12 to 13. Each section averaged 16 students, fostering a classroom environment that

supported both personalized instruction and group engagement. Kingswood Middle School integrates students with diverse learning needs across all classes, in total 15% of the study sample has students with Individualized Education Plans (IEPs) and 504 Plans (K. Hunt, personal communication, November 8, 2024). This integrated approach ensures that students with various academic and developmental needs participate in the curriculum alongside their peers, providing a representative sample of the broader school community.

Treatment

The treatment involved a six-week nature journaling program integrated into the existing earth and life science curriculum. Each week, students participated in a 45- to 60-minute structured journaling session designed to encourage exploration, observation, and reflection. When the weather permitted, sessions took place outdoors in a variety of ecological environments around the school campus, such as a wooded area, a pond, and an open field. On days when outdoor access was not possible due to inclement weather, students continued journaling indoors using classroom-based natural settings such as planted terrariums, aquariums, and classroom pets. In addition, technology-enhanced experiences such as live zoo or nature webcams, allowed students to observe animal behaviors and ecosystems remotely, maintaining consistency in observation-based learning regardless of location.

The journaling activities were structured to foster scientific skills and engagement by guiding students to observe and document natural phenomena in detail. Each session incorporated a variety of components designed to develop students' observational skills, curiosity, and ability to articulate their findings. First, each session began with observation prompts to direct students' focus and stimulate curiosity about their surroundings. These prompts

varied by session and included tasks such as finding something very small and describing it in as much detail as possible, listening closely and creating a map to identify where sounds are coming from, or looking for evidence of animals or insects. By encouraging students to use multiple senses, these prompts helped them tune into specific details in their environment and record their observations in depth.

Next, students engaged in drawing and descriptive writing as they documented their observations. They were encouraged to create sketches and add descriptive annotations, which helped develop their ability to notice and convey small details. Through these practices, students practiced articulating their observations while beginning to ask questions about the natural phenomena they encountered.

Finally, each session concluded with questioning and reflection activities to deepen students' scientific inquiry skills. After documenting their observations, students were prompted to formulate questions related to what they observed, such as why leaves change colors or what animal could have left the tracks. These reflective questions encouraged students to connect their observations to broader scientific concepts and think critically about the natural world. This structure helped students integrate inquiry, observation, and reflection, enhancing their engagement and understanding of scientific practices.

To capture the impact of nature journaling on students' scientific skills and engagement, I used multiple data collection tools designed to assess changes in observational abilities, attitudes, and engagement with science. These tools included the Engagement Scale Survey, Open-Ended Survey and Interviews, Observation Checklist, and Nature Journal Content Analysis. Each tool is

described in detail in the following section, with references to corresponding appendices and an explanation of the data processing methods used for analysis.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for work with human subjects was maintained (Appendix A).

Data Collection and Analysis Strategies

I designed the Engagement Scale Survey to measure changes in students' confidence in scientific observation skills, engagement with science, and attitudes toward nature journaling. The survey included a series of 5-point scale items grouped into thematic categories: confidence in scientific skills, engagement with science, perceptions of nature journaling, and use of observation skills. Students responded to similar prompts before and after the six-week treatment. The survey aimed to provide quantitative insights into shifts in students' self-perceptions regarding scientific skills and interests over the duration of the treatment. (Appendix B).

To quantitatively analyze changes in students' engagement and attitudes, data from the Engagement Scale Survey were examined using a combination of descriptive and inferential statistical tools. Students rated each statement on a scale from 1 (Strongly Disagree) to 3 (Neutral) to 5 (Strongly Agree). To visualize shifts in responses, box-and-whisker plots were generated for each individual item and composite category. These plots illustrated central tendencies (medians), variability (interquartile range), and potential outliers, offering a clear visual comparison between pre- and post-survey distributions.

In addition, I conducted a Chi-Square Goodness of Fit test for each survey item to determine whether the observed post-treatment distribution of responses significantly deviated from the expected distribution based on pre-survey data. To further examine trends in student responses, stacked bar graphs were created for each thematic category. These graphs visually represented allowed a side-by-side comparison of pre and post treatment.

To complement the quantitative measures, qualitative data was collected through the Open-Ended Survey. This survey allowed students to express their thoughts and feelings about science in their own words. The survey, administered before and after the journaling sessions, included questions exploring students' perceptions of science, specifically what they find most interesting or challenging, as well as their emotional responses to observing nature. Responses were coded thematically to identify trends. Responses were transcribed and then analyzed using an inductive thematic coding process. Initial codes were developed by identifying common phrases and ideas in the data (open coding) such as changes in confidence in scientific observation or changes in engagement with nature. These were then refined into broader themes through axial coding (Appendix C).

During each journaling session, I developed an Observation Checklist designed to capture both quantitative and qualitative evidence of student engagement and behavior during each session. This tool focused on three key dimensions of engagement: physical, emotional/behavioral, and overall engagement. Each category was scored using a four-point rubric, where a score of 1 indicated minimal engagement and a score of 4 represented full, sustained engagement. Physical engagement indicators included whether students were actively writing or drawing in their journals, referencing their surroundings, and observing different

features of the natural environment. Emotional and behavioral engagement reflected students' enthusiasm, focus, and visible curiosity, while the overall engagement score synthesized these observations into a measure of each student's investment in the activity. As students participated, I moved throughout the observation area with a clipboard and checklist, assessing and scoring students based on clearly defined behaviors outlined in the engagement rubric (Appendix D). I completed the checklist for each student, capturing frequency and quality of engagement behaviors across sessions. These observations were documented in real-time and later reviewed for consistency. Scores for each student were recorded across all six sessions, allowing for analysis of individual and group engagement trends over time. Field notes were taken to record unique or noteworthy behaviors, adding depth to the checklist data. Data from the checklist were tallied and analyzed for patterns across the sessions. Quantitative analysis focused on the overall engagement scores, as this measure offered the most comprehensive snapshot of student participation. Mean scores were calculated for each of the six sessions to examine trends over time.

Finally, to evaluate the depth of student engagement, inquiry, and scientific thinking throughout the treatment, I developed a comprehensive Nature Journal Content Analysis tool. This coding system was designed specifically for this study to assess the quality and progression of student journal entries across six nature journaling sessions. Student nature journals were collected and analyzed for evidence of scientific inquiry, curiosity, and critical thinking.

To ensure the analysis was both manageable and representative of the broader student population, a random sample of 20% of student journals was selected from across the five science sections on Team Quest. This resulted in 16 journals out of the total 74 being analyzed.

Students were randomly chosen from each class roster to ensure proportional representation. Each selected student's entries from all six sessions were included in the analysis, allowing for both longitudinal observation of individual growth and broader insight into trends across the sample. Each journal entry was meticulously evaluated across six dimensions: level of inquiry, type of questions, quality of drawings, use of scientific vocabulary, drawing-question link, and level of environmental interaction. Each category included multiple sub-levels, ranging from basic to advanced engagement (Appendix E).

For level of inquiry, entries were evaluated based on the types of observations or wonderings students expressed. A basic entry might include a simple note such as the flower is red, while a more advanced entry might include a question demonstrating scientific curiosity, like asking why red flowers seem to attract more bees than yellow ones in a specific area. In types of questions, responses were coded based on the depth and focus of the questions. A basic question might focus on identification, such as asking the type of tree being observed. In contrast, a more complex question might explore environmental interactions or biological processes, such as how a tree might adapt to reduced rainfall over time.

The quality of drawings was assessed in terms of detail, accuracy, and alignment with observations. A simple sketch of a leaf with few distinguishing features was considered basic, whereas an advanced entry included detailed, labeled illustrations showing parts like veins or stem texture, along with notes on visible damage or changes over time. Some students also included comparative drawings or progressive sketches tracking changes from one session to the next. Use of scientific vocabulary was evaluated by the accuracy, appropriateness, and frequency of scientific terms. A student at the beginning stages might describe seeing bugs on a plant,

whereas more advanced entries referenced specific organisms such as aphids and described ecological interactions, such as nutrient transport through phloem or mutualism observed with ants. For drawing-question link, journal entries were examined for evidence that students understood relationships within natural systems. A basic observation might note the presence of insects and birds in a tree, while a higher-level response recognized the tree's role as a microhabitat supporting various organisms and explained how it contributes to a local food web.

Finally, the engagement and interaction with the environment was determined by how students engaged physically and cognitively with their surroundings. Minimal interaction might include only a brief description of a stationary object. In contrast, strong engagement was evident when students returned to previous locations to document change, used multiple senses to explore their surroundings, or incorporated active monitoring over time. For example, one student tracked the gradual color change of a maple leaf over several days, using visual and tactile observations and generating questions about seasonal transitions and pigmentation.

Each entry received a score across these six dimensions according to the established codes, which were tallied to quantify levels of engagement, inquiry, and growth over time. To ensure reliability in the coding process, all entries were initially hand-coded, and a subset of these were rechecked for consistency. Codes were then compiled in a spreadsheet to calculate descriptive statistics such as frequencies and percentages for each rubric category.

Furthermore, thematic coding was employed to reveal patterns in journal entries, such as frequently observed phenomena and types of scientific questions. This thematic analysis provided insight into students' development in observational skills, curiosity, and their ability to

make connections to larger scientific ideas, illuminating how nature journaling contributed to fostering critical thinking and sustained interest in scientific exploration throughout the study.

Together, the integration of these data sources offered a comprehensive, triangulated understanding of how nature journaling impacted middle school students' engagement, curiosity, and development of scientific habits of mind. This multifaceted methodology provided robust evidence of the effectiveness of nature journaling as a tool for promoting meaningful science learning in diverse educational settings (Table 1).

Table 1. Data Triangulation Matrix.

Focus Question	**Data Source #1**	**Data Source #2**	**Data Source #3**	**Data Source #4**
How does nature journaling affect engagement in middle school science students?	Likert Scale Pre- and post-surveys	Open ended Survey Pre and Post Responses	Nature Journaling Content Analysis	Observational Checklist

CHAPTER FOUR

DATA ANALYSIS

The purpose of this action research project was to examine how nature journaling influenced middle school students' engagement in science. To understand the impact, I gathered data from a variety of sources: pre- and post-surveys with Likert-scale items, observational checklists from six outdoor journaling sessions, coded samples from student nature journals, and students' open-ended reflections. Together, these instruments offered a triangulated view of student experiences and outcomes, which are organized into five emergent themes: Confidence in Science, Engagement in Science, Personal Connection to Nature and Science, Observation and Inquiry Skills, and Scientific Communication and Expression.

