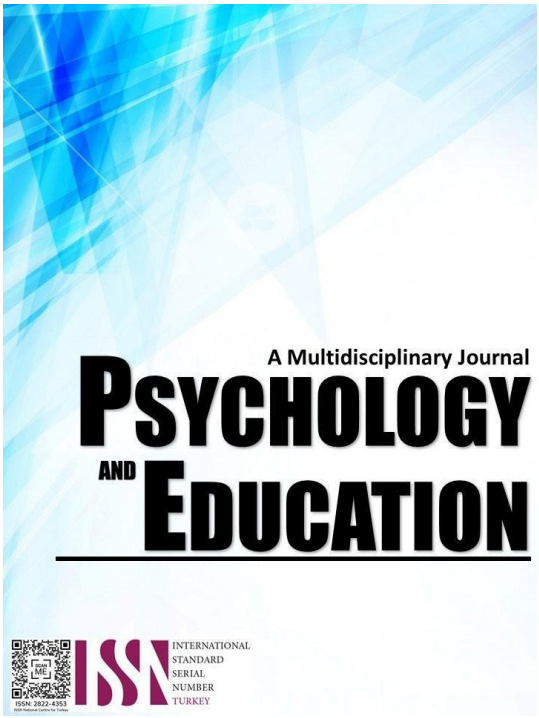
ENHANCING SCIENCE 10 LEARNING THROUGH PHOTO ELICITATION-BASED INTERACTIVE ACTIVITIES ON BIODIVERSITY



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Research Article

Enhancing Science 10 Learning Through Photo Elicitation-Based Interactive Activities on Biodiversity

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Abstract

Understanding biodiversity goes beyond memorizing facts; it also requires seeing, experiencing, and making connections to the world around us. However, traditional teaching methods often fail to capture students' interest and deepen their appreciation for biodiversity. Hence, this qualitative study employing an action research approach explored how photo-elicitation-based interactive activities can enhance Science 10 students' learning experiences at San Jose National High School- Lapuz National High School Annex. By using real-life images of biodiversity, the study aimed to make learning more engaging and meaningful. The study was conducted among 48 students who participated in classroom observations, student reflection journals, and focused group discussions. Thematic analysis was applied to identify patterns in students' understanding, experiences, and challenges. Findings revealed that photo-elicitation helped students develop a deeper understanding of biodiversity concepts, making learning more relatable and interactive. The visual approach made learning more engaging, sparking curiosity and encouraging active discussions. Many students found the approach enjoyable and thought-provoking, though some initially struggled with interpreting images. Over time, guided discussions helped them improve their analytical thinking and environmental awareness. More importantly, the study revealed a positive shift in students' attitudes toward biodiversity conservation. Thus, it reinforced that photo-elicitation is a powerful tool for making biodiversity education more engaging and thought-provoking. It goes beyond memorization, allowing students to see biodiversity as something real and relevant.

Keywords: *photo-elicitation, biodiversity education, interactive learning, Science 10, student engagement, conservation awareness. Philippines*

Introduction

In today's rapidly changing environment, biodiversity is under serious threat from habitat destruction, climate change, pollution, and human exploitation. These issues have caused significant disruption in ecological balance, threatening the sustainability of life-supporting systems such as clean air, potable water, and food sources (IPBES, 2019). However, many students struggle to appreciate the importance of biodiversity, partly due to traditional, lecture-based science instruction that fails to create real-world connections (Dirzo et al., 2014).

Globally, the United Nations (2023) reports that nearly one million species are at risk of extinction due to deforestation, climate change, and overexploitation of natural resources. This alarming statistic highlights the urgent need to raise awareness among younger generations. Despite various conservation campaigns, the lack of engaging science education approaches has led to a gap in students' environmental literacy and active participation in biodiversity preservation (Monroe et al., 2019).

In the Philippine context, the country is one of the world's 17 megadiverse nations, yet it faces severe biodiversity threats due to rapid deforestation, climate pressures, and wildlife exploitation (DENR, 2022). According to Ong et al. (2020), environmental education in the Philippines remains largely textbook-centered and fails to foster students' appreciation for local ecosystems. There is a need to bridge the disconnect between students and their immediate natural environments by promoting localized, experiential learning strategies.

In South Cotabato, biodiversity hotspots like Mt. Matutum are endangered by illegal logging, mining, and agricultural expansion. The Provincial Environment Management Office (PEMO, 2023) reported continued encroachment on protected areas, putting endemic species such as the Philippine eagle at risk. Villanueva and Santos (2021) further note that monoculture and pesticide use are degrading soil and biodiversity in farmlands. These threats underscore the need for school-based biodiversity education that emphasizes local ecological issues and fosters community-based stewardship.

While photo-elicitation has been effectively used in social research to provoke reflection and discussion, its potential in science classrooms—particularly in biodiversity education—remains underexplored (Garcia et al., 2022). Photo-elicitation-based interactive activities offer students a multisensory experience that promotes critical thinking, emotional connection, and environmental responsibility (David et al., 2021). However, many science teachers still rely heavily on rote memorization and textbook instruction, missing opportunities to engage learners in meaningful scientific inquiry.

This study addresses the research gap identified by Garcia et al. (2022) and Monroe et al. (2019), who emphasize the limited application of photo-elicitation and inquiry-based visuals in biodiversity learning. By integrating photo-elicitation-based interactive activities into

Science 10 instruction, this study explores an innovative strategy to promote student engagement and deeper understanding of local biodiversity. The findings may serve as a basis for revising instructional practices, especially in public schools, to support more contextualized and student-centered approaches to biodiversity education.

Research Questions

This study aimed to assess science learning through photo-elicitation-based interactive activities on Biodiversity among the Grade 10 students. Specifically, it sought to answer the following questions:

1. How does a Photo-elicitation-based interactive approach enhance students' understanding of biodiversity and influence their beliefs about biodiversity?
2. What are the students' experiences and beliefs of using photo-elicitation activities in learning biodiversity?
3. What challenges and benefits do students encounter in using a Photo-elicitation-based approach in science 10?
4. How can research-based elicited photos be incorporated into instruction?

Literature Review

Photo Elicitation as an Educational Tool

Photo-elicitation is a pedagogical method involving the use of photographs as prompts for discussion or reflection, which has gained traction in academic research targeted at enhancing educational outcomes. This technique facilitates the sharing of insights and personal experiences related to imagery displayed, which is particularly beneficial in biodiversity education. According to Cohen et al. (2019), the incorporation of photo elicitation into biodiversity curricula enables students to actively visualize and engage with various species, effectively bolstering their learning and retention. Torres and Castillo (2021) further supported this by demonstrating that the integration of photo elicitation with interactive activities can significantly increase student motivation and interest in biodiversity topics, thereby reinforcing curriculum design strategies aimed at ecological education.

The use of photo elicitation in educational contexts provides a distinctive platform for students to express their thoughts and feelings regarding environmental issues and biodiversity. A study conducted by DeWalt (2015) illustrated that this technique can uncover students' intrinsic connections to nature, ultimately shaping their understanding and stewardship of biodiversity. By employing visual stimuli, educators can evoke deeper personal reflections and encourage critical discussions surrounding ecological topics. Integrating photo-elicitation-based interactive activities into biodiversity education emerges as a groundbreaking approach aimed at improving student engagement and comprehension. Numerous studies highlight how these methods not only foster personal connections with biodiversity but also stimulate critical thinking and collaborative learning (Koller et al., 2016; Cohen et al., 2019; Fischer et al., 2022).

Interactive Activities in Science Education The integration of interactive activities into science education has garnered considerable attention to enhance students' engagement and understanding of intricate subjects like biodiversity. Harper and Smith (2020) conveyed that photo elicitation fosters emotional and cognitive connections with subject matter through visual stimuli, thereby promoting deeper comprehension and retention. As an effective method for addressing topics that students may perceive as abstract or remote, photo elicitation invites substantial engagement.

Furthermore, inquiry-based learning strategies have proven to be effective in promoting critical thinking and problem-solving skills concerning biodiversity issues. Research by Bell et al. (2018) indicated that students engage more readily in scientific inquiry when presented with relevant, real-world challenges associated with biodiversity. Fischer et al. (2022) corroborated this, stating that interactive learning environments enhanced through innovative methods like photo elicitation allow students to delve into biodiversity through collective discussion and shared experiences, leading to a more profound understanding of the content (Bell et al., 2018; Fischer et al., 2022). Such pedagogical strategies are essential for teaching biodiversity, as they require learners to connect various ecological components and comprehend their interactions within ecosystems (Hawkes, 2018).

Utilizing Visual Stimuli in Teaching

Incorporating visual stimuli, such as photographs, offers numerous benefits in educational settings. Firstly, it enhances cognitive engagement by stimulating students' senses and encouraging connections between visual information and verbal/graphic representations (Carspecken, 1996). This multisensory approach is particularly effective in science education where abstract concepts require concrete visual representations. Secondly, photo elicitation nurtures critical thinking and reflective skills. According to Gibson et al. (2021), when students analyze and interpret images, they engage in higher-order thinking, fostering essential analytical capabilities for scientific inquiry. Additionally, the collaborative nature of photo elicitation encourages social interaction among students, contributing to community-building and collective knowledge construction (Mason, 2017).

Lastly, visuals can evoke emotional responses, rendering learning more relatable and significant. Emotional engagement may enhance motivation and interest in the subject matter, particularly in biodiversity, where students can develop a greater appreciation for environmental issues and social justice (McGregor, 2018).

