

Promoting Citizen Science in Kamnoetvidya Science Academy Students through the KVIS Explorer Activity using the iNaturalist Application

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Abstract

Citizen science enables the public to contribute to research through data collection and information sharing, while fostering learning and environmental engagement. Kamnoetvidya Science Academy (KVIS), in Wangchan District, Rayong Province, is surrounded by diverse habitats, including orchards and nearby forests such as Khao Khun In, providing an ideal setting for biodiversity exploration. This study evaluated the effects of the “KVIS Explorer” activity on students’ participation in citizen science and their knowledge and attitudes towards biodiversity. The activity was conducted during pre-session camps in May 2024 and 2025, involving 59 and 67 grade 10 students, respectively. Students worked in groups of 5–6 to survey organisms across the school, recording observations on the iNaturalist platform. In 2024, students contributed 310 observations (68% plants, 18% invertebrates, 11% vertebrates, 2% fungi), and in 2025, 237 observations (48% plants, 35% invertebrates, 7% vertebrates, 6% fungi). Research-grade records accounted for 29% in 2024 and 16% in 2025, while frequently observed species included *Tridax procumbens*, Banana trees (*Musa* spp.), and Tokay geckos (*Gekko gecko*). Student feedback showed positive attitudes, with satisfaction scores of 4.56 ± 0.76 in 2024 and 4.26 ± 0.88 in 2025, and self-reported knowledge gains of 4.61 ± 0.73 and 4.43 ± 0.72 , respectively. In 2025, a pre- and post-test with six questions, including images of local flora and fauna, revealed a significant increase in biodiversity knowledge (paired t-test, $t = 11.19$, $p < 0.01$). Notably, 24 students from 2024 and 9 from 2025 continued using iNaturalist independently, contributing 92 additional records in total, indicating sustained engagement. These findings show that the KVIS Explorer activity enhanced biodiversity documentation, fostered learning, and promoted further participation in citizen science. Combining hands-on exploration with digital tools effectively supports engagement with biodiversity and citizen science in school settings.

Keywords: citizen science, high school students, iNaturalist, biodiversity

Introduction

Citizen Science is an approach that allows the public to actively contribute to scientific research through activities such as volunteering to collect, observe, and record useful data. In recent years, citizen science projects have been growing globally, especially in the field of natural history. For example, the City Nature Challenge, launched in 2016 by the Natural History Museum of Los Angeles County in collaboration with the California Academy of Sciences (USA), is a biodiversity survey project that encourages public participation in cities worldwide (Sakurai et al., 2022). Another example is the Global Big Day, first organized on May 9, 2015, by the Cornell Lab of Ornithology (USA). This global birdwatching event invites participants to record as many bird species as possible within 24 hours. During the first event, 6,065 bird species were reported, representing 60% of all known bird species worldwide (Fitzpatrick, 2015).

In Thailand, several organizations have adopted the citizen science concept for activities promoting natural resource and environmental conservation. For example, on May 14, 2016, the Bird Conservation Society of Thailand (BCST) organized Thailand's first participation in the Global Big Day, inviting universities to compete in recording the highest number of bird species within 24 hours (eBird, 2016). Similarly, between April 29 and May 2, 2022, the National Science and Technology Development Agency (NSTDA) and its partners organized City Nature Challenge 2022 for the first time in Thailand, promoting citizen science by encouraging participants to record biodiversity using the iNaturalist application (Suppinan, 2022).

The iNaturalist platform, developed in 2017 by National Geographic and the California Academy of Sciences, is a citizen science tool that allows people around the world to upload photographs of living organisms. When users capture and upload images along with GPS location and other additional data, the iNaturalist AI processes the image and provides an initial identification, classifying the organism as an animal, plant, or other type of organism. The system can sometimes suggest a species name, while in other cases, it can only identify the genus, depending on the image quality and the information provided. Later, expert users help confirm the identification. If at least two-thirds of the experts agree, the observation is designated as research grade, making it suitable for use in scientific research (California Academy of Sciences, 2023).

Kamnoetvidya Science Academy (KVIS), a gifted science high school focused on science and technology education for Grades 10–12 (students aged 15–18 years). Most KVIS students come from various parts of Thailand, primarily from urban areas, that may have limited opportunities to explore nature depends on family background. Since KVIS is located in Wangchan District, Rayong Province which was originally established on an old orchard and is adjacent to a natural forest area, Khao Khun In. This unique setting makes KVIS an ideal learning environment for students to explore biodiversity. Therefore, the Department of Biology and Environmental Science established the KVIS Biodiversity Project, a citizen science project under iNaturalist platform (iNaturalist, 2008) (Figure 1), which encourages KVIS students to explore nature and upload their observations. The project began in October 2021, with only 11 active users at that time. Subsequently, groups of students interested in biodiversity helped map the school boundaries in iNaturalist using GPS and launched campaigns to inform and encourage other students to use the application. Constructivist theory, one of the major learning theories, suggests that students actively construct their knowledge through experiences and interactions with the real-world environment (Bou Saad et al., 2025). Therefore, active learning strategies, such as discovery-based learning help foster students' curiosity and provide essential foundational skills for nurturing scientific