Increased Confidence in Science

Analysis of the Likert-scale survey data revealed clear improvements in students' self-reported confidence with scientific skills. On the pre-survey, 15% of students selected "Strongly Agree" and 25% selected "Agree," for a combined 40% expressing confidence. By the post-survey, those numbers had increased to 31% and 33% respectively, totaling 64%, a 24-percentage-point gain. At the same time, responses in the "Disagree" and "Strongly Disagree" categories dropped sharply from a combined 26% to just 8%, with no students selecting "Strongly Disagree" at all. The proportion of students choosing "Neutral" also declined from 34% to 28%, suggesting that more students moved away from uncertainty and toward a confident stance regarding their scientific abilities (Figure 2).

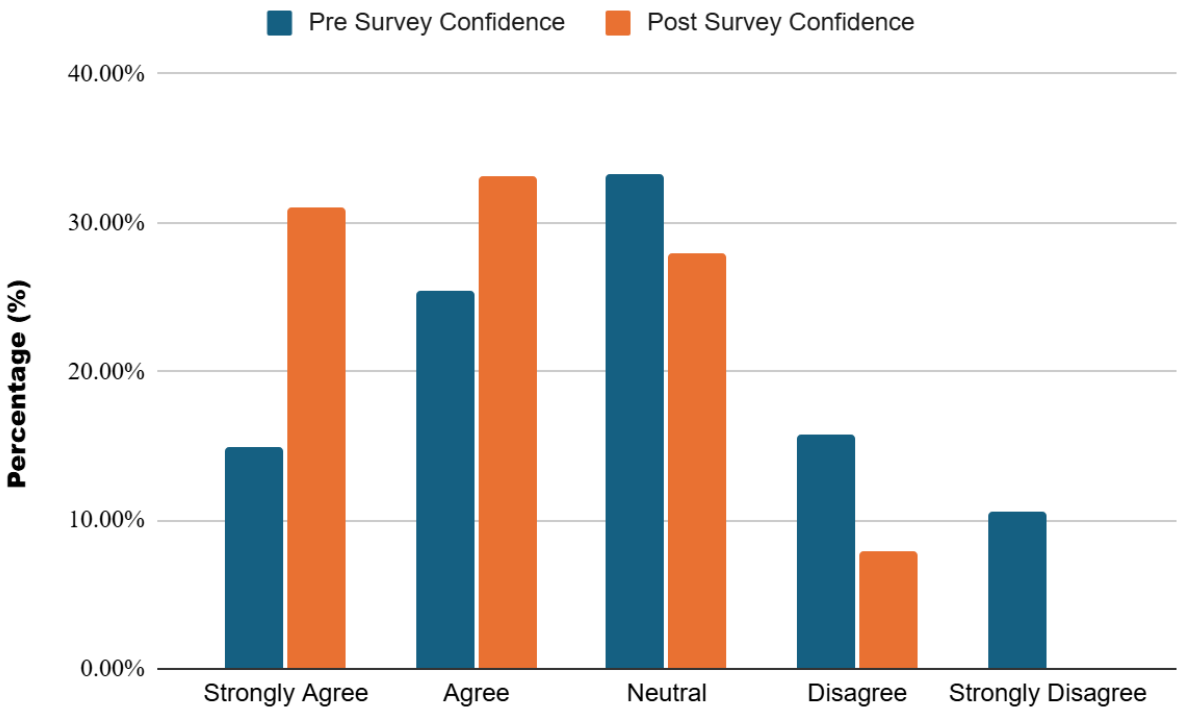

Figure 2. Distribution of Student Confidence Percentages Before and After Nature Journaling Treatment (*N*=74).

Survey results showed provides further insight by visually displaying the spread and clustering of responses on three confidence-related survey items: confidence in making observations, asking scientific questions, and recording scientific ideas. The pre-survey data show wider variability and lower overall response values, with responses ranging from 1 to 5 and broader interquartile ranges (the box portions of each distribution). This suggests that students entered the treatment with varied levels of confidence and greater uncertainty. After the treatment, the post-survey responses cluster more tightly around the upper values (4–5), and the spread of data narrows. This indicates greater consensus among students and a general upward shift in confidence across all three areas.

For example, the boxplots for “I feel confident in my ability to make observations” and “I can ask good scientific questions” show that post-treatment responses had fewer low-end values, with the majority of responses falling in the upper two categories. Outliers and minimum values that were present in the pre-survey disappear entirely in the post-survey for all three items. The narrowing of the boxes and the shift upward of the medians reinforce the interpretation from the frequency data: more students saw themselves as capable scientific thinkers by the end of the treatment. (Figure 3).

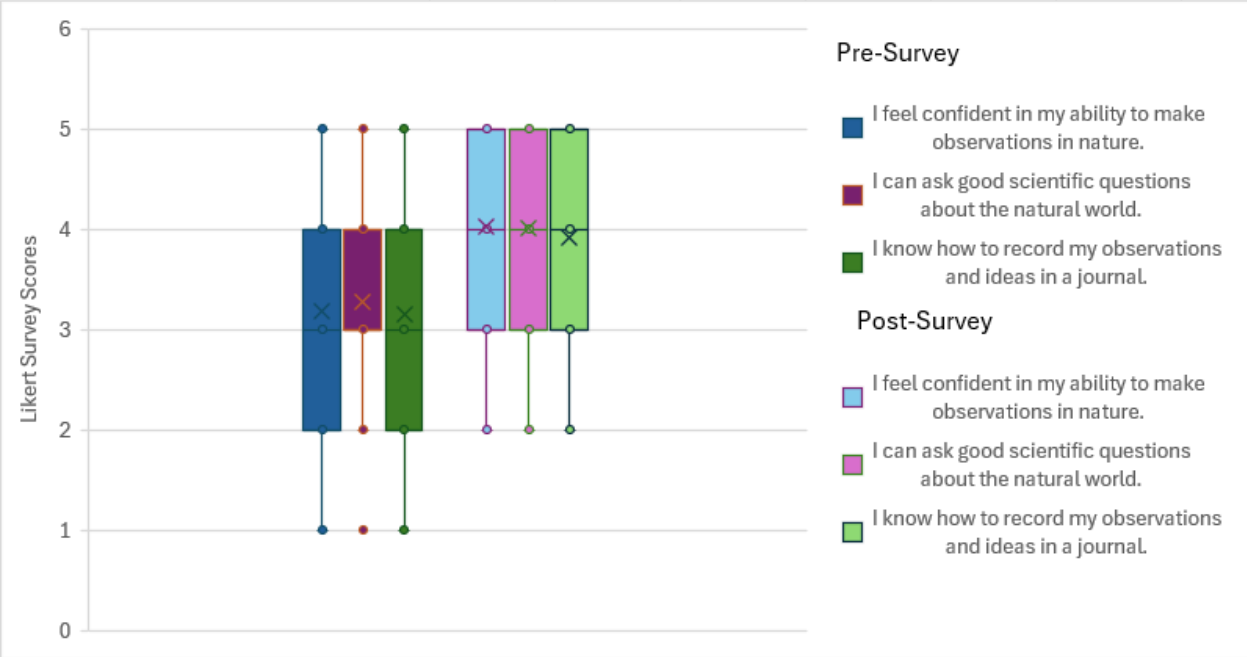

Figure 3. Pre- and Post-Survey Comparison of Student Confidence in Science Skills (*N*=74)

To assess the reliability of these changes, a Chi-Square Goodness of Fit test was conducted for each confidence-related item. The test examines whether the differences in pre- and post-survey response patterns are likely to be due to chance or reflect a real effect. For all three items related to confidence, making observations, asking questions, and recording ideas,

the Chi-Square test returned results that were statistically significant at the $p < 0.05$ level. This means there is strong evidence that the treatment had a measurable effect on how students perceived their scientific abilities.

Qualitative data provided additional evidence of increased confidence. Before the treatment, students often expressed hesitancy in their ability to observe and reflect scientifically, with comments like "I'm not really confident but I could be better. " Post-treatment reflections reflected greater autonomy and self-awareness: "Yes, because I can pick what I am interested in and take time to draw and think. " Student journals also illustrated this transition, as entries became more detailed, accurate, and expressive over time. One student reflected, “It’s easier to explain when I’ve drawn it too,” revealing how the visual elements of journaling enhanced their comfort with scientific expression.

Observational checklist data collected over the six-week treatment showed a consistent upward trend in student engagement. Average engagement scores increased from 3. 06 in Session 1 to 3. 36 in Session 6, with the highest recorded engagement at 3. 39 in Session 4 (Figure 4).

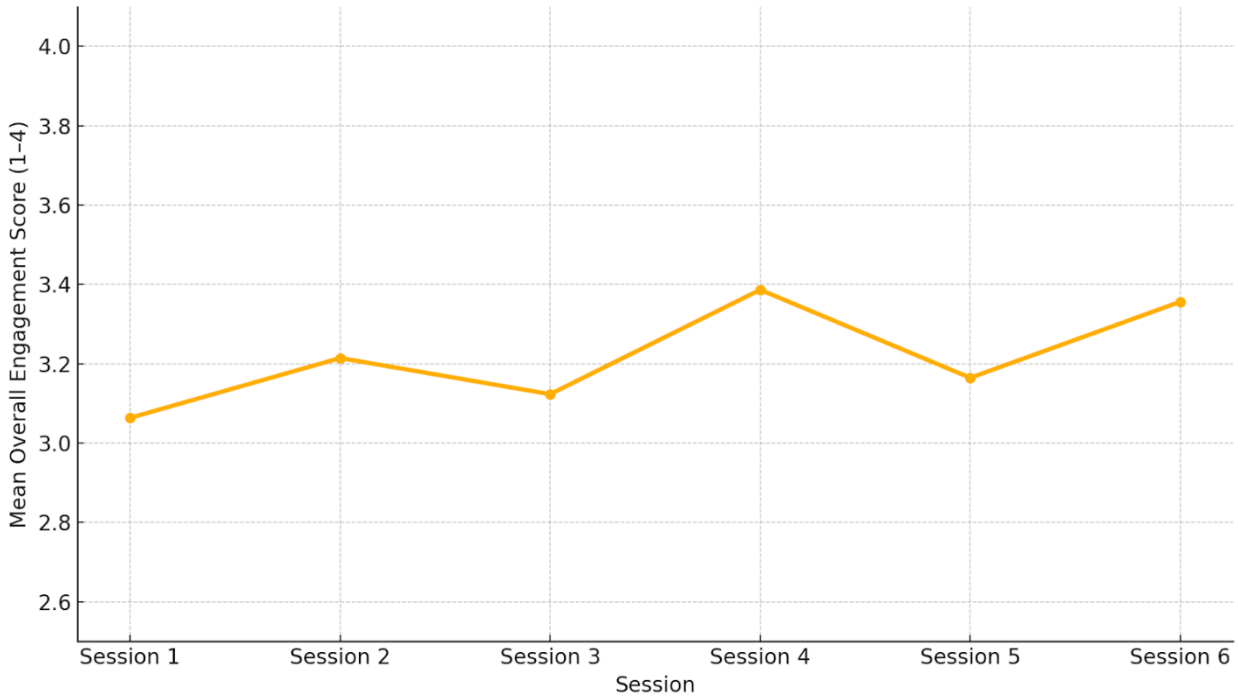

Figure 4. Mean Overall Student Engagement Scores Across Nature Journaling Sessions *(N*=74).