Models of Inquiry-Based Learning

Models of inquiry-based learning align with interactive activities that invite experiential learning through observation and image analysis. This methodology is particularly effective in biodiversity education, as it allows students to investigate real-world issues, such as habitat loss and species extinction, fostering a sense of responsibility towards environmental stewardship (Miller, 2021).

Understanding biodiversity's significance requires effective pedagogical strategies to convey the importance of ecosystems and species interactions. Research indicates that active learning environments significantly enhance knowledge retention and problem-solving abilities compared to traditional lecture settings (Kuo, Hsu, & Goh, 2018). Furthermore, visual aids, including videos and images, enhance learners' capacity to recall detailed information tied to specific species and habitats (Buchanan et al., 2020).

Importance of Biodiversity Education

Biodiversity education is essential for cultivating a generation that values and actively participates in conservation efforts. It plays a vital role in promoting environmental awareness and stewardship among students (Bohnsack, 2020). A solid understanding of biodiversity's importance enables students to become informed citizens capable of effecting environmental change.

Millennium Ecosystem Assessment (2005) underscored that biodiverse ecosystems provide indispensable

services such as air purification, pollination, and disease regulation. Therefore, effective biodiversity education enriches student knowledge and equips them to confront contemporary environmental challenges. Integrating biodiversity education into curricula enhances critical thinking and problem-solving skills, empowering students to engage with issues such as climate change, habitat loss, and sustainable practices (Sarkar et al., 2020).

Current Pedagogical Approaches to Teaching Biodiversity

Contemporary pedagogical strategies for teaching biodiversity emphasize inquiry-based learning, hands-on activities, and technology integration. Inquiry-based learning encourages students to pose questions, conduct investigations, and draw conclusions about biodiversity through direct engagement with their surroundings (Flick, 2018). This educational approach aligns with constructivist pedagogies, emphasizing that students develop knowledge through collaborative experiences and interactions.

On the other hand, Harper (2002) discussed that photo elicitation serves as an innovative strategy enhancing biodiversity education, utilizing visual stimuli to provoke student discussion and reflection. Cox and Degnan (2016) added that incorporating visual elements in science education substantially increases student interest and comprehension levels.

The employment of photo elicitation in interactive activities allows for deeper exploration of biodiversity, resulting in richer discussions and heightened emotional connections to the subject matter (Gubrium & Holstein, 2002). Additionally, technology-enhanced learning tools, such as digital platforms for biodiversity mapping or virtual field trips, broaden students' understanding of global biodiversity issues, even in classrooms lacking direct access to natural ecosystems (Bowers et al., 2018). Collectively, these diverse pedagogical practices aim to create engaging and significant learning experiences that not only inform students but also instill a sense of responsibility and agency concerning biodiversity conservation.

Constructivist Theories of Learning

Constructivism posits that learners construct knowledge through interactions with their environment. This perspective emphasizes the necessity of active learning, where students engage proactively in their educational journeys rather than passively receiving information (Bruscia, 2020). According to Piaget (1976), learning involves adaptation through assimilation and accommodation, while Vygotsky (1978) underscored the social context of learning and the value of collaborative interactions in knowledge construction. In science education, constructivist approaches have demonstrated considerable efficacy in facilitating deeper understanding of scientific concepts, as students actively engage with material, critique their assumptions, and co-construct knowledge through exploration and discussion (Driver & Easley, 1978).

Research consistently indicates that the incorporation of hands-on activities enhances classroom engagement and comprehension, especially for complex subjects like biodiversity (Barrow, 2006). As an interactive tool, photo elicitation embodies constructivist principles, capturing students' interest and prompting them to relate scientific concepts to their own experiences and perspectives.

Engagement's Role in Scientific Inquiry

Engagement stands as a pivotal element in scientific inquiry, directly affecting students' motivation and determination in their learning pursuits. Fredricks et al. (2004) defined engagement as encompassing behavioral, emotional, and cognitive dimensions, all pivotal in crafting meaningful learning experiences in science. When students are engaged, they are more likely to achieve a deeper understanding of scientific concepts and processes (Gonzalez & Fuchs, 2016).

Through interactive activities that foster engagement—such as those seen in photo elicitation—students improve their inquiry skills and nurture collaborative learning environments (Baker et al., 2020). By prompting discussions and reflections on biodiversity-related visual materials, students can connect prior knowledge with new information, thus enriching their scientific understanding and inquiry

capabilities. These findings resonate with Hattie's (2009) emphasis on the importance of active learning and teacher-student interactions in fostering academic success.

Methodology

Research Design

This study employed a qualitative research design to explore the effectiveness of photo-elicitation-based interactive activities in enhancing Science 10 students' learning about biodiversity. Qualitative research focuses on understanding human experiences, perspectives, and the meaning individuals assign to phenomena in natural settings (Creswell,2013). This design is appropriate as it allows for an in-depth examination of students' experiences, reflections, and engagement with biodiversity concepts through interactive classroom practices. A systematic inquiry conducted by educators to improve teaching practices and student learning outcomes (Mertler, 2019).

The photoelicitation method, where images serve as stimuli for discussion and learning, was integrated into interactive activities to foster deeper understanding and critical thinking about biodiversity (Harper,2002). This approach supports the principle of constructivist learning theory, which emphasizes the active role of students in constructing knowledge through visual and experiential learning (Piaget,1952; Vygotsky, 1978). Through classroom observations, student reflection journals, and focus group discussions, the study captured rich, contextual insights into how students interact with and make sense of biodiversity topics presented through visual stimuli.

Respondents

This study was conducted among the Grade 10 students at San Jose NHS-Lapuz NHS Annex, San Jose Norala, South Cotabato. A total of 48 students, consisting of 26 boys and 22 girls, were engaged in classroom activities that incorporated photo-elicitation techniques, where images were used to stimulate discussions, reflections, and deeper conceptual understanding of biodiversity (Harper, 2002). These students were purposely selected as the subjects and participants of the study. They were identified as a trustworthy source of information and data.

Instrument

This study employed a qualitative data collection instrument, specifically classroom observations, students' reflection journals and focus group discussions (FGDs), to explore the impact of photo-elicitation-based interactive activities on Science 10 students' learning about biodiversity. These instruments were chosen to provide rich, descriptive insights into students' engagement, learning experiences, and conceptual understanding (Creswell & Poth,2018).

Classroom observations were conducted to document students' participation, engagement, and interactions during photo-elicitation activities. The researcher used an observation checklist to systematically record students' responses, discussions, and behaviors in relation to the learning activities (Mertler, 2019). Observation helped capture real-time learning dynamics and provided contextual understanding of how students process visual information related to biodiversity.

Students' Reflection journals to record their thoughts, insights, and learning experiences after engaging with photoelectric-based activities. Reflection journals are effective tools for assessing students' perceptions and conceptual changes, allowing researchers to analyze patterns in students' learning (Kolb,1984).

Focus Group Discussions were conducted to gain deeper insights into students' learning experiences. Groups of students participated in semi-structured discussions facilitated by the researcher, focusing on their engagement with images, critical thinking processes, and how photo-elicitation influenced their learning. The discussions were audio-recorded and transcribed for thematic analysis (Krueger & Casey, 2015).

Procedure

This study followed a standardized operating procedure to ensure a systematic and rigorous research process. After receiving approval from the Dean of the Graduate School. The researcher proceeded with the following steps. Initially, an approval letter requesting permission to conduct the study was sent to the Division Superintendent of the Division of South Cotabato and the School Principal of SJNHS-LNHS Annex to utilize the researcher's official time for data gathering purposes.

It was followed by the implementation of photo-elicitation-based activities. During this phase, the photo-elicitation-based interactive activities were integrated into regular Science 10 Classes. The researcher introduced biodiversity-related images that were carefully curated to stimulate discussion and enhance conceptual understanding. Students were encouraged to analyze, describe, and reflect on the images. Connecting them to real-world biodiversity concepts. This phase followed constructivist and experiential principles, emphasizing student-centered exploration (Kolb,1984; Vygotsky,1978).

The data collected in this study were analyzed using thematic analysis, a qualitative approach used to identify, analyze, and interpret

patterns of meaning within the data (Braun & Clarke, 2006). This method was chosen because it allows for a systematic examination of students' engagement, reflections, and discussions related to photo-elicitation-based interactive activities on biodiversity.

Data Analysis

In this study, data were analyzed using various statistical methods. Research Question 1 used descriptive statistics to summarize the demographic profile of the respondents (gender, age, grade level, socio-economic status) through frequencies and percentages. Research Question 2 also utilized descriptive statistics (mean and standard deviation) to measure the level of English language learning in terms of motivation, parental involvement, learning environment, and teaching strategies, based on the survey responses. Similarly, Research Question 3 applied descriptive statistics to analyze students' academic performance using their General Weighted Average (GWA) and critical thinking skills, based on the survey questionnaire. For Research Question 4, regression analysis was used to examine the relationship between English language learning factors and students' English language skills. This helped identify which factors significantly predict academic performance and critical thinking skills.