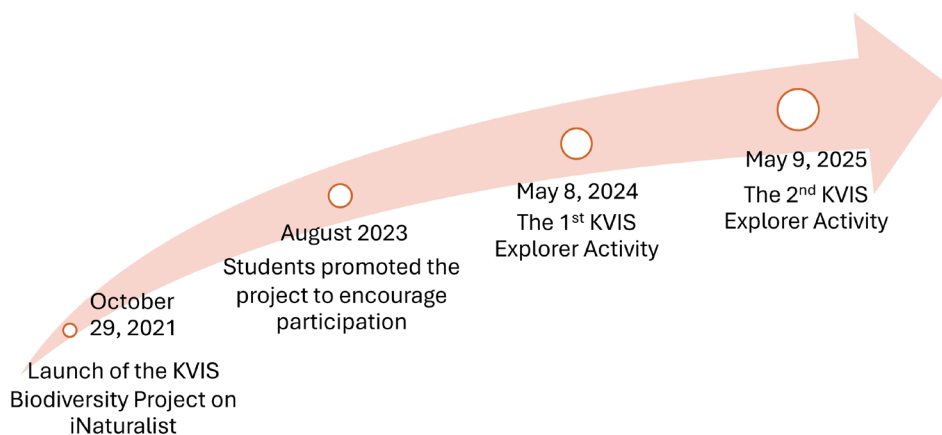


Figure 1. Development of KVIS biodiversity data from the launch of KVIS Biodiversity Project in 2021 until in the 2nd KVIS Explorer Activity.

thinking (Bou Saad et al., 2025; Linda et al., 2025). Accordingly, biology teachers in KVIS have encouraged students to engage in direct field observations and use iNaturalist as a tool in various classroom and extracurricular activities.

In this study, we created active learning activity called KVIS Explorer for incoming Grade 10 students during the pre-session camps on May 8, 2024, and May 9, 2025, to cultivate the concept of citizen science among KVIS students through a nature exploration activity within the school and introduced students to record biodiversity data in school using the iNaturalist application. This activity aimed to improve the biodiversity database of the KVIS Biodiversity Project, foster the concept of citizen science, and promote environmental awareness among KVIS students.

Materials and methods

This study was conducted during the KVIS Explorer activity, which was part of the pre-session camps held on May 8, 2024, and May 9, 2025. All participants were Grade 10 KVIS students (aged 15–16 years), totaling 126 students, including 59 from 2024 and 67 from 2025 (Table 1). The activity consists of 3 steps including.

Step 1

The session began with a 20-minute introductory lecture on the concept of citizen science and the use of the iNaturalist application.

Step 2

Students were then divided into groups of 5–6 to explore the diversity of organisms in various areas of the school, including academic buildings, the cafeteria, student dormitories, teacher dormitories, and connecting pathways. They were given 45 minutes to take pictures using their mobile phone cameras and upload them to iNaturalist. All observations uploaded from the school area were automatically included in the KVIS Biodiversity Project (<https://www.inaturalist.org/projects/kvis-biodiversity-project>)

Table 1. Total participants in the KVIS Explorer Activity in the 2024 and 2025.

	2024	2025
Total participants	59	67

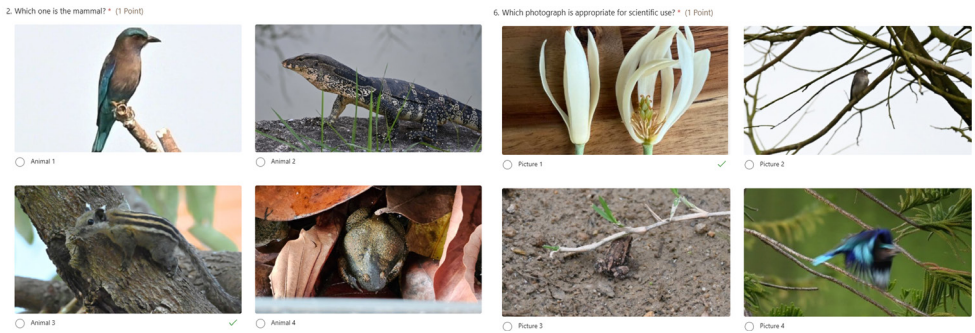


Figure 2. Examples of questions in Pre-Test and Post-Test Questions Used in the KVIS Explorer Activity.

Step 3

Teachers summarized the records submitted by students on iNaturalist and provided examples of the species observed during the activity. After that