The field notes accompanying these scores provided context: early sessions often required redirection and encouragement, while later sessions were characterized by self-direction and sustained focus. Students began independently selecting observation sites, quickly immersing themselves in journaling tasks, and even requesting extended outdoor time. One student remarked, “Can I stay out here longer? I didn’t finish my questions.”

Likert survey items related to engagement supported these trends. Students showed increased enthusiasm for learning science, greater eagerness to explore science topics independently, and more consistent anticipation for classroom science lessons. The post-survey distributions for key engagement indicators shifted noticeably toward the upper end of the scale. For example, on the item “I feel excited about learning new things in science,” more students selected “Agree” and “Strongly Agree” on the post-survey compared to the pre-survey. In contrast, lower-end responses such as “Disagree” or “Strongly Disagree” became less frequent or disappeared entirely. Similarly, “I look forward to science lessons at school” and “I am eager to explore new science topics on my own” also showed tighter clustering of responses at levels 4 and 5, suggesting increased overall agreement.

Pre-survey data show wider variability and a greater number of responses in the middle and lower categories, particularly for the item “I think science is relevant to my everyday life.” After the treatment, responses to this item were more concentrated in the 4–5 range, indicating that students were more likely to view science as meaningful and applicable to their lives. (Figure5).

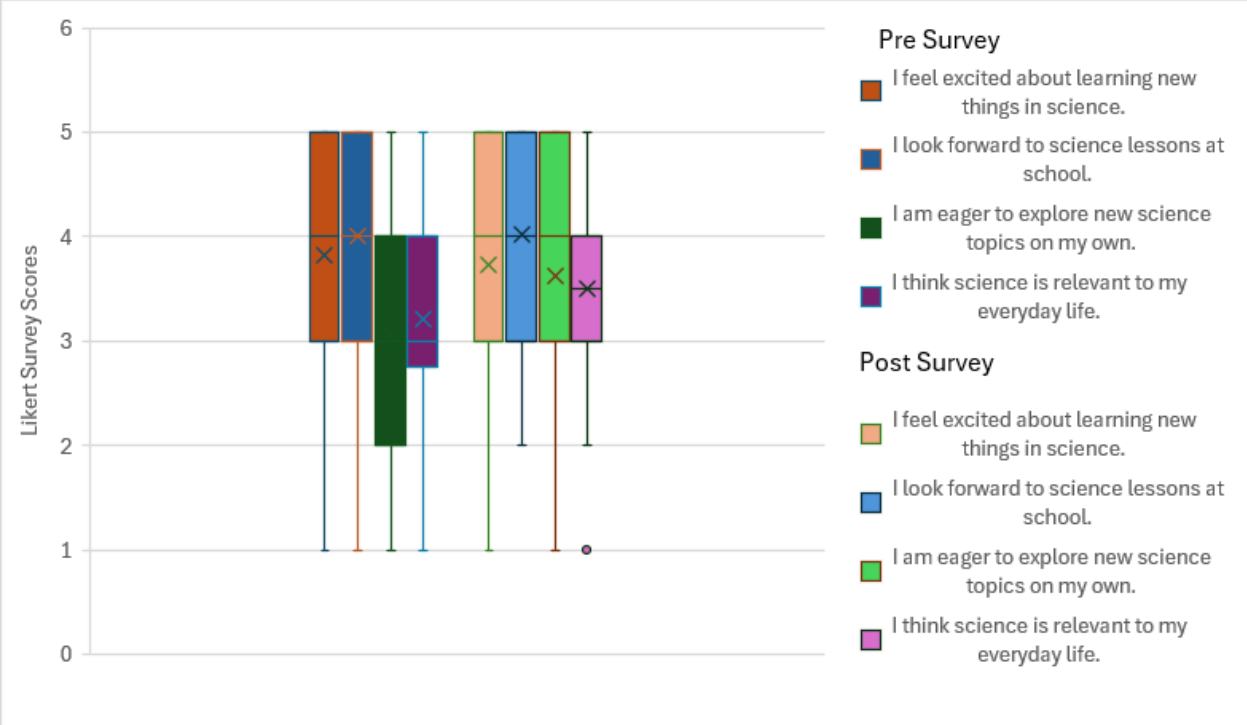

Figure 5. Pre- and Post-Survey Comparison of Student Engagement in Science (*N*=74)

The reduced spread of responses also indicates that more students felt similarly positive about their science experiences after the treatment. Students described nature journaling as enjoyable and intellectually stimulating: "Nature journaling made me realize how science is all around us," and "I felt like I was doing real science."

Content analysis of journal entries indicated high levels of engagement. The most frequent level coded was ENG3 (Active Engagement), with nearly 50 entries, indicating that many students demonstrated detailed observations, used multiple senses, and returned to previous observation sites. According to the rubric, ENG3 is characterized by students making detailed observations, using multiple senses, and demonstrating investment through behaviors like returning to previous observation sites or expanding upon earlier entries (Appendix E). This indicates that many students were actively engaged in their journaling practice, going beyond

surface-level participation. One example of ENG 3 seen in Figure 6 in the drawing pots inside pots shows the student carefully observing the physical structure of nested pots, noted new details such as shadows, and applied shading techniques to enhance realism.

Following that, ENG4 (Sustained Engagement) accounted for approximately 33 entries. As described in the rubric, ENG4 indicates students consistently revisited ideas or questions across multiple entries, exhibited deep interest in their subject, and often incorporated cross-session comparisons or ongoing investigations (Appendix E). This suggests that a significant portion of students went beyond basic participation and consistently demonstrated excitement for learning and revisiting earlier observations. An example of this is seen in Figure 6 in the Atlantic Puffin drawing. It shows where the student created multiple detailed drawings, incorporated scientific facts about puffin adaptations and behavior, and posed a biologically meaningful question connecting observation to broader ecological concepts.

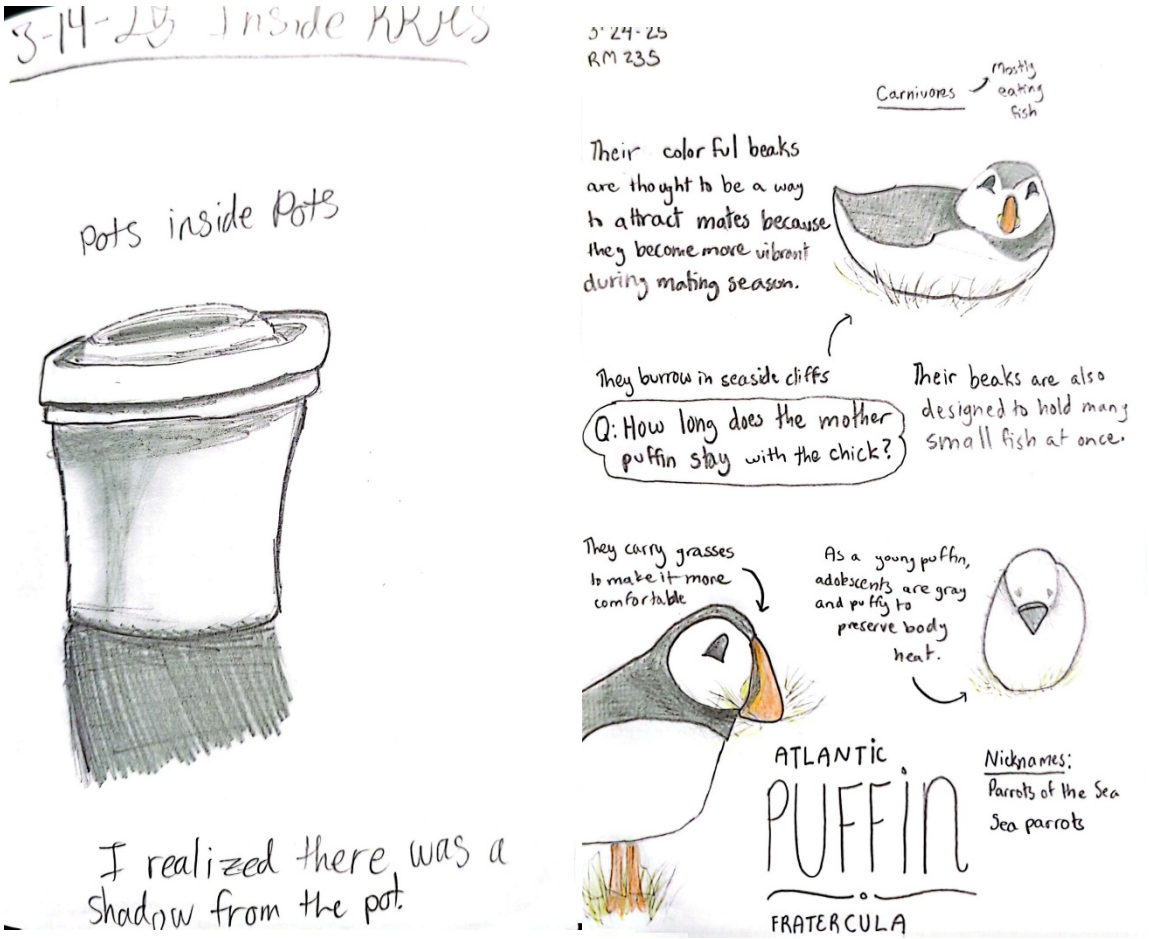

Figure 6. Examples of student nature journal entries demonstrate different levels of engagement. *Note.* Pots Inside Pots illustrate ENG3 (Active Engagement) which shows detailed observation and sensory engagement with realistic shading and structural attention. Atlantic Puffins demonstrates ENG4 (Sustained Engagement) which demonstrates extended interest with multiple sketches and ecological questioning.