Ethical Considerations

In the study Enhancing Science 10 Learning through Photo-Elicitation-Based Interactive Activities on Biodiversity, several ethical considerations were addressed in assessing innovative teaching methods such as photo-elicitation. A key ethical concern was ensuring that all participants benefit equally from the learning experience. Van den Bergh et al., (2014) highlighted that educational interventions should provide equal opportunities and advantages to all participants, ensuring no student is disadvantaged in the learning process. Without the use of standardized assessments, it is crucial to capture students' initial understanding and learning outcomes through alternative methods, such as observations or other forms of assessment, to better cater to diverse student needs. Overall, while innovative teaching methods offer great potential to enhance learning, the ethical considerations in the conduct of such research must be handled with care. By ensuring equal benefits for all participants, obtaining informed consent, and securing participant confidentiality, the integrity of the study and the well-being of the participants were upheld

Another important ethical consideration was to obtain informed consent. It involved clear communication of the study's purpose, methods, and potential impacts to all participants (McLaughlin, 2017). This also considered the students, teachers, and possibly their parents or guardians. Explanations were clearly conveyed as to how the interactive activities are conducted, what students may gain, and how their data may be used. The communication was transparent and thorough to ensure that all participants can make informed decisions about their involvement in the study. Ethical research practices also guaranteed that participants have the right to withdraw at any time without facing any consequences, thus respecting their autonomy and dignity throughout the research process (Creswell & Poth, 2018).

Confidentiality and data protection are also crucial aspects of ethical research in education. It is vital that researchers safeguard the anonymity of participants and protect their data from unauthorized access. Ensuring that any information collected during the study is stored securely and used only for research purposes is necessary to maintain trust (Bourke, 2019). The measures such as de-identifying data in reports or publications to preserve participants' anonymity while contributing to the academic discourse on effective science education methods were considered.

Results and Discussion

This section presents the results of the study on Enhancing Science 10 Learning Through Photo-elicitation-Based Interactive Activities on Biodiversity. This study employed thematic analysis, a widely used qualitative data analysis method for identifying, analyzing, and interpreting patterns or themes within data (Braun & Clarke,2006). The finding was derived from a qualitative data collected through classroom observation, reflections journals, and focus group discussions (FGDs).

Theme Map on The Role of Photo-Elicitation in Deepening Biodiversity Understanding

The thematic analysis revealed six key themes that demonstrate the transformative role of photo-elicitation in biodiversity. These themes include moving beyond memorization, increasing awareness of biodiversity, enhancing classification skills, recognizing human impact, fostering critical thinking, and improving engagement in learning. Each theme provides valuable insights into effectiveness of visual learning strategies in improving students' conceptual understanding of biodiversity.

Theme1. From Memorization to Meaningful Understanding

Photo-elicitation facilitates a transformative shift in students' learning, moving from rote memorization to meaningful understanding of biodiversity. Prior to the intervention, many students relied on memorizing textbook definitions and static content, often struggling to apply concepts beyond written terms. However, when introduced to biodiversity through photo-elicitation activities, learners demonstrated an enhanced grasp of ecological relationships, species interdependence, and real-world applications of theoretical knowledge.

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One participant shared,

"Noon, inaalala ko lang ang mga kahulugan ng ecosystem, pero nang Makita ko ang ang mga aktwal na larawan, naunawaan ko kung paano Nagkakaugnayan at umaasa ang mga hayop at halaman sa isa't-isa."
[Before I only memorized definitions of ecosystems, but when I saw the actual photos, I understand how animals and plants depend on each other.] *(P1)*

"Akala ko noon pare-pareho lng ang lahat ng puno,pero natutunan kong Tukuyin ang iba't ibang uri ng mga species sa ating local na kapaligiran"
[I thought all tress were the same, but I learned to identify different species in our local environment.] *(P3)*

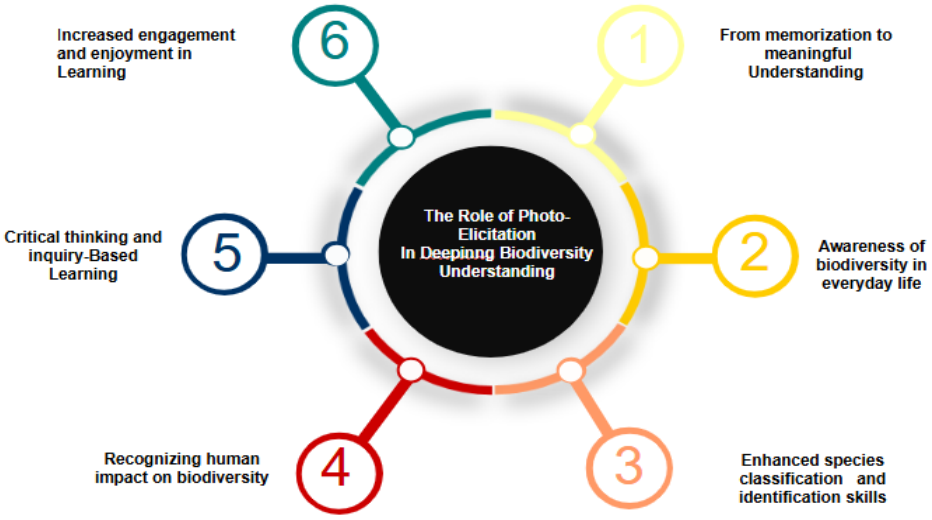

Figure 1. *Schematic Diagram on the Role of Photo-Elicitation in Deepening Biodiversity Understanding***.**

These reflections highlight the significance of using visuals to promote deeper cognitive processing. When students analyze actual images of local biodiversity, learning becomes contextualized and more relevant to their lived experience. As supported by David et al. (2021), visual-based learning fosters personal connections and enhances comprehension, especially in abstract scientific topics. Through imagery, learners are able to move beyond surface-level recall and toward applying, analyzing, and evaluating information—skills that are critical in environmental education.

The use of photo-elicitation aligns with Bruner's (1966) theory of representation, which suggests that learning progresses through enactive (action-based), iconic (image-based), and symbolic (language-based) stages. By engaging in iconic learning through photographs, students achieve a richer understanding before transitioning to abstract concepts. Similarly, Vygotsky's (1978) socio-cultural theory emphasizes that knowledge construction is socially mediated and dependent on tools—such as visual aids—used within a shared learning environment. Photo-elicitation, therefore, functions as both a cognitive and social tool that facilitates collaborative meaning-making and critical reflection.

The findings imply that science instruction should integrate more experiential and visual methodologies, such as locally relevant photographs, case studies, and interactive discussions, to deepen students' understanding. Rather than merely memorizing terms, learners should engage with real-world representations that develop their environmental literacy and ecological awareness.

Concluding Statement:

This theme underscores the pedagogical value of photo-elicitation in bridging the gap between theoretical knowledge and practical understanding. Through visual learning, students not only retain information more effectively but also cultivate a genuine awareness of biodiversity and its significance in their lives. As such, incorporating image-based strategies into science education represents a vital step toward more meaningful, student-centered learning.

Theme 2: Awareness of Biodiversity in Everyday Life

Another key theme that emerged from the analysis is the heightened awareness of biodiversity in students' immediate surroundings after participating in photo-elicitation activities. Initially, many students perceived biodiversity as a distant, abstract concept limited

to textbook discussions or far-off ecosystems. Through exposure to real-world and locally-sourced biodiversity photographs, students began to recognize the presence and richness of life forms within their own communities.
One student reflected,
"Dati, iniisip ko na ang biodiversity ay basta nasa mga aklat lamang, pero Nang makita ko ang mga larawan, naunawaan kong nasa paligid ko pala Ito."
[I used to see biodiversity as just something in textbooks, but when I see the photos, I realized it's everywhere me.] *(P2)*

Another participant stated,
" Noong una, ang alam ko lang ay mga karaniwang hayop, pero matapos ang mga gawain, nakatuklas ako ng mga species na hindi ko pa nakikita noon.
" [At first, I only knew common animals, but after the activities, I discovered species I had never seen before.] *(P5)*

These responses reflect how photo-elicitation helps bridge the gap between classroom knowledge and everyday experience. By examining visual representations of local biodiversity, students begin to notice and appreciate ecological details in their own environment. According to Delos Reyes et al. (2022), learning strategies that incorporate real-world biodiversity visuals cultivate observation skills and ecological consciousness. This increased attentiveness can lead to more meaningful engagement in conservation and environmental stewardship.
The findings are also supported by experiential learning theories, particularly Kolb's (1984) model, which emphasizes learning through direct experience and reflection. When students interact with authentic biodiversity photos and relate them to their surroundings, they engage in active learning cycles that promote deeper understanding and retention. Furthermore, Bandura's (1986) social cognitive theory suggests that observational learning plays a central role in behavior change. Seeing familiar yet previously unnoticed species in photographs can spark interest, inspire further exploration, and shape positive environmental attitudes.
The implications for science educators are significant. Teachers can enhance biodiversity learning by incorporating activities that allow students to explore their environment—such as biodiversity mapping, nature walks, species identification, and local photography documentation. These strategies can cultivate ecological literacy, empowering learners to act as informed stewards of their local ecosystems. ((Kolb, 1984; Bandura, 1986).

Concluding Statement:
This theme reveals that photo-elicitation serves as a catalyst for students to perceive biodiversity not just as a school subject but as an integral part of their daily lives. By making learning locally relevant and observational, educators can foster environmental awareness and a deeper personal connection to nature—essential foundations for conservation-oriented behavior.

Theme 3: Enhanced Species Classification and Identification Skills
The study's findings reveal that photo-elicitation significantly enhances students' skills in species classification and identification. Rather than solely depending on verbal or textual information, students were able to visually assess, compare, and differentiate biological traits through the analysis of biodiversity images. This direct visual engagement allowed learners to better understand the distinct characteristics and taxonomic categories of various organisms.