ENG2 (Moderate Engagement) was present in around 24 entries. According to the rubric, ENG2 is defined by students showing effort in their observations but with limited depth or follow-up (Appendix E). These entries may include some description and drawing but lack further questioning or reflection. Only 15 entries were categorized as ENG1 (Minimal Engagement), indicating that disengagement was relatively rare. The rubric defines ENG1 as entries that are brief, lack detail, and show little effort or connection to the journaling activity,

indicating that disengagement was relatively rare. These entries featured behaviors such as prolonged focus, detailed observations, questioning, and a willingness to explore ideas further, all indicators of authentic scientific engagement.

Strengthened Personal Connection to Nature and Science

Likert survey data indicated that the nature journaling treatment helped foster a stronger emotional and cognitive connection between students and the natural world. When combining "Strongly Agree" and "Agree" responses, the percentage increased from approximately 51% pre-survey to 62% post-survey, reflecting a substantial growth in positive perceptions. This suggests that a greater number of students felt more confident, engaged, or connected to the content after participating in the journaling activities. Conversely, combining the "Disagree" and "Strongly Disagree" categories shows a decrease from about 21% before the treatment to just 9% after, indicating a significant reduction in negative or resistant attitudes (Figure 7).

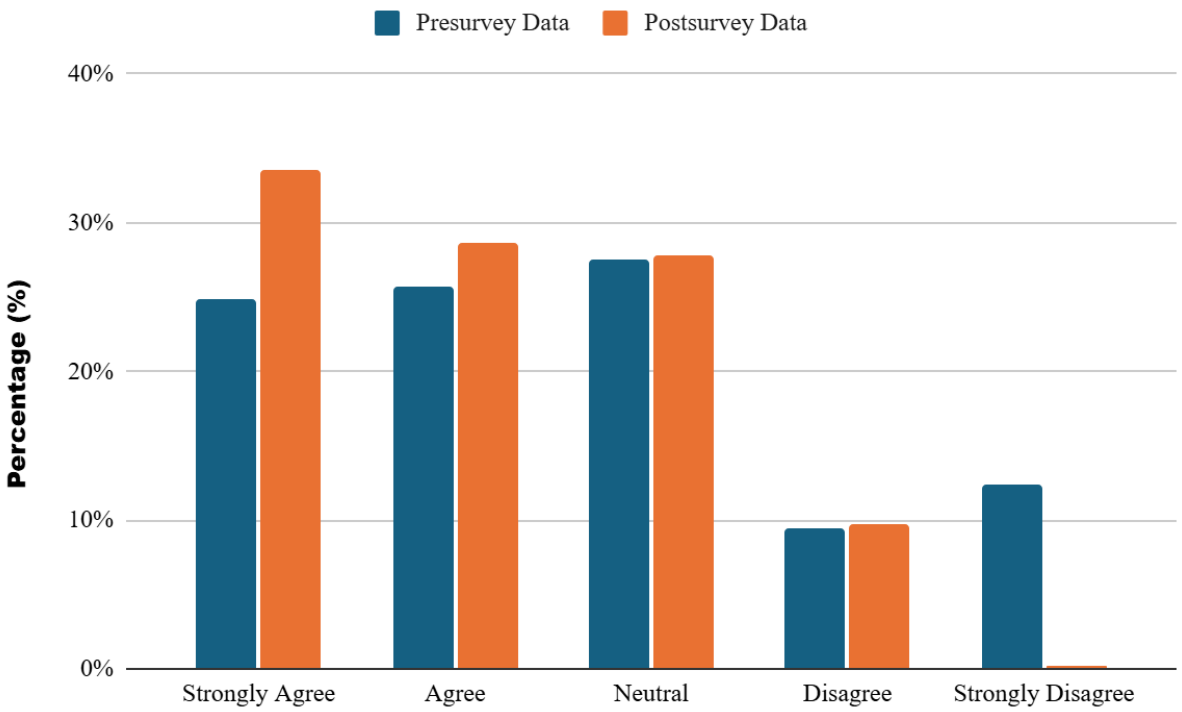

Figure 7. Distribution of Student Connection to Nature Percentages Before and After Nature Journaling Treatment (*N*=74).

Across all statements, the post-survey data shows consistently high distribution (4 or 5) and reduced variability, indicating that most students reported positive attitudes after the treatment. On the item "I enjoy spending time outdoors in nature," the pre-survey boxplot indicated a wide range of attitudes. After the treatment, responses were clustered tightly between 4 (Agree) and 5 (Strongly Agree), with the minimum value rising and variability decreasing, suggesting that nature journaling increased students' emotional connection and enjoyment of being outside. Similar trends were observed in the items "I enjoy drawing and writing about what I see in nature" and "I think exploring nature is fun and interesting," where post-survey distributions shifted upward, with fewer students responding below a 3 and more selecting 4 or 5.

After the treatment, these items displayed tighter distributions, with a larger percentage of students selecting “Agree” or “Strongly Agree,” and fewer selecting “Neutral” or lower. Curiosity about the environment also remained high, with responses to “I am curious about how living things interact with their environment” clustered around 4, showing that nature journaling sustained or enhanced student interest in ecological relationships. Overall, the data highlights that the journaling experience promoted not only scientific engagement but also deeper personal enjoyment, creativity, and appreciation for nature, reinforcing nature journaling as a powerful interdisciplinary learning tool (Figure 8).

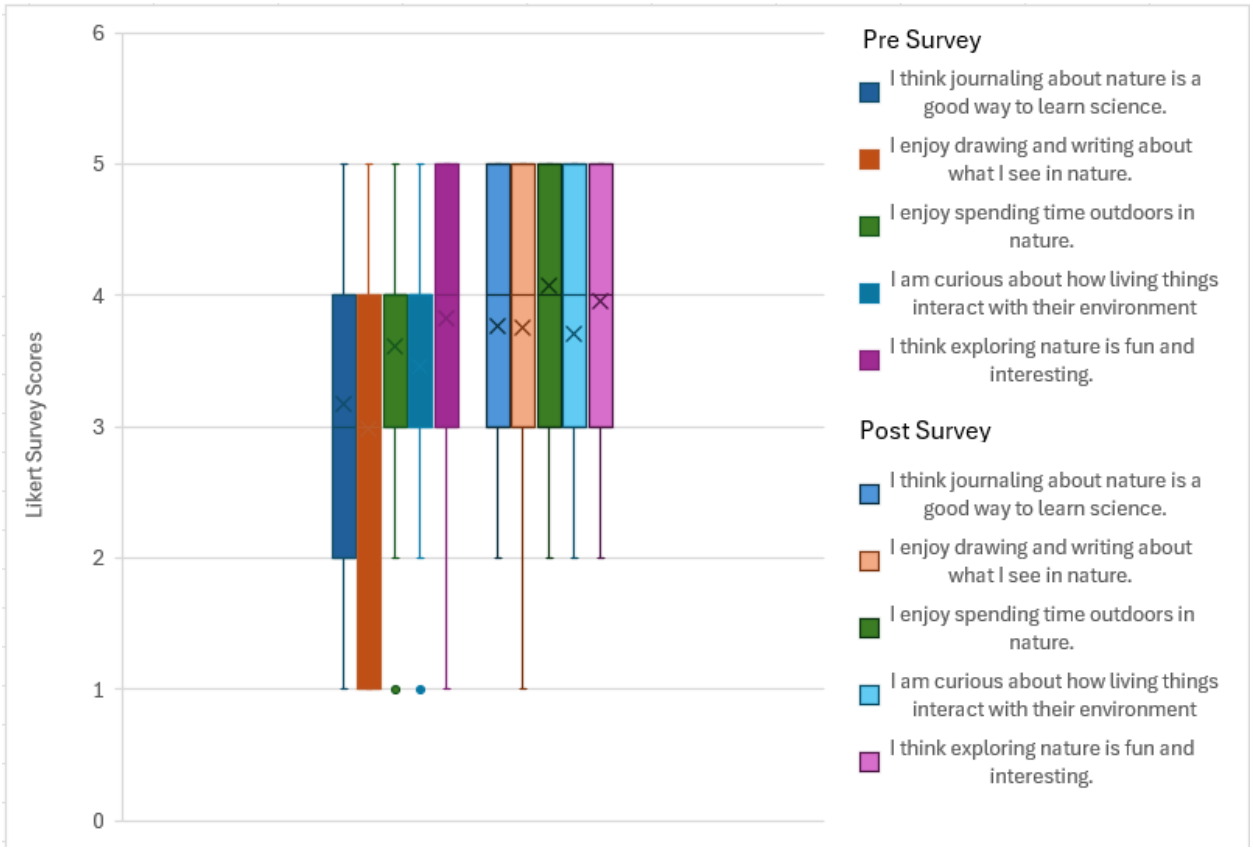

Figure 8. Pre- and Post-Survey Comparison of Student Perception of Nature and Nature Journaling (*N*=74)

Journal entries corroborated this emotional shift. Students frequently expressed awe, curiosity, and mindfulness. Reflections such as “This is my favorite part of the day” and “It helps me slow down and really see what’s around me” illustrated the calming and immersive nature of the journaling experience. Students noted specific sensory experiences such as noticing how snow drips from trees or how bark textures feel that they previously overlooked.

In their journals, drawing quality supported this trend as well, 51% of entries were annotated drawings (DRAW 4) or showed progression (DRAW 5), indicating careful attention to detail and a growing appreciation for the complexity of natural phenomena. DRAW4 (Annotated Drawing), per the rubric, refers to entries where students included labeled diagrams that connect visual features with scientific vocabulary or descriptions. DRAW5 (Progressive Drawing) represents entries in which students developed more complex illustrations over time, sometimes showing multiple views, comparisons, or visual changes across sessions demonstrating close attention to natural features and changes (Appendix E).

For example, one student’s drawing of a manatee featured labeled parts such as “flippers,” “tail,” and “small eyes,” demonstrating the use of annotations to connect visual observation to scientific ideas (DRAW4). Similarly, a series of timed orchid sketches showed a clear progression from basic shapes to intricate petal structures and shading, reflecting an increasingly sophisticated approach to observation (DRAW5) (Figure 9).

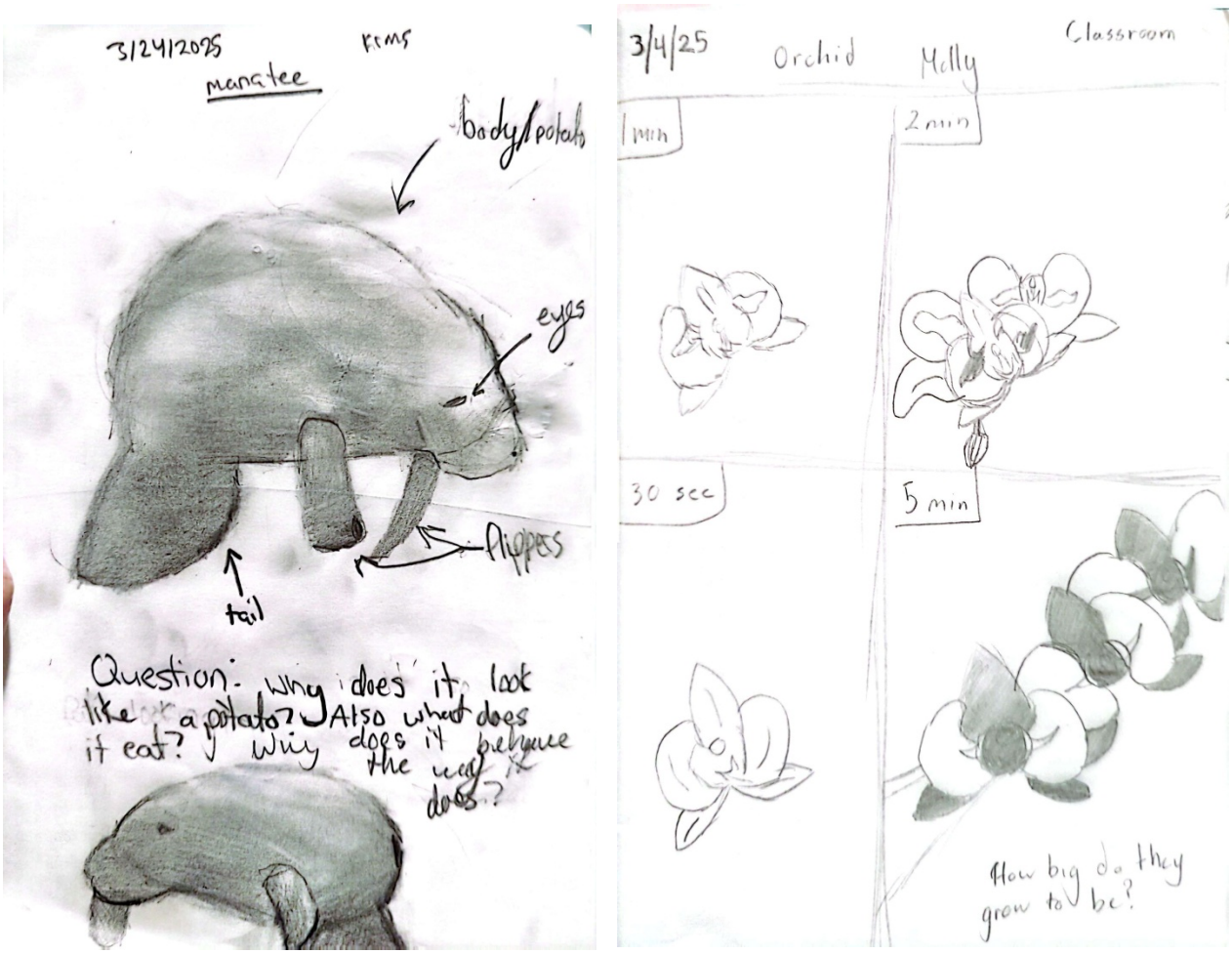

Figure 9. Examples of Student Nature Journals. Manatee drawing illustrates DRAW4 (Annotated Drawing) by labeling parts connect drawing to scientific vocabulary. Orchid timed drawings demonstrate DRAW5 (Progressive Drawing) by showing an increased detail and complexity over sessions.

Student quotes such as, “When I stop and really look, it’s like there’s a whole tiny world out here,” and “I can’t believe I’ve walked past this tree every day and never noticed how cool the bark pattern is,” reflect a shift in perception and attentiveness. Others expressed a desire to stay outside longer or asked for colored pencils to better capture what they saw, showing both creative engagement and emotional resonance. These findings suggest that nature journaling

fostered not just scientific skills, but also a more mindful, personal, and lasting relationship with the natural environment.

Before the nature journaling treatment, many students expressed a general appreciation for the outdoors, often referencing recreational activities or broad observations. Comments such as “I love nature and I like exploring, hiking, rock climbing,” and “I like to hike, walk, and spend time with animals” reflect a pre-existing enjoyment of nature, but not necessarily a reflective or observational connection. When asked what they noticed outside, students mentioned simple features like “the colors, the shapes,” or “the sun, moon, sunset, and sunrise,” suggesting they were aware of nature but not engaging with it deeply.

After participating in nature journaling, however, students described more nuanced and thoughtful relationships with the natural world. Several remarked on how much they had previously overlooked, writing things like “how much I was missing,” and “not everything is as it seems.” They noticed new layers of complexity: “Many different animals have many different behaviors,” and “I feel like I notice how animals act around others more.” This increased observational depth was paired with growing patience and mindfulness: “Nature journaling has helped me take my time,” and “I look more carefully now at textures and small changes.” One student summed up the experience with, “I focus on little details more now.” Together, these reflections show a meaningful transformation in how students engaged with their environment. The shift from general enjoyment to intentional observation and reflective insight suggests that nature journaling helped students form a deeper, more personal connection to the natural world.

Development of Observation and Inquiry Skills

Students showed marked improvement in their ability to observe natural phenomena with depth and curiosity. Likert Survey responses reveal a clear improvement in student attitudes toward their observation skills following the nature journaling treatment. When combining "Strongly Agree" and "Agree" responses, the total increased from approximately 42% in the pre-survey to 60% in the post-survey, reflecting an 18% gain in students who felt confident in their ability to observe details in nature. At the same time, the combined total of "Disagree" and "Strongly Disagree" responses dropped from 27% to just 10%, indicating a marked reduction in students who felt unsure or negative about their observation skills. While neutral responses remained relatively stable only shifting from 31% to 29%, the overall shift toward agreement suggests that nature journaling helped students become more attentive, reflective, and confident in their ability to notice and interpret natural phenomena (Figure 10).

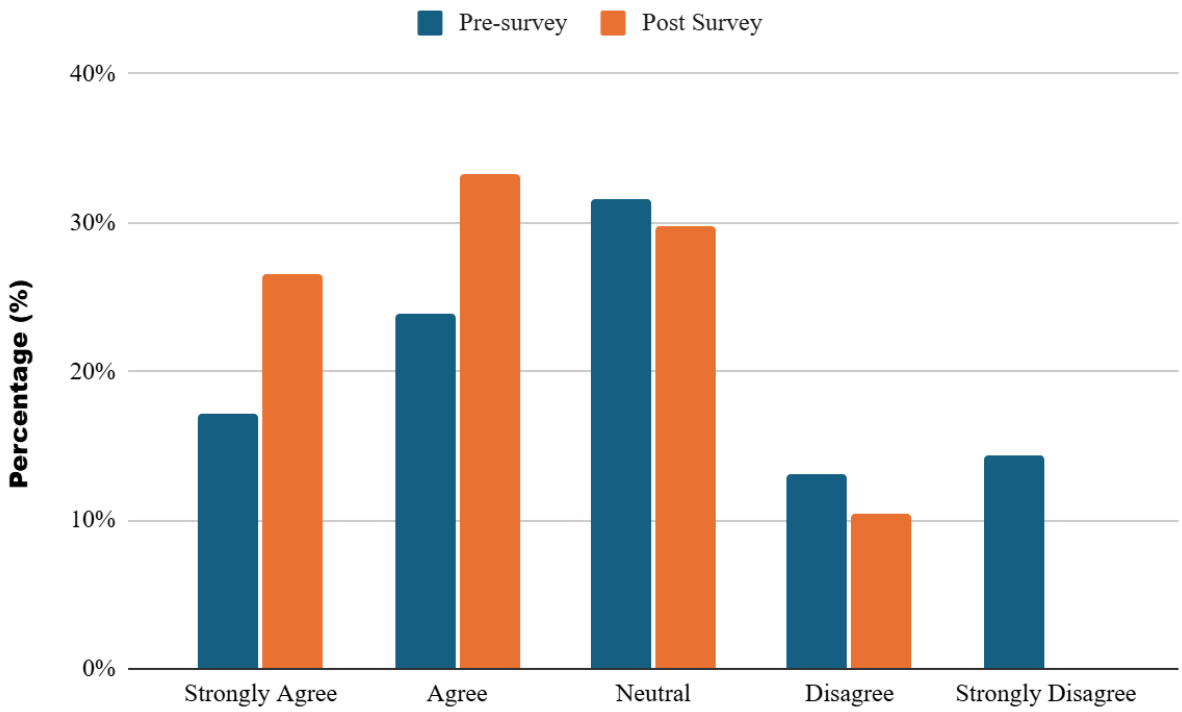

Figure 10. Distribution of Student Perception of Observation Skills Before and After Nature Journaling Treatment (*N*=74).

When comparing the Likert pre- and post-survey responses reveal a clear improvement in students' observation and inquiry skills following the nature journaling treatment. For the item "I can notice small details when I look at plants, animals, or natural objects," the median response increased from 3 (Neutral) to 4 (Agree), with a tighter distribution in the post-survey, indicating greater consistency and confidence among students in their ability to observe fine details. A similar pattern emerged in response to "I can explain my observations to others clearly," where the median also rose from 3 to 4, and fewer low-end responses were recorded, suggesting improved communication skills. For the statement "I feel comfortable using my senses (sight, sound, touch) to explore nature," the post-survey median again increased from 3 to 4, with the lowest outliers disappearing altogether (Figure 11).