One student remarked,
"Marami akong natutunan tungkol sa klasipikasyon ng mga species dahil
Naikumpara ko ang iba't-ibang katangian sa mga larawan."
[I learned a lot about species classification because I could compare different characteristics in photos.] *(P1)*

Another participant shared,
"Ang pagtingin sa mga tunay na larawan ay tumulong sa akin na maunawaan kung paano nakakapekto ang mga gawain ng tao sa biodiversity."
[Seeing real images helped me grasp how human activities impact biodiversity.] *(P3)*

These statements indicate that the use of real-life biodiversity images strengthened students' observational and analytical abilities. Through visual comparisons, students were able to discern morphological features, adaptive traits, and the effects of human interventions on ecosystems. This aligns with the findings of Garcia et al. (2022), who noted that photo-elicitation deepens learners' understanding of biological diversity by making classification more tangible and context-driven.
The use of visual materials for species identification is also supported by Bruner's (1966) iconic representation stage, which asserts that learners understand complex ideas more effectively through images before abstract symbols. Additionally, Mayer's (2009) Cognitive Theory of Multimedia Learning emphasizes that integrating words and visuals enhances comprehension by using dual coding pathways in the brain, allowing for improved retention and application of knowledge.
The implications for science education are clear: integrating high-quality biodiversity images, digital classification apps, and interactive identification tools into the curriculum can improve students' taxonomic literacy. Tasks that involve analyzing species

through photos—such as dichotomous key activities, visual trait comparisons, and field photo documentation—can build students' confidence and skill in applying scientific classification systems.

Concluding Statement:
This theme highlights the importance of visual learning in developing students' ability to identify and classify species. Photo-elicitation provides a practical, engaging platform for teaching taxonomy, moving students beyond abstract definitions toward meaningful, applied understanding. In doing so, it empowers learners with essential scientific skills while reinforcing the importance of biodiversity awareness.

Theme 4: Recognizing Human Impact on Biodiversity
The fourth emergent theme centers on how photo-elicitation enhanced students' awareness of the negative impact of human activities on biodiversity. The students expressed that image showing deforestation, pollution, habitat destruction, and endangered species helped them understand the urgency and severity of human-induced environmental degradation. These visual cues evoked emotional reactions that deepened their connection to conservation issues.
As one student shared:
"Ang pagtingin sa mga tunay na larawan ay naktulong sa akin na maunawaan kung paano nakakaapekto ang mga Gawain ng tao sa Biodiversity." [Seeing real images helped me grasp how human activities impact biodiversity.] *(P3)*

Another added:
"Ang mga pictures ng endangered species ay nagbibigay sa akin ng ng higit na pagtuunan ng pansin ang tungkol sa inyu ng conservation." [The pictures
of endangered species made me more aware of conservation issues.] *(P5)*

These reflections indicate that visual stimuli—particularly authentic and emotionally charged images—fostered both cognitive and affective engagement with the topic. The photos served as a mirror, allowing students to visualize the real-world consequences of human actions on ecosystems. This engagement went beyond surface-level awareness, leading to a critical evaluation of the human role in biodiversity loss and a personal commitment to conservation efforts.
The responses suggest that photo-elicitation is effective in transforming abstract environmental concepts into concrete realities that resonate emotionally with learners. This connection is essential for nurturing pro-environmental attitudes and actions.

Implication:
The use of photo-elicitation in biodiversity education has significant implications. It underscores the need for educational approaches that not only inform but also emotionally engage students. Visual tools—such as photographs, infographics, and documentaries—can be leveraged to enhance environmental literacy and foster empathy toward nature.
Educators should consider integrating image-based inquiry in their pedagogy to encourage deeper reflection on environmental issues. Moreover, students may be tasked with creating photo journals or conducting photo documentation of local environmental problems to further localize their understanding and inspire actionable solutions.

This finding is supported by Harper (2002), who emphasized that photo-elicitation enhances the depth and richness of reflection by linking visual stimuli to emotional and cognitive processing. Similarly, Louv (2008) stressed the importance of reconnecting learners with nature through experiential and visual engagement to combat the growing disconnect from the natural world. Furthermore, Mayer and Sims (1994) noted that the use of images can improve comprehension by offering dual channels for processing information—both visual and verbal. These studies validate the use of photo-elicitation as a tool for deepening student understanding of biodiversity and human impact.

Concluding Statement:
Overall, this theme highlights that photo-elicitation can serve as a powerful educational strategy to raise awareness of human impact on biodiversity. By making invisible environmental threats visible, students are encouraged not only to understand but to care—and eventually act—for the preservation of biodiversity. This underscores the transformative potential of image-based learning in fostering both scientific literacy and environmental stewardship.

Theme 5: Critical Thinking and Inquiry-Based Learning
Photo-elicitation also played a crucial role in stimulating students' curiosity and analytical thinking. Instead of passively receiving information, students asked deeper questions, conducted research, and analyzed biodiversity concepts critically.
*"Pinapaisip ako ng mga larawan kung bakit may ilang hayop na
nanganganib habang ang iba naman ay patuloy na namumuhay."*
[The photos made me question why some animals are endangered while others thrive.] *(P2)*

"Hinihikayat ako nitong mag-research pa tungkol sa mga species na Nakita sa mga larawan.
[It encouraged me to research more about the species I saw in the pictures.] *(P3)*

"Ang activity na ito ay nagturo sa akin na suriin ang ecosystem sa halip
Na isaulo lamang ang mga pangalan ng mga species."
[The activity made me analyze ecosystem instead of just memorizing species names.] *(P5)*

These responses suggest that phot-elicitation fosters inquiry-based learning, encouraging students to seek knowledge independently, analyze ecological relationships, and draw connections between species and habitats. Educators may adopt problem-based learning approaches, where students investigate biodiversity challenges using photo analysis, real-world case studies, and independent research projects. This approach promotes scientific reasoning and ecological literacy.

Theme 6: Increased Engagement and Enjoyment in Learning

A major finding of this study is that students found photo-elicitation more engaging and enjoyable compared to traditional biodiversity learning methods. Many students expressed that they found lecture-based lessons uninteresting, whereas images made learning more dynamic, interactive, and immersive.

"Ang tradisyonal na mga aralin ay madals puro pagmememorize, pero
Nakakaengganyo it."
[Traditional lessons were mostly memorizing, but this was more engaging.] *(P1)*

"Dati, nababagot ako sa mga leksyon, pero dahil sa mga larawan, naging
mas nakakaengganyo at interactive ang pag-aaral."
[I used to get bored with lectures, but photos made learning more interactive.] *(P2)*

"Sa pamamagitan ng mga larawan, mas naunawaan at naimagine ko nang
Mas malinaw ang mga konsepto kaysa sa simpleng teksto lamang."
[With photos, I could visualize concepts better than just text.] *(P2)*

These responses reflect a strong preference for visual and experiential forms of learning. The shift from text-heavy instruction to a visually rich modality allowed students to not only grasp concepts more easily but also to participate more actively in the learning process. Visual stimuli captured their interest, sustained attention, and enhanced their ability to retain information.

This is consistent with existing literature asserting that visual learning tools improve students' cognitive engagement and make abstract scientific concepts more tangible (Çimer, 2012). In a similar study, Tunnicliffe and Reiss (2017) highlighted the effectiveness of image-based exploration in deepening understanding of biodiversity by engaging students in authentic, real-world contexts. Furthermore, photo-elicitation fosters emotional involvement, which, as emphasized by Harper (2002), enhances memory retention and personal relevance in learning.

The implication of these findings is that science educators should integrate photo-elicitation and similar multimedia strategies into biodiversity lessons to increase student motivation, participation, and comprehension ((Harper, 2002; Clark-Ibáñez, 2004). Implementing photo-based discussions, biodiversity documentation projects, and reflective visual journals can transform traditional classrooms into interactive learning environments.

Educators are also encouraged to use photo-elicitation alongside other constructivist strategies to foster creativity, collaboration, and critical thinking. This aligns with inquiry-based learning approaches where students construct knowledge through observation, questioning, and discussion—experiences that are both engaging and educationally rich (Hmelo-Silver et al., 2007).

Concluding Statement

The findings of this study affirm that photo-elicitation is not only an effective instructional tool for conveying biodiversity content but also a catalyst for increasing student engagement and enjoyment in learning. By transitioning from passive, lecture-based instruction to active visual inquiry, students are more likely to internalize ecological concepts and develop a genuine interest in conservation. Future studies could explore comparative frameworks between photo-elicitation and emerging technologies such as virtual and augmented reality to examine their relative impacts on biodiversity education across diverse learning contexts.

Theme Map on Students' Experiences with Photo-Elicitation

The findings of this study highlight the significant role of photo-elicitation in biodiversity education, revealing both its strengths and areas for improvement. Through thematic analysis, four key themes emerged that provide insights into students' experiences and

beliefs regarding the use of photo-elicitation in learning biodiversity. Each theme illustrates how visual learning enhances engagement, fosters emotional connections, presents challenges, and requires better structuring for optimal effectiveness.

Figure 2. *Schematic diagram on Students' Experiences with Photo-Elicitation*

Theme 1: Photo-Elicitation Enhances Engagement and Motivation

One of the most prominent findings is that photo-elicitation make biodiversity learning more engaging, interactive, and curiosity-driven. Compared to traditional lecture-based methods, students found that analyzing real biodiversity images transformed their learning experience into something more exploratory and hands-on. The visual representation of species and ecosystems made students feel more involved in their learning process, encouraging them to observe, analyze, and discuss biodiversity concepts actively.
"Pakiramdam ko ay isa akong scientist na nagmamasid sa kalikasan
Sa halip na basta na lamang mag memorize ng mga terms.."
[I felt a scientist observing nature instead of just memorizing terms.] *(P2)*

This response indicates that photo-elicitation shifts learning from passive memorization to active scientific observation, allowing students to engage with biodiversity as researchers rather than just learners. This shift is essential in fostering critical thinking, scientific literacy, and inquiry-based learning. Educators should actively integrate photo-elicitation into biodiversity lessons as an effective strategy to enhance student engagement. By incorporating visual learning methods, students can develop a deeper and more interactive understanding of ecological concepts. Additionally, encouraging hands-on biodiversity photography projects can help students improve their observational and analytical skills, allowing them to explore their environment while documenting and analyzing species. Further, interactive discussions based on real-world biodiversity images may be prioritized to sustain curiosity and motivation, enabling students to actively engage with the subject matter, ask meaningful questions, and develop critical thinking skills in biodiversity education.