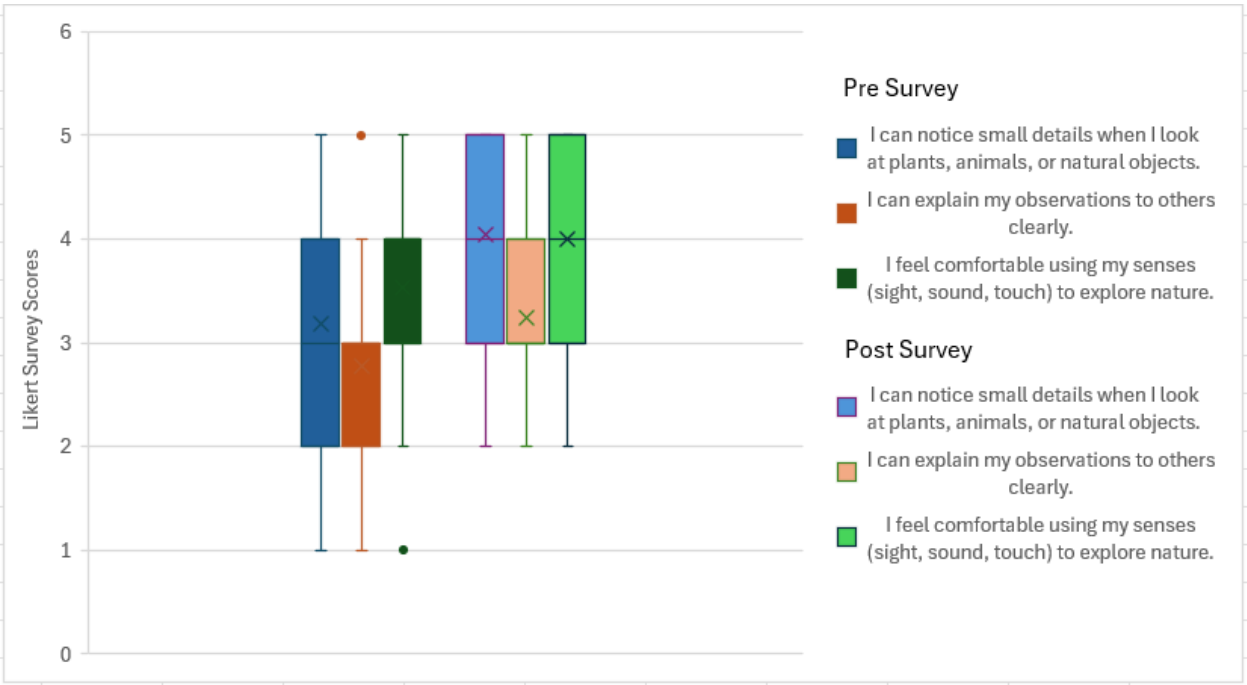

Figure 11. Pre- and Post-Survey Comparison of Student Perception of Observation Skills (*N*=74)

These changes reflect a growing sense of comfort and confidence in students' scientific practices. Overall, the data show that nature journaling not only supported the development of observation and sensory engagement but also enhanced students' ability to reflect on and articulate their experiences which is a key component of scientific inquiry.

Journal analysis provides strong evidence that students developed meaningful observation skills throughout the nature journaling treatment. Nearly half of all journal entries (48%) were coded as DRAW4 or DRAW5, indicating that students consistently created detailed, annotated, or progressive drawings—demonstrating close attention to natural features and changes over time. In addition, 67% of entries included DQL3 or DQL4 coding, meaning that students made clear connections between their observations and the questions they asked. DQL3 (Drawing-Question Link, Intermediate) reflects entries where students explicitly connected their drawings to the questions they asked, such as annotating a plant feature and asking about its

function. DQL4 (Drawing-Question Link, Advanced) involves more sophisticated integration of drawing and inquiry such as posing biologically meaningful questions directly informed by observed structure or behavior. This suggests that their drawings were not just artistic but served as tools for inquiry and reflection.

In one example, a student created a careful sketch of a plant with long, narrow leaves and posed the question, "Why are the leaves shaped like this?" This question is directly linked to a specific feature observed and drawn, reflecting an intermediate level of scientific inquiry focused on understanding structural adaptations in plants (Figure 12).

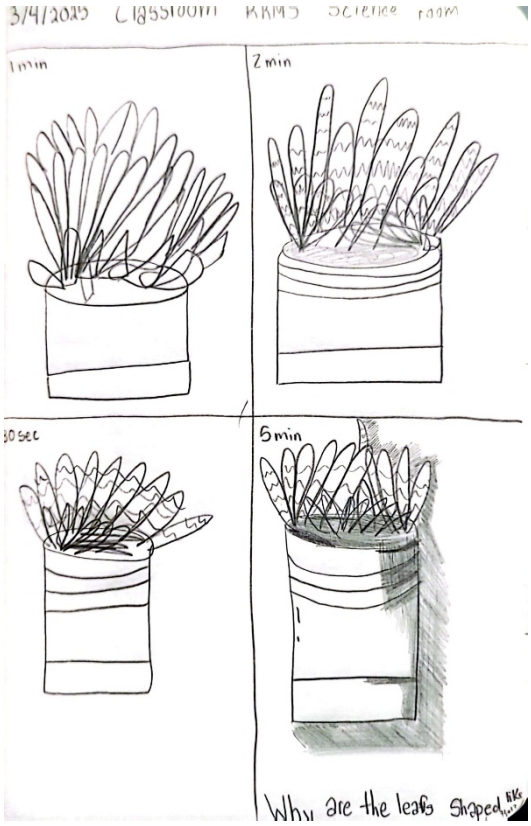

Figure 12. Example of a student nature journal entry demonstrating a detailed connection between drawing and scientific questioning (DQL3) by showing a direct link between observed leaf shape and guiding question.

Furthermore, over 50% of entries contained VOC3 or VOC4 vocabulary codes, reflecting students' increasing use of accurate scientific language and their ability to explain the patterns or processes they observed. VOC3 (Scientific Vocabulary—Moderate) represents accurate use of some scientific terms related to the observed content. VOC4 (Scientific Vocabulary—Advanced) indicates students used domain-specific vocabulary appropriately and demonstrated understanding of processes, relationships, or systems for example, referencing photosynthesis, predator-prey relationships, or mutualism. Together, these data points illustrate that nature journaling helped students become more focused, thoughtful observers who could describe, represent, and reflect on their experiences in scientifically meaningful ways.

Observational behavior in the field confirmed these gains. As the treatment progressed, students demonstrated increased independence and attentiveness during journaling sessions, often settled into their observation spots quickly and remained focused throughout the activity. One student, initially hesitant to draw, began actively sketching and requested extra time to add more detail, stating, "I'm actively trying to draw now." Another student, after spending several minutes studying a single leaf, reflected, "I had no idea how much detail there was to draw," highlighting a growing awareness of patterns, textures, and complexity in natural objects. These findings suggest that nature journaling supports the development of foundational scientific habits: keen observation, critical questioning, and sustained curiosity.

Improved Scientific Communication and Expression

Though not originally a focus of this study, gains in scientific communication emerged prominently through both quantitative and qualitative data. Post open-ended questions showed students felt more comfortable using drawing and writing as tools to express scientific

understanding. Reflections included statements like, “It’s easier to explain when I’ve drawn it too,” and “I write more now because I notice more.”

Journal entries reinforced this narrative. More than half of student journals included integrated visual-verbal explanations of observed phenomena. Approximately 29% of journals featured annotated or labeled diagrams (DRAW4), demonstrating students' ability to use drawings not merely for illustration, but as tools for reasoning and explanation.

In addition, 78% of journals included scientific vocabulary, with 41% demonstrating the use of domain-specific language. One example, a student completed a series of progressively detailed drawings of a purple-colored plant and posed the question, "Is it dark purple because of natural evolution or breeding?" This entry reflects the appropriate use of scientific terms such as evolution and breeding, indicating the student’s ability to incorporate foundational biological concepts into their observations (Figure 13).

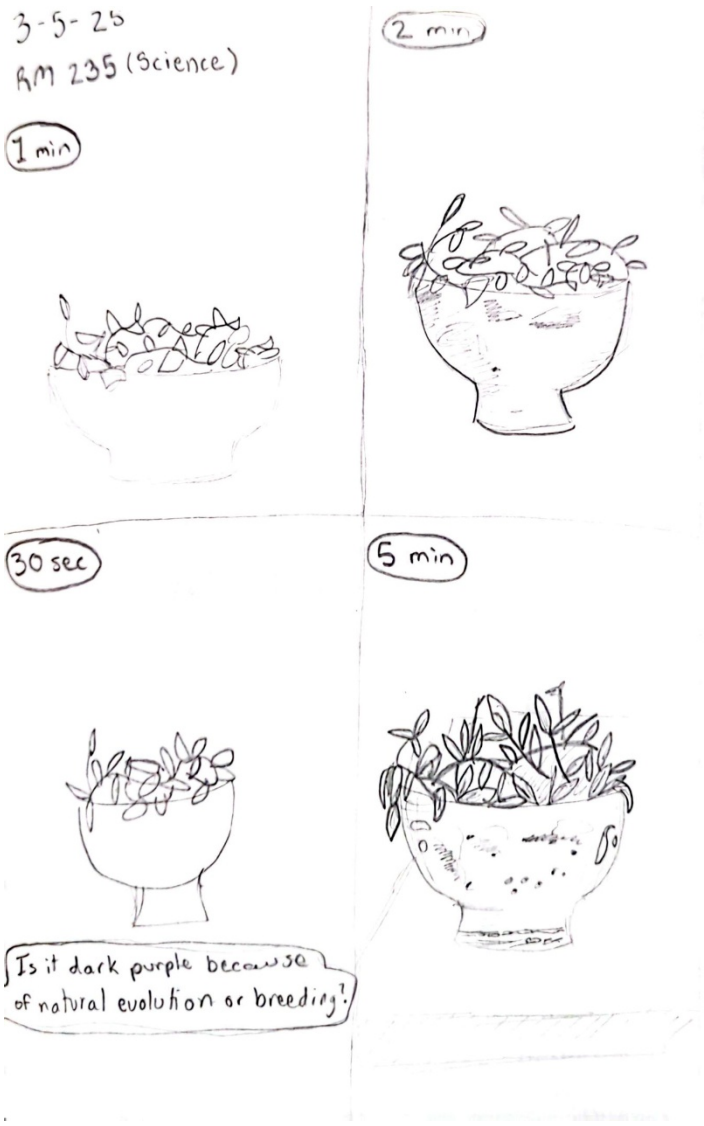

Figure 13. Example of a student nature journal entry demonstrating the use of scientific vocabulary by using scientific terminology and ecological understanding in observation.

On a rainy day during the treatment, students participated in an indoor nature journaling activity using live zoo web cameras to observe animals in real time. Despite the change in setting, students remained highly engaged and applied their observational and inquiry skills to a new context. One student, while watching a lion via webcam, labeled it as a carnivore and connected it to its ecological role, writing, “It’s part of the food web because it eats herbivores

like zebras." This entry not only demonstrated the student's ability to apply domain-specific vocabulary but also reflected a conceptual understanding of predator-prey relationships and energy flow within ecosystems. This shift signals a deeper conceptual understanding and increased ability to communicate complex scientific ideas. Students explicitly stated that drawing helped clarify and expand their thinking: "When I draw it, I can explain it better," and "Drawing shows things I wouldn't think to write about." These statements reflect the multimodal nature of scientific literacy supported by nature journaling.

The nature journaling treatment led to five key outcomes for my middle school science students. First, students gained confidence in their science skills, with more students reporting they felt capable of observing and asking questions. Second, engagement in science increased, students were more focused, motivated, and excited to learn. Third, many formed a stronger personal connection to nature, describing the experience as calming, enjoyable, and eye-opening. Fourth, their observation and inquiry skills improved, as shown through detailed drawings and thoughtful questions in their journals. Finally, students showed growth in scientific communication, using vocabulary and visuals to clearly express their thinking. Overall, nature journaling helped students see science in a new, more meaningful way.

CHAPTER FIVE

CLAIM, EVIDENCE, AND REASONING

Claims From the Study

At the heart of this research was a simple but powerful idea: that by slowing down and connecting with the natural world, students might also connect more deeply with science. This research began with a simple question: Would nature journaling help my middle school students feel more connected and engaged in science? I remember spending hours quietly observing, recording, sketching. It was in those quiet moments that I learned how science begins—not always with answers, but with wonder. I hoped that by giving my students those same opportunities, I could help them become more curious, thoughtful, and engaged scientists. As I moved through this study, what became clear was just how much nature journaling helped students slow down and see. It wasn't just about drawing a tree or writing down facts—it became about curiosity, attention, and connection.

One of the strongest claims supported by the data is that nature journaling significantly increased student engagement in science. Observation checklist data, journal coding, and survey responses all point to a noticeable shift in how students interacted with both the content and their environment. In the early sessions, students were often unsure, some hesitant to draw, and others distracted by their peers. However, by the third or fourth session I saw something shifted. Using my observation checklist and field notes, I saw more and more students kneeling by sleeping flower beds, touching rocks, spotting something new, and sketching with intent. It went from hesitant scribbles to careful, thoughtful entries. Many students began using all their senses to

explore their surroundings, and over the course of the sessions, their journals reflected that growth. The scoring showed more entries with extended curiosity (ENG4), questions rooted in genuine wonder, and detailed observations.

These changes were echoed in student reflections and post-survey responses. Students described feeling calmer, more curious, and more confident. Many expressed surprise on how much they enjoyed the process, particularly the combination of art and science. Several wrote that they "noticed more now" or "felt like real scientists," directly linking their growth to the journaling experience.

Another clear pattern was that students were developing real scientific inquiry and observation skills. The coding system I designed revealed a clear progression from basic factual questions to more complex, investigative ones. Their questions changed—from "What is this?" to "Why is this happening?" or "What would happen if…?" In their journals, students were moving beyond the surface. They were building confidence in their ability to observe and question, and they were using more accurate scientific vocabulary to do it.

What stood out the most, though, was the way many students started making personal connections to science and the natural world. I saw reflections about peace, curiosity, and even joy. One student wrote, "I never realized how relaxing it is to just sit and listen. I want to do this more at home." One wrote, "I feel like I understand the outdoors more now, and I want to keep going outside." Others shared that it helped them feel calm or curious or that it made them notice things they had never seen before. These kinds of reflections indicate not only engagement but a developing science identity. Students began seeing themselves as observers, thinkers, and questioners.

The pre- and post-surveys backed this up too. On nearly every question, students reported feeling more confident, more interested in science, and more connected to nature after our six-week experience. It wasn't a huge leap for every single student, but the overall trend was clear, nature journaling made science more personal, more real, and more engaging. Together, these claims show that nature journaling supported both cognitive and emotional engagement in science, bridging the academic and the personal in a way that made science feel more real and meaningful to students.

Value of the Study and Consideration for Future Research

This study confirmed something I've long felt in my gut as a teacher: when students are invited to slow down, look closely, and connect with their surroundings, science becomes alive. Nature journaling gave my students a way into scientific thinking that felt natural, creative, and accessible. They weren't being told what to learn, they discovered it for themselves. This offers valuable insights into science pedagogy, especially in middle school settings where student engagement can often wane. It demonstrates that creating space for curiosity, reflection, and observation can deepen students' scientific thinking. For my students, nature journaling became a tool for connecting with science in a way that felt relevant and personal.

This study highlights something often missing in middle school science: time and space for noticing. In a fast-paced, test-driven world, we don't always give kids the chance to observe, to really see and think deeply. This study showed that when we do, they rise to the occasion. They become curious, reflective, and engaged. From a pedagogical standpoint this study affirms, nature journaling follows that science instruction that prioritizes student talk, inquiry, and discourse. Nature journaling fits squarely within this framework. It gives students ownership

over their observations, encourages them to ask authentic questions, and integrates writing and drawing as forms of scientific expression.

There's also value in how adaptable this practice is. Nature journaling doesn't require fancy equipment or an elaborate curriculum. It can be done in a patch of grass behind the school or along a sidewalk. It weaves together science, art, writing, and reflection in a way that supports all kinds of learners, including those who might not always shine in traditional classroom settings. The flexibility of the format, the sensory richness of the outdoors, and the slower pace created entry points for students with different strengths and needs. In a field where engagement and inclusion are constant concerns, nature journaling presents a highly adaptable and equitable strategy.

Looking forward, I think there's so much potential to expand this work. In terms of future research, there are several promising directions to explore. I would be interested in studying long-term impacts of nature journaling, how sustained practice over a semester or year might influence science identity, retention of content, or even interest in STEM careers. Additionally, cross-disciplinary studies that pair journaling with language arts or social studies could shed light on how it supports broader academic skills. There is also room to investigate how students with different learning profiles engage with nature journaling, particularly those with IEPs or those who are traditionally underrepresented in science.

That said, there are limits to how broadly these findings can be applied. This study focused on one seventh-grade team at a single rural middle school, with a relatively homogenous student population in terms of race and geographic background. While the results were promising, they reflect the specific context, teaching style, and environmental setting of this

school. Replicating the treatment in urban schools, more diverse classrooms, or different grade levels may yield different outcomes. Future studies would benefit from broader sampling across varied school settings to strengthen the generalizability of findings and better understand how nature journaling works in diverse learning environments.

There's growing interest in practices that support mindfulness, social-emotional learning, and environmental stewardship. As Warkentin (2011) and Louv (2008) suggest, nature-based experiences cultivate emotional awareness, ecological connection, and personal reflection. Meanwhile, Laws and Lygren (2020) emphasize how journaling encourages sustained attention and mindfulness in observation. These findings reinforce nature journaling as a valuable interdisciplinary tool that aligns with both academic and emotional development goals. I hope future research continues to explore its role in building not just scientific knowledge, but thoughtful, connected learners.

Impact of Action Research on the Author

This process changed me. This experience reflects the core principles of action research, which emphasizes practitioner inquiry, reflection, and iterative improvement (Mertler, 2020). By systematically studying my own practice, I was able to make informed changes grounded in real classroom experiences. Engaging in this action research has been nothing short of transformative for me, both as a teacher and as a learner. At the beginning, I felt unsure. I knew I wanted to try something new, something more in line with my own values and experiences, but I didn't yet know how to study it systematically. I worried whether the students would take it seriously, whether I could balance teaching and data collection, and whether I would find anything meaningful in the results. However, as the weeks went on, I began to see my teaching practice in

a whole new light. I found myself tuning into small moments I might have missed before: a student kneeling in the mud to draw a worm, another closing their eyes as they listen to the water dripping after a rainstorm, a third getting excited to see the sleeping koala move. These moments reminded me of why I became a science teacher in the first place.

Through this research, I've become more intentional about creating space for curiosity. I've learned that engagement isn't just about excitement, it's about connection. My students connected with nature, with each other, and with themselves. I connected with them too; in ways I hadn't expected. We shared discoveries, frustrations, laughter, and quiet moments. That connection-built trust, engagement, and joy in our classroom.

Personally, I feel more confident in using data to guide my decisions and more grounded in my own values as an educator. I've always believed that students learn best when they care about what they're doing. This project gave me the tools to prove it and to share that message with others.

Professionally, I'm excited to keep going. I want to expand nature journaling across my school and continue learning alongside my students. I know now that inquiries don't always start with a lab or a lecture that it can start with a question scribbled in a field notebook. And sometimes, that's where the best science begins. Nature journaling has become more than just an activity. It is a philosophy of teaching that I intend to carry forward, one sketch and one question at a time.

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APPENDICES

APPENDIX A

EXEMPTION MSU INSTITUTIONAL REVIEW BOARD

Hello Kerr, Stephanie,

Your protocol was reviewed by the IRB and has been approved.

PI: Kerr, Stephanie

Approval Date: 11/27/2024

Title: The Effects of Using Nature Journaling with Middle School Science Students

Protocol #: 2024-1854-EXEMPT

Review Type: Exemption

Expiration Date: 11/27/2029

APPENDIX B

ENGAGEMENT SCALE SURVEY

Pre-Survey

Instructions: For each statement, please circle the number that best represents your level of agreement.
1 = Strongly Disagree | **2** = Disagree | **3** = Neutral | **4** = Agree | **5** = Strongly Agree

---

Confidence in Scientific Skills:

- I feel confident in my ability to make observations in nature.