Theme 2. Emotional and Cognitive Connections Strengthen Learning
Another significant outcome is that photo-elicitation evokes strong emotional responses, which deepens students' cognitive engagement. By visually encountering local species, threatened animals, and conservation issues, students develop a more personal and emotional connection to biodiversity. The emotions triggered range from awe and appreciation to concern and urgency, influencing students' awareness and attitudes toward conservation.
"Ang mga larawan ng mga nanganganib na hayop ay naddulot sa akin
Ng lungkot at pag-aalala."
[The photos of endangered animals made me feel sad and concerned.] *(P5)*

This reflection illustrates how the emotional impact of visual content extends beyond simple recognition of biodiversity topics and into the realm of ethical responsibility and advocacy. Emotional engagement activates deeper thinking processes and leads students to internalize environmental messages more meaningfully. It contributes to the formation of value systems that prioritize sustainability and conservation.

This finding supports the literature, particularly the work of Weber (2006), who emphasized that emotional responses are central to environmental decision-making and behavior. Similarly, Swan and Riley (2015) noted that emotional connections formed through visual experiences improve students' environmental empathy and foster long-term commitment to conservation values. Photo-elicitation, therefore, serves as more than just a cognitive tool—it is also a bridge to affective learning that influences attitudes and actions.

The implication for science education is that learning materials should not only inform but also inspire. Educators should integrate emotionally resonant images—such as those portraying endangered species, damaged ecosystems, and successful conservation efforts—into discussions and activities ((Barrett & Smigiel, 2007; Ojala, 2012). These visual stimuli should be paired with guided reflections, group dialogues, and writing tasks that help students process their emotional reactions and link them to ecological concepts and ethical issues.

Furthermore, involving students in community-based biodiversity documentation projects or local conservation campaigns can intensify their emotional investment and make environmental learning more experiential and socially relevant.

Concluding Statement

In summary, photo-elicitation enhances not only the cognitive but also the emotional aspects of learning biodiversity, fostering compassion, reflection, and a deeper sense of responsibility. By linking visual learning to real-world conservation challenges, educators can nurture environmentally conscious learners who are both informed and inspired to act. This dual impact of emotional and cognitive engagement highlights the potential of photo-elicitation as a transformative educational strategy in environmental education.

Theme 3. Challenges in Species Identification and Understanding

While photo-elicitation enhances engagement, some students struggled with species identification and description, mainly due to unclear image details, lack of prior knowledge, or difficulty in memorizing species names. This suggests that although visuals aid learning, they require proper guidance and additional support for maximum effectiveness.

"May ilang larawan na mahirap surriin dahil kulang at di malinaw and detalye." [Some pictures were hard to analyze because they lacked clear details.] *(P2)*

This statement underscores the limitations of relying solely on photographs for instruction without adequate context or scaffolding. When the visual information is unclear or lacks supportive explanation, students may become frustrated or confused, potentially hindering their learning experience.

This challenge aligns with findings in the literature. According to D'Costa and Schlueter (2013), while visuals are effective in promoting observational skills, they must be paired with guided instruction to improve classification accuracy. Similarly, McConney et al. (2011) emphasized that visual-based science learning is most effective when accompanied by supplementary resources, such as dichotomous keys and field guides, which enable students to verify and clarify their observations.

To address these concerns, educators must ensure that high-resolution, contextually relevant images are used in photo-elicitation activities. Visuals should be complemented by structured materials such as digital databases, printed species guides, and classification charts to support deeper understanding. Educators may also facilitate expert-led discussions, interactive group identification tasks, and scaffolded inquiry projects that provide the background knowledge necessary for students to analyze species effectively.

Workshops or short modules on basic taxonomy and species identification can help build student confidence and skill in biodiversity documentation. When paired with authentic inquiry tasks, this approach can enrich student experiences and foster more accurate scientific thinking.

Concluding Statement

In conclusion, while photo-elicitation effectively sparks curiosity and visual engagement, its success in teaching biodiversity depends on the quality of imagery and the presence of structured support systems. By integrating detailed resources, contextual explanations, and hands-on classification training, educators can maximize the learning potential of photo-elicitation, transforming it from a visually stimulating activity into a deeply educational experience that strengthens both observational and analytical skills.

Theme 4. Desire for More Time and Discussion in Photo-Analysis

Some students felt that time constraints limited their ability to fully engage with biodiversity images. The lack of sufficient time for discussion and analysis prevented them from exploring biodiversity concepts in-depth, reducing the potential benefits of photo-elicitation.

"Nais ko sanang magkaroon kami ng mas maraming oras upang talakayin ang bawat larawan sa klase."
[I wished we had more time to discuss each photo in class.] *(P5)*

This response suggests that students perceived the discussions as valuable and sought more opportunities to analyze, interpret, and reflect on the biodiversity topics presented. The lack of sufficient time led to a missed opportunity for deeper understanding and critical engagement.

Supporting this, Aulls and Shore (2008) emphasized that time for discussion is essential in inquiry-based classrooms, allowing students to connect observations to prior knowledge and construct meaning collaboratively. Similarly, Murphy et al. (2011) argued that interactive science learning—especially visual or case-based—requires sufficient time for students to process information and engage in meaningful dialogue. When students are rushed through photo-based tasks, the educational value may be diminished, limiting their ability to draw insightful conclusions or raise meaningful questions.

To address this, educators should intentionally allocate adequate classroom time for guided group discussions, collaborative analysis, and structured reflection activities such as journaling or think-pair-share ((Brookfield, 2012; Gillies, 2016). These strategies promote deeper interpretation of biodiversity visuals and foster higher-order thinking skills. Additionally, using breakout group formats or station-based learning can encourage all students to participate more actively and thoroughly explore images from multiple perspectives.

Concluding Statement

In summary, while photo-elicitation stimulates curiosity and active learning, its full impact is achieved only when students are provided with sufficient time to engage in thoughtful discussion and reflection. Educators must recognize that deep analysis of biodiversity images cannot be rushed and should design instructional schedules that prioritize inquiry, reflection, and dialogue. By doing so, the use of photo-elicitation can reach its potential as a transformative tool in biodiversity education.

Theme Map on Challenges and Benefits Students Experiences When Using a Photo-Elicitation-Based Approach in Science 10.

Figure 3. *Schematic diagram on Challenges and Benefits Students Experiences When Using a Photo-Elicitation-Based Approach in Science 10*

The findings highlight both difficulties in species identification, ecological interpretation, and image complexity, as well as effective strategies such as group discussions, teacher guidance, practice, and independent research. Below, each theme is discussed in detail, incorporating student statements, interpretation, and implications for instruction.

Theme 1. Challenges in Species Identification and Classification

One of the most common difficulties students faced was differentiating species with similar characteristics. Since many organisms share closely related features, students found it challenging to identify distinguishing traits using photos alone. Additionally, some biodiversity images lacked clarity or sufficient details, making species identification even more difficult.

"May ilang species na magkamukha, kaya naging mahirap ang pagkilala sa mga ito."
Some species looked very similar, making identification tricky.] *(P1)*

"Hindi lahat ng pictures ay may sapat na detalye upang ipakita ang mahahalagang pagkakaiba."
[Not all photos had enough details to show key differences.] *(P5)*

This feedback underscores a key issue in photo-elicitation: while images serve as a valuable tool for engaging students, they must be clear and detailed enough to support accurate species identification. Students' difficulties in recognizing subtle differences reflect a need for carefully curated images that accurately represent species traits and characteristics.

This aligns with the research of Harper (2002), who emphasized that photo-elicitation fosters deeper engagement by encouraging emotional and reflective responses, thus enhancing understanding. Similarly, Çimer (2012) noted that students learn science more effectively when actively engaged in tasks that involve real-world observation. The visual nature of photo-elicitation promotes observation-based learning, making it easier for students to connect images with their prior knowledge and experiences (Tunnicliffe & Reiss, 2017).

The implications of this theme for science educators are substantial. Instructors should ensure that the images used in biodiversity education are of high quality, clearly showcasing key species differences. Teachers can support this process by providing additional resources, such as field guides or taxonomy charts, to help students interpret visual cues. Furthermore, educators may incorporate activities like biodiversity photography projects, species identification challenges, and group discussions to foster engagement and reinforce the learning process. These methods resonate with constructivist learning theories, which stress the importance of hands-on, experiential learning (Bruner, 1996).

By integrating photo-elicitation into biodiversity education, students can move beyond passive memorization and actively participate in scientific inquiry, deepening both their ecological understanding and sense of environmental responsibility ((Harper, 2002; Schönfelder & Bogner, 2018).. These experiences allow students to connect classroom learning to real-world biodiversity concerns, promoting lifelong scientific literacy and stewardship.