◯①②③④ 5

- I can ask good scientific questions about the natural world.

◯①②③④ 5

- I know how to record my observations and ideas in a journal.

◯①②③④ 5

Engagement with Science:

- I feel excited about learning new things in science.

◯①②③④ 5

- I look forward to science lessons at school.

◯①②③④ 5

- I am eager to explore new science topics on my own.

◯①②③④ 5

- I think science is relevant to my everyday life.

◯①②③④ 5

Nature Journaling and Nature Perceptions:

- I think journaling about nature is a good way to learn science.

◯①②③④ 5

- I enjoy drawing and writing about what I see in nature.

◯①②③④ 5

- I enjoy spending time outdoors in nature.

◯①②③④ 5

- I am curious about how living things interact with their environment.

◯①②③④ 5

- I think exploring nature is fun and interesting.

◯①②③④ 5

Scientific Observation Skills:

- I can notice small details when I look at plants, animals, or natural objects.

◯①②③④ 5

- I can explain my observations to others clearly.

◯①②③④ 5

- I feel comfortable using my senses (sight, sound, touch) to explore nature.

◯①②③④ 5

Post-Survey

Instructions: For each statement, please circle the number that best represents your level of agreement.
1 = Strongly Disagree | **2** = Disagree | **3** = Neutral | **4** = Agree | **5** = Strongly Agree

---

Confidence in Scientific Skills:

- After this project, I feel more confident in making observations.

◯①②③④ 5

- I can ask even better questions about what I see in nature.

◯①②③④ 5

- I feel more skilled in recording my scientific ideas and observations.

◯①②③④ 5

Engagement with Science:

- After using nature journaling, I feel more motivated to study science.

◯①②③④ 5

- I look forward to learning more about science in the future.

◯①②③④ 5

- I feel inspired to explore new science topics outside of school.

◯①②③④ 5

- Nature journaling showed me how science is connected to everyday life.

◯①②③④ 5

Nature Journaling Perceptions:

- I think nature journaling has helped me understand science better.

◯①②③④ 5

- I enjoy nature journaling more than I did before this project.

◯①②③④ 5

- I would like to continue nature journaling in other subjects.

◯①②③④ 5

- I like spending time in nature more after doing nature journaling.

◯①②③④ 5

- I have become more curious about how living things interact with their environment.

◯①②③④ 5

- I think exploring nature is even more fun and interesting now.

◯①②③④ 5

Scientific Observation Skills:

I have improved my ability to notice details in plants, animals, or natural objects.

◯①②③④ 5

- I am better at explaining my observations and ideas about nature to others.

◯①②③④ 5

- I feel more confident in using my senses to explore the natural world.

◯①②③④ 5

APPENDIX C

OPEN ENDED SURVEY

Pre-Nature Journaling Questions (Before Sessions)

1. **Attitudes Toward Science:**
    - "How do you feel about science? What do you enjoy or find challenging about it?"
    - "What do you think scientists do, and do you see yourself doing something similar?"
2. **Observation Skills:**
    - "How good are you at noticing details in nature or your surroundings?"
    - "When you see something outside, what kinds of things do you pay attention to?"
3. **Engagement & Confidence:**
    - "How confident do you feel when you have to explain or write down what you've seen or observed?"
    - "Do you enjoy spending time outside? What do you like to do in nature?"
    - Is there anything else you'd like me to know?

Post-Nature Journaling Questions (After Sessions)

1. **Attitudes Toward Science:**
    - "Has your opinion about science changed after doing these nature journaling sessions? Why or why not?"
    - "What did you learn about nature or science that surprised you?"
2. **Observation Skills:**
    - "Do you feel like you notice more details in nature now compared to before? Can you give an example?"
    - "How has nature journaling helped you observe or understand things differently?"
3. **Engagement & Confidence:**
    - "Did you enjoy the nature journaling activity? What part did you find the most engaging or interesting?"
    - "Do you feel more confident now in writing about or drawing what you observe? Why or why not?"
    - Is there anything else you'd like me to know?

APPENDIX D

OBSERVATIONAL CHECKLIST

Student Name: _____ Date: _____

1. Physical Engagement

☐ Actively writing or drawing in their journal.

☐ Frequently referencing surroundings (plants, animals, sky, etc.).

☐ Moving to different areas to observe.

☐ Pausing to reflect or study something in detail.

Physical Engagement Score (1-4): ____

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2. Emotional/Behavioral Engagement

☐ Shows excitement or enthusiasm about observations.

☐ Remains focused, with minimal distractions.

☐ Demonstrates curiosity by asking questions or seeking to explore further.

Emotional/Behavioral Engagement Score (1-4): ___

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3. Overall Engagement in the Process

☐ Completes journal entries with care and thoroughness.

☐ Spends adequate time on each task.

☐ Enjoys the process and appears engaged.

Overall Engagement Score (1-4): ___

Field Notes: Write any additional observations or notable behaviors related to the student's engagement:

Engagement Rubric

Score	Description
4	Excellent - Fully engaged: actively participates, shows enthusiasm, moves around, and often reflects on observations.
3	Proficient - Generally engaged: participates consistently, shows interest, occasionally reflects, and explores surroundings with moderate enthusiasm.
2	Developing - Partially engaged: sporadic participation, limited enthusiasm, minimal movement, or reflection.
1	Needs Improvement - Disengaged: little to no participation, remains in one spot, no curiosity or reflection, appears frustrated or uninterested.

Use the rubric to assess each category (Physical, Emotional/Behavioral, and Overall Engagement) and calculate the total engagement score for each student.

APPENDIX E

NATURE JOURNAL CONTENT ANALYSIS CODE

Nature Journaling Content Analysis Coding

1. Level of Inquiry

This category assesses the level of curiosity and scientific inquiry shown in students' entries, reflected through the types of questions asked and statements made.

- **INQ1: Basic Questions**: Simple factual questions (e. g., "What kind of tree is this?").
- **INQ2: Hypothetical Questions**: Questions showing curiosity about causes or mechanisms (e.g., "Why do these leaves change color in the fall?").
- **INQ3: Probing or Investigative Questions**: Questions that suggest further investigation or experimentation (e.g., "Will this flower bloom next week if I check this spot?").
- **INQ4: Wonder Statements**: Expressions of curiosity or wonder, without asking a direct question (e. g., "I wonder why this bird returns to the same branch").

2. Types of Questions

This category looks at the specific kinds of questions asked by students to assess the depth of their thinking.

- **Q1: Descriptive Questions**: Questions that focus on identifying or naming (e. g., "What type of bird is this?").
- **Q2: Cause-and-Effect Questions**: Questions that try to understand why something happens (e. g., "Why are these leaves turning yellow?").
- **Q3: Process Questions**: Questions about how something works or changes over time (e. g., "How long does this plant take to grow?").
- **Q4: Hypothetical or Speculative Questions**: Deeper thinking about potential outcomes (e. g., "Will the flowers' color change if the weather is colder?").
- **Q5: Action-Oriented Questions**: Questions that invite further investigation or experiment (e. g., "What will I find under this rock if I check again tomorrow?").

3. Drawing-Question Link

This category assesses the connection between a student's drawing and their accompanying questions or observations.

- **DQL1: No Question-Observation Link**: No evident connection between drawing and question (e.g., drawing a tree but asking about the weather).
- **DQL2: Basic Link**: A direct but simple link between the drawing and the question (e. g., drawing a flower and asking, "What kind of flower is this?").

- **DQL3: Detailed Link**: Questions that engage deeply with the drawing, asking how or why (e. g., drawing a damaged leaf and asking, "What insect might be eating this?").
- **DQL4: Extended Inquiry Link**: Drawings and questions that reflect understanding of broader patterns or cycles (e. g., drawing flower stages and asking, "How does sunlight affect blooming?").

4. Quality of Drawings

This category evaluates the level of detail, focus, and engagement in the drawings, which often reflects the depth of observation.

- **DRAW1: Basic Drawing**: Simple or incomplete sketches with minimal detail.
- **DRAW2: Descriptive Drawing**: More detailed drawings highlighting key features (e.g., leaves with visible texture).
- **DRAW3: Comparative Drawing**: Drawings that compare multiple subjects (e.g., two types of leaves or flowers side by side).
- **DRAW4: Annotated Drawing**: Drawings labeled or annotated with specific observations or questions (e. g., "holes in the leaf" or "dark spots on petals").
- **DRAW5: Progressive Drawing**: Series of drawings showing development or changes over time (e.g., tracking plant growth or the phases of the moon).

5. Use of Scientific Vocabulary and Concepts

This category assesses the student's use of scientific language and conceptual understanding in their journaling.

- **VOC1: Minimal Use of Scientific Terms**: Little to no use of scientific vocabulary.
- **VOC2: Basic Use of Scientific Terms**: Common scientific terms are used appropriately (e. g., "insects," "leaves").
- **VOC3: Specific and Accurate Use of Concepts**: Use of precise terms related to scientific processes (e. g., "photosynthesis," "precipitation").
- **VOC4: Application of Scientific Concepts**: Applying scientific knowledge to explain observations (e. g., "The leaves change color due to the breakdown of chlorophyll").

6. Engagement and Interaction with the Environment

This category evaluates the level of engagement with both the environment and the journaling process.

- **ENG1: Minimal Engagement**: Brief or shallow entries with little exploration.
- **ENG2: Moderate Engagement**: Some exploration, but limited follow-up (e. g., observing a plant but not returning to it).
- **ENG3: Active Engagement**: Detailed observations and returning to previous spots, using multiple senses (e.g., smelling flowers, touching leaves).
- **ENG4: Sustained Curiosity**: Continual exploration, revisiting past questions, and demonstrating excitement for learning.

Example for Coding:

Student Name	**Entry #**	**Inquiry (INQ)**	**Question Type (Q)**	**Drawing-Question Link (DQL)**	**Drawing Quality (DRAW)**	**Vocabulary (VOC)**	**Engagement (ENG)**	**Notes**
Jane Doe	1	INQ3	Q2	DQL3	DRAW4	VOC3	ENG3	Good attention to detail and questioning