Concluding Statement

In conclusion, while photo-elicitation serves as a powerful tool for enhancing student engagement and motivation, it also brings challenges that need to be addressed to maximize its effectiveness. Clear, detailed images are crucial for accurate species identification, and supplementary resources such as guides and taxonomy tools can support students in overcoming these difficulties. By incorporating well-structured visual tasks and hands-on activities, educators can transform biodiversity education into a dynamic, inquiry-based experience that nurtures scientific thinking and environmental awareness.

Theme 2. Difficulty in Understanding Ecological Relationships from Static Images

Students reported that photos alone were not sufficient to understand how species interact with their environment. Unlike videos or live observations, static images fail to capture dynamic ecological relationships, making it difficult to see predator-prey interactions, mutualism, or the impact of environmental changes on biodiversity.
"Mahirap maunawaan ang ugnayang ekolohikal gamit lamang ang mga larawan." [It was hard to understand ecological relationships just from photos.] *(P2)*

This feedback suggests that while photo-elicitation is a useful tool for fostering engagement and raising awareness of species and ecosystems, it has limitations in conveying the more complex, dynamic aspects of biodiversity. Biodiversity education goes beyond simply identifying species; it also involves understanding how organisms interact with one another and their environments. The lack of motion or the inability to show sequential events, as seen in videos or field-based observations, made it more challenging for students to comprehend ecological relationships through still images alone.

This challenge aligns with findings from studies in visual learning and ecology education. For example, Anderson and Shadbolt (2007) noted that while static images can provide insight into species and habitats, they fail to depict the full range of ecological interactions,

such as food webs or interspecies cooperation. The work of Duschl and Gitomer (1991) emphasizes that true understanding of ecological processes requires more than just visual stimuli—it requires interactive, real-time observation or simulations that allow students to witness ecological events unfolding.

Interpretation

This theme reveals that while photo-elicitation can significantly enhance engagement in biodiversity learning, it is not sufficient on its own for teaching complex ecological interactions. Educators must find ways to complement photo-based activities with other dynamic resources such as videos, simulations, or hands-on fieldwork. These approaches allow students to see ecological processes in action, helping them connect the dots between species and the environment in a more comprehensive way.

Implications

The findings of this theme have important implications for biodiversity education. Educators should integrate a variety of multimedia resources—such as videos, animations, and live observations—into biodiversity lessons to help students better understand the dynamic relationships that shape ecosystems (Mayer, 2009; Moreno & Mayer, 2007). For example, a lesson could include a video showing predator-prey behavior, followed by a discussion of the species' ecological roles. Additionally, field trips or outdoor investigations could allow students to directly observe and document these interactions, further enriching their learning experience.

Moreover, using interactive tools like virtual ecosystems or ecological simulations can offer students opportunities to explore biodiversity in a more holistic manner. These digital tools can simulate changes in ecosystems over time, allowing students to see how species interactions are influenced by environmental changes, such as climate shifts or habitat destruction.

In conclusion, while photo-elicitation provides valuable insights into species and ecosystems, it is not always sufficient for conveying the full complexity of ecological relationships. For a more comprehensive understanding of biodiversity, educators must combine photo-based learning with other resources that can capture the dynamic nature of ecological processes. By incorporating videos, simulations, and field experiences, educators can enhance students' ability to understand and appreciate the intricate web of interactions that sustain ecosystems, leading to a deeper and more nuanced understanding of biodiversity.

Theme 3. The Need for Additional Background Information

Students expressed a need for additional knowledge to correctly interpret biodiversity images. Some images alone were not enough, requiring context, prior learning, or expert explanations to understand species classification and ecological roles.

"Minsan kailangan ko ng karagdang impormasyon upang maipaliwanag nang tama ang mga larawan."
[I sometimes needed extra information to interpret the pictures correctly.] *(P3)*

This statement highlights the importance of supporting photo-elicitation activities with foundational knowledge. Without a strong background in biodiversity concepts, students may struggle to make informed observations or accurately classify species. This is especially true when images depict unfamiliar species or complex ecological relationships that require prior learning or expert input to fully understand.

Interpretation

This theme underscores that while photo-elicitation is an engaging tool, it should not be used in isolation. It is most effective when accompanied by preparatory materials or discussions that provide students with the necessary knowledge to interpret and analyze biodiversity images accurately. Students need to connect what they see in the photos to broader ecological concepts, such as species characteristics, ecological roles, and environmental impacts. Without this contextual knowledge, students might miss critical details in the images or misinterpret species classification and ecological relationships.

These findings align with research on visual literacy in science education, which stresses that interpreting images requires a combination of visual and contextual understanding. According to Tunnicliffe and Reiss (2017), students' ability to interpret scientific images is deeply tied to their existing knowledge base. When students lack prior knowledge or context, the educational value of visual stimuli is diminished.

Implications

The findings from this theme suggest that educators should provide preparatory instruction or supplementary materials before engaging students in photo-elicitation activities. For instance, field guides, glossaries, and introductory lectures on biodiversity concepts can help build the necessary foundation. This approach would allow students to better connect their existing knowledge to the new information they encounter in the images.

In addition to preparatory instruction, educators could use scaffolding strategies during photo-analysis sessions. These could include guided questions, expert-led discussions, or peer collaborations to help students analyze the images within a meaningful context. Interactive learning tools, such as species identification apps or online databases, could further support students by providing real-time access to information about the species depicted in the images.

Furthermore, incorporating active learning strategies, such as group discussions or project-based activities, could provide students with the opportunity to share their thoughts and learn from one another, which enhances their understanding of the material.

In conclusion, the effectiveness of photo-elicitation in biodiversity education can be significantly enhanced when students are equipped with sufficient background knowledge and contextual information. By providing preparatory materials and creating opportunities for guided discussions, educators can help students develop the necessary skills to analyze biodiversity images accurately. This comprehensive approach ensures that students gain a deeper understanding of species, ecosystems, and ecological relationships, fostering more meaningful and impactful learning experiences.

Theme 4. Complexity of Some Biodiversity Images

Some biodiversity images were too detailed or overwhelming, making analysis difficult without guidance. High complexity images contained too many organisms, intricate backgrounds, or microscopic details, leading to confusion among students.

"Ang ilang larawan ay masyadong komplikado upang surriin."

[Some images were too complex to analyze.] *(P4)*

This statement reveals that while detailed images can provide rich information about biodiversity, they may also be intimidating or confusing for students without proper scaffolding. Students may struggle to isolate key features or understand the relationships between various elements in a complex image, thus hindering their ability to analyze and learn from it.

Interpretation

The complexity of some biodiversity images suggests that photo-elicitation activities must be carefully tailored to the cognitive levels and prior knowledge of students. While intricate images can enhance the depth of learning, they may also create barriers to engagement if not presented in a manageable way. For students, particularly those without a strong background in ecological concepts or scientific observation skills, highly detailed images may overwhelm rather than enlighten.

This aligns with findings from educational research on visual literacy, which emphasizes the need for students to develop skills in dissecting complex images in order to extract meaningful information. According to Clark and Lyons (2010), students need specific strategies and tools to analyze detailed images effectively. Without guidance, complex images can lead to cognitive overload, where students are unable to process the visual information meaningfully.

Implications

The findings from this theme suggest that educators need to consider the level of complexity in the biodiversity images they use and ensure that these images are appropriate for students' developmental stages. For highly detailed images, educators may need to provide additional guidance, such as:

- **Breaking down the image**: Providing students with step-by-step instructions on how to analyze the image, starting with large, visible features and working toward smaller, more intricate details.
- **Focusing on specific features**: Teachers can highlight key elements of the image that are central to the learning objectives, guiding students to focus their attention on relevant details rather than becoming overwhelmed by the entire image.
- **Providing context**: Giving students background information or contextual knowledge before analyzing complex images can help them better understand the significance of the visual elements.
- **Using simpler images initially**: Introducing students to more straightforward images before progressing to more complex ones can help them build confidence and develop their analytical skills progressively.

Additionally, students could be encouraged to work in pairs or small groups to analyze complex images collaboratively. Group work not only reduces the cognitive load but also fosters peer learning, allowing students to share insights and collectively make sense of the complex visual stimuli.

Conclusion

In conclusion, while detailed biodiversity images offer rich educational potential, their complexity can pose challenges to students without proper guidance. Educators should aim to strike a balance between the level of detail in the images and the students' ability to interpret them. By providing structured analysis techniques, contextual information, and opportunities for collaboration, teachers can

help students successfully engage with even the most complex biodiversity images. This approach will ensure that students are not only able to analyze biodiversity visuals effectively but also gain a deeper understanding of the ecological concepts they represent.

Theme 5. Collaborative Learning through Group Discussions

Group discussions helped students clarify difficult biodiversity concepts and gain new insights from peers. By sharing perspectives and observations, students could identify species more effectively and interpret ecological relationships.

"Nag-usap kami bilang isang grupo upang maunawaan ang mahihirap na konsepto."

[We discussed as a group to figure out difficult concepts.] *(P1)*

This statement emphasizes how peer discussions facilitated the exchange of ideas, making challenging biodiversity concepts more approachable. In group settings, students were able to refine their thinking, question each other's assumptions, and build on their collective knowledge, fostering a more comprehensive understanding of biodiversity.

Interpretation

The responses suggest that group discussions provided an important avenue for students to engage with complex ecological topics. Collaborative learning encourages students to actively participate in the learning process, leading to a more dynamic and interactive experience. Peer interaction often helps students see concepts from different angles, which deepens their understanding and promotes critical thinking.

Research on collaborative learning supports these findings, with studies indicating that peer discussions not only enhance cognitive skills but also promote metacognitive awareness. By explaining concepts to one another and considering alternative viewpoints, students become more aware of their own thought processes and are better able to articulate their understanding (Johnson, Johnson, & Holubec, 2008). This process helps students identify gaps in their knowledge and solidify their comprehension of biodiversity concepts.

Implications

The implications of this theme suggest that educators should intentionally design learning activities that incorporate group work and peer discussions (Johnson & Johnson, 1999; Slavin, 2014). To maximize the benefits of collaborative learning, teachers can:

- **Foster a safe and inclusive environment**: Encouraging students to feel comfortable sharing their ideas and asking questions is key to productive group discussions. Teachers should establish ground rules that promote respect and open-mindedness in peer interactions.
- **Use structured discussion prompts**: To guide the discussion, educators can provide questions or scenarios related to biodiversity that encourage students to think critically and explore different aspects of the topic.
- **Encourage peer teaching**: Assigning students to explain concepts to one another or leading small-group discussions can reinforce their understanding and build confidence in their knowledge.
- **Integrate group analysis of biodiversity images**: In the context of photo-elicitation, teachers can have students work together to analyze complex images, making observations, and formulating hypotheses as a group. This collaborative analysis can be especially valuable when dealing with challenging species identification or ecological relationships.

Concluding statement

In conclusion, group discussions are a powerful tool for enhancing students' understanding of biodiversity. By working together, students not only clarify complex concepts but also develop critical thinking, communication, and collaborative skills. The social nature of learning through group discussions allows for a deeper exploration of biodiversity topics and fosters a more engaged, active learning environment. Teachers should therefore consider incorporating group-based activities into their biodiversity curriculum to promote peer learning, strengthen analytical skills, and support students in mastering challenging scientific concepts.

Theme 6. Teacher Guidance Enhances Learning Through Inquiry-Based Approach

Students found that teacher-led questioning encouraged critical thinking and deeper engagement with biodiversity images. Inquiry-based approaches helped them focus on key characteristics and ecological roles.

"Ginagabayan kami ng guro sa pamamagitan ng pagatatanong ng mga mapanuring katanungan."

[The teacher guided us by asking thought-provoking questions.] *(P2)*

This response highlights how teacher-led inquiry fosters a more structured and focused exploration of biodiversity topics. By asking open-ended questions, the teacher prompted students to observe, analyze, and interpret the images more critically, moving beyond surface-level identification to a deeper understanding of ecological relationships and conservation issues.

Interpretation

Teacher guidance through inquiry-based questioning serves as a catalyst for students to think critically and analytically. Without this scaffolding, students may focus on simple memorization or superficial descriptions, missing the deeper connections between species and ecosystems. This approach is consistent with constructivist learning theories, which emphasize that knowledge is best constructed through active problem-solving and guided reflection (Bruner, 1996).

Research in inquiry-based learning supports the idea that when teachers use open-ended questions, they help students develop critical thinking skills and deepen their understanding of complex concepts. According to King (1994), effective inquiry teaching involves posing questions that encourage students to reflect on their prior knowledge, analyze new information, and engage in discussions that promote deeper learning.

Implications

The findings of this theme suggest that teachers should actively guide students through inquiry-based activities, especially in subjects like biodiversity where complex relationships and ecological concepts are involved. To maximize the effectiveness of teacher-guided inquiry, educators can:

- **Ask open-ended questions**: Teachers should ask questions that do not have simple answers but require students to think critically and consider multiple perspectives. For example, "How might climate change affect the species in this image?" or "What role does this species play in its ecosystem?"
- **Promote reflective thinking**: Encourage students to think about how the biodiversity they are learning about connects to real-world issues. Questions like "How does this species' role in the ecosystem relate to human activities?" can foster broader environmental awareness.
- **Provide scaffolding for complex concepts**: As students grapple with more challenging biodiversity topics, teachers can break down complex questions into smaller, more manageable parts. This approach will ensure students are not overwhelmed and can engage with the material step by step.
- **Facilitate discussions**: Instead of just providing answers, teachers should guide students through discussions, encouraging them to explain their reasoning, ask follow-up questions, and explore different viewpoints. This fosters a more collaborative learning environment.

Concluding statement

In conclusion, teacher guidance through inquiry-based approaches significantly enhances the learning experience in biodiversity education. By asking thought-provoking questions and encouraging critical analysis, teachers help students engage more deeply with biodiversity images and concepts. This method not only promotes scientific inquiry but also fosters a deeper understanding of ecological relationships and environmental issues. Educators should therefore continue to integrate inquiry-based strategies into their teaching practices, particularly when using photo-elicitation, to help students develop critical thinking skills and a more profound understanding of the natural world.

Theme 7. The Role of Practice in Improving Analytical Skills

Students improved their species identification and biodiversity analysis skills through regular exposure and practice. Repetition helped them recognize patterns and enhance confidence in photo-elicitation tasks.

"Ang pagsasanay ay nakatulong sa akin upang mas gumaling sa pagapapaliwanag ng mga larawan ng biodiversity."
[Practice helped me get better at interpreting biodiversity photos.] *(P4)*

This response illustrates the value of repetition in learning—students developed their skills not instantly but progressively, as they encountered more visual examples and applied their knowledge repeatedly.

Interpretation

The theme highlights that learning analytical skills in biodiversity education, like many cognitive skills, requires time and repeated effort. Visual literacy, especially in interpreting complex ecological images, is not innate; it must be cultivated through experience and

guided practice. As students repeatedly analyze photos of different species and ecosystems, they develop the ability to focus on key identifying features, connect ecological concepts, and explain their observations more clearly.

This supports the ideas of Kolb's Experiential Learning Theory (1984), which emphasizes the importance of learning through experience, reflection, and application. Practice gives students the opportunity to internalize scientific concepts, test their understanding, and refine their analytical strategies.

Implications.

For educators, this finding emphasizes the importance of sustained, repeated engagement with visual biodiversity materials. A one-time exposure is not sufficient for skill mastery ((Bransford, Brown, & Cocking, 2000; Ericsson, Krampe, & Tesch-Römer, 1993). Therefore, teachers should:

Incorporate photo-elicitation regularly in the lesson flow, not just as a one-time activity, so that students have multiple opportunities to practice and apply their skills ((Bransford et al., 2000).

Track student progress over time through photo journals or portfolio work, allowing them to see how their observational and interpretive abilities have evolved (Ericsson et al., 1993).

Use varied and increasingly complex images to challenge students as they grow more confident, introducing new species, habitats, and ecological interactions gradually (Mayer, 2009).

Provide feedback and reflection opportunities after each session to help students understand their strengths and areas for improvement.

Encourage peer-to-peer explanation, where students explain how they identified certain features or made their conclusions. This reinforces learning through articulation and comparison of thought processes.

Conclusion

In summary, repeated practice plays a crucial role in developing students' analytical skills in biodiversity education. With regular exposure to biodiversity images, students gain confidence, improve accuracy, and enhance their ability to interpret ecological details. Photo-elicitation is most effective when implemented consistently, allowing students to build visual literacy and critical thinking over time. Educators should design lesson sequences that include ongoing opportunities for practice, reflection, and application to support skill development in a meaningful and lasting way.

Theme 8. Independent Research Strengthens Understanding

Students found self-directed research valuable for filling knowledge gaps and strengthening their understanding beyond classroom discussions.

"Nag rsearch pa ako nang higit tungkol sa mga species na nakita ko sa mga larawan."

[I researched more about the species I've seen in the photos.] *(P5)*

This response emphasizes how photo-elicitation encourages students not only to engage with classroom content but also to go beyond it, actively seeking new information. It reflects a learner's intrinsic motivation to understand what they see—transforming the learning process from teacher-led instruction to student-led exploration.

Interpretation

The integration of visual stimuli in science learning appears to trigger curiosity and a desire to explore. When students are emotionally and intellectually engaged with the visuals, they are more inclined to pursue additional knowledge outside of formal instruction. This aligns with *constructivist learning theories*, particularly the idea that students build knowledge through exploration, inquiry, and meaningful experiences (Piaget, 1954; Vygotsky, 1978).

Additionally, this supports the work of Zimmerman (2000) on self-regulated learning, where motivated learners set their own goals, seek information independently, and monitor their own progress. Students who conducted independent research were not only reinforcing their understanding but also practicing scientific inquiry—an essential skill in biodiversity education.

Implications

This theme has several practical implications for science educators:

- **Encourage student-led investigations** by assigning research-based extensions to photo-elicitation tasks (e.g., "Choose a species from today's image and write a short report on its ecological role").
- **Integrate digital and print resources** (field guides, online biodiversity databases, conservation websites) that students can use to conduct independent study.
- **Celebrate independent findings** through mini-presentations, group sharing, or reflection journals to motivate continued exploration and validate student efforts.
- **Guide students in evaluating sources** to ensure their research is accurate and scientifically sound, promoting digital literacy alongside content knowledge.
- **Design inquiry projects** that allow students to investigate local species or conservation issues, applying both classroom knowledge and independent research skills.

Conclusion

In conclusion, independent research acts as a vital complement to photo-elicitation-based learning. It empowers students to take ownership of their learning and reinforces their understanding through self-initiated exploration. When students go beyond what is taught in class to learn more about the organisms they observe, they develop deeper scientific literacy and a stronger personal connection to biodiversity. Educators should therefore create space for and encourage independent inquiry, equipping students with the skills and resources to pursue learning beyond the classroom.

Theme Map on Student's Experience with Photo-Elicitation

Figure 4. *Schematic Diagram on Student's Experience with Photo-Elicitation*

This study examined how research-based elicited photos can be incorporated into instruction, particularly in biodiversity education. The findings highlight effective strategies that enhance learning, including comparative image analysis, guided discussions, real-world connections, and multi-sensory learning approaches. Additionally, challenges such as image complexity, participation imbalances, and time constraints were identified. The discussion below interprets these themes, incorporating student transcripts, key insights, and instructional implications.

Theme 1. Comparative Image Analysis Enhances Learning

Students found that comparing images side by side helped them differentiate species and understand biodiversity characteristics more effectively. By placing images next to each other, they were able to identify key distinctions in species traits, behaviors, and adaptations. This technique reinforced pattern recognition skills, enabling students to develop a deeper understanding of biodiversity.

"Ang paghahambing ng mga pictures nang magkatabi ay nakatulong sa akin na maunawaan ang mga pagakakaiba sa pagitan ng mga species."

[Comparing images side by side helped me understand differences between species.] *(P1)*

This response suggests that comparing multiple images at once can make complex information more digestible. By visually juxtaposing species, students were able to see and understand subtle differences in traits, behaviors, and adaptations. The process of side-by-side comparison not only aids in the identification of species but also helps students develop critical observational skills. Furthermore, such analysis supports the development of higher-order thinking, as students must observe and interpret multiple variables in a single context.

Implications

The findings from this theme underline the importance of visual comparison in biodiversity education and suggest several teaching strategies:

Use paired or grouped images to highlight similarities and differences between species, environments, or behavioral patterns. For instance, showing images of different habitats or species at various stages of growth allows students to observe biodiversity in a more comprehensive manner.

Incorporate activities where students can physically compare images, such as sorting or categorizing species based on common traits. This can be done both in the classroom and in fieldwork exercises.

Encourage the use of digital tools that allow for interactive image comparisons, such as educational apps or virtual platforms where students can zoom in on specific details, adjust image settings, and annotate their observations.

Promote discussions and group work, where students can share insights and opinions on what makes one species different from another, allowing for a deeper and collaborative learning experience.

Conclusion

The technique of comparative image analysis significantly enhances students' ability to understand and appreciate the diversity of life forms. By facilitating the identification of key features and differences, it enables students to move beyond superficial observations and develop a more nuanced understanding of biodiversity. This approach fosters both pattern recognition and critical thinking, essential skills for scientific inquiry and environmental literacy.

Theme 2. Discussions Deepen Understanding and Collaboration

Collaborative discussions after photo analysis helped students gain new insights, recognize details they may have missed, and refine their understanding of biodiversity concepts. Many students noted that peer contributions helped them expand their interpretations and learn from different perspectives.

"Nagustuhan ko ang discussion pagakatapos naming suriin ang mga
Larawan dahil may mga bagay na itinuro ang aking classmate na hindi ko
Napansin.
" [I liked when we had discussions after analyzing the photos because my classmates pointed out things I didn't notice.] *(P2)*

This response highlights the value of collaborative learning in deepening students' engagement with the material. Group discussions allow students to verbalize their thoughts, which can lead to a deeper critical analysis of biodiversity. In these interactions, students expand their perspectives, building a more holistic understanding of the subject matter. By hearing from classmates who may have noticed different details, students are prompted to revisit their observations and consider alternative interpretations, leading to a more comprehensive view of the biodiversity concepts being studied.

Implications

The findings from this theme underscore the importance of collaborative learning in science education, especially when working with complex topics like biodiversity. The following strategies can enhance the effectiveness of group discussions:

Structured group activities: Implement structured activities where students discuss specific questions related to the images. This can help guide the conversation and ensure that key concepts are addressed, fostering critical thinking and deeper analysis.

Peer teaching: Encourage students to take on the role of the "teacher" during discussions, allowing them to explain their observations and reasoning to others. This reinforces their understanding and helps clarify concepts for their peers.

Encourage diverse perspectives: Foster an environment where all students feel comfortable sharing their ideas, ensuring that quieter students are also given a chance to contribute. This can be achieved by breaking the class into smaller discussion groups or using online platforms for asynchronous discussions.

Use of follow-up questions: After discussions, teachers can ask follow-up questions to encourage reflection on what was learned and to help students identify areas where they need further clarification.

Conclusion

The theme of discussions enhancing understanding shows that collaborative learning plays a key role in science education, especially in subjects like biodiversity. Through group discussions, students refine their thinking, broaden their perspectives, and strengthen their analytical skills. This process not only deepens their understanding of biodiversity but also encourages critical thinking and the development of communication skills, which are vital for both academic success and future environmental stewardship

Theme 3. Guided Questions Improve Focus and Observation

Students found that having structured guiding questions helped them stay focused on key biodiversity traits and scientific details. Without clear prompts, they sometimes struggled to identify relevant information from the photos.

"Ang pagkakaroon ng mga guide questions habang tinitingnan ang mga larawan ay nakatulong sa akin na magtuon sa mahahalagang detalye."

[Having guiding questions while looking at the photos helped me focus on key details.] *(P3)*

This response suggests that structured questioning is essential for enhancing students' observational skills and ensuring that they engage with the material in a purposeful way. The guiding questions serve as cognitive tools, helping students navigate complex images and direct their attention to the most critical elements, such as species identification, ecological roles, and the interrelationships between organisms. By focusing on specific traits or behaviors, students become better at differentiating species and understanding ecological dynamics.

Implications

The findings from this theme point to several pedagogical strategies for improving the effectiveness of photo-elicitation in biodiversity education:

Develop targeted guiding questions: Teachers should craft questions that focus on specific aspects of biodiversity, such as species

characteristics, ecological relationships, or environmental contexts. This will help students focus their observations on important details, ensuring they analyze the photos with a clearer purpose.

Use progressively challenging questions: Start with simpler questions that help students identify basic features, and gradually introduce more complex questions that challenge them to think critically about ecological roles and species interactions.

Encourage reflection: After completing the analysis, encourage students to reflect on how the guiding questions helped them understand the images and whether they noticed details they would have missed otherwise. This reinforces the value of the questioning process.

Integrate inquiry-based learning: Teachers can integrate these guiding questions into an inquiry-based learning framework, where students are encouraged to ask their own questions based on their observations, further stimulating curiosity and independent thinking.

Conclusion

The role of guided questions in improving focus and observation in photo-elicitation activities cannot be overstated. By offering structured prompts, educators can ensure that students remain focused on critical details, improving their ability to analyze and interpret biodiversity images effectively. This approach supports the development of scientific inquiry skills, such as observation, questioning, and classification, which are essential for deepening students' understanding of biodiversity.

Theme 4. Connecting Images to Real-World Issues Strengthens Learning

Students found that linking biodiversity images to real-life environmental challenges made learning more meaningful and impactful. Seeing visual representations of ecosystem destruction, species extinction, or conservation efforts helped them understand biodiversity's importance in sustaining life on Earth.

"Mas marami akong natutunan nang ikonekta naming ang mga larawan sa totoong isyung pangkapaligiran."

[I learned more when we connected the images to real-life environmental issues.] (P4)

"Napagtanto ko po mula sa mga larawan kung gaano kaseryoso ang mga isyung pangkapaligiran.

" [The images made me realize how serious environmental issues are.] *(P9)*

These responses suggest that real-world context is essential in making biodiversity education relevant and engaging. By framing the images within the context of current environmental crises, students were able to visualize the immediate impacts of biodiversity loss and better understand the urgency of addressing these challenges. This connection helped them view biodiversity not only as a scientific concept but as an ethical and environmental responsibility.

Students' awareness of environmental issues, such as habitat destruction or species endangerment, became more acute when they could see tangible examples through the images. This exposure likely triggered emotional and ethical responses, fostering a stronger sense of stewardship and motivating them to think critically about ways to address biodiversity loss.

Implications

The findings from this theme suggest several key strategies for improving biodiversity education through photo-elicitation:

Incorporate real-world environmental challenges: Educators should incorporate images depicting ongoing environmental issues, such as deforestation, pollution, or wildlife trafficking, and link these issues to the scientific concepts being studied. This will help students understand the relevance of biodiversity in their daily lives.

Foster ethical discussions: After analyzing the images, educators can lead discussions about environmental ethics and the importance of conservation. Engaging students in debates and discussions about real-world environmental challenges will help them become more responsible and conscious citizens.

Connect local and global perspectives: Encourage students to explore both local biodiversity issues and global environmental challenges. This can help them recognize that the health of local ecosystems is interconnected with global ecological well-being, making the learning experience more holistic.

Promote action-based learning: When students realize the gravity of environmental issues through visual exposure, they may be more motivated to take action. Educators can introduce projects that involve community engagement or conservation initiatives to empower students to become part of the solution.

Concluding statement

Connecting biodiversity images to real-world issues not only deepens students' understanding of the subject matter but also nurtures their environmental awareness and ethical responsibility. By bridging the gap between scientific knowledge and environmental action, photo-elicitation helps students see the tangible consequences of biodiversity loss and the critical need for conservation efforts. This approach creates more meaningful and impactful learning experiences, shaping students into informed and responsible stewards of the environment.

Conclusions

Based on the summary of findings, the following conclusions are drawn. The study concluded that the photo-elicitation-based interactive approach significantly enhanced students' understanding of biodiversity and positively influenced their environmental beliefs. Students found this approach to be highly engaging and meaningful, which deepened their learning experiences and fostered a stronger personal connection to biodiversity. While some minor challenges were encountered, the overall benefits were more substantial, including improved collaboration, strengthened critical thinking, and increased engagement in science learning. Furthermore, the integration of research-based elicited photos into instruction proved to be an effective strategy in supporting inquiry-based learning, reinforcing content relevance, and enhancing visual learning experiences in the classroom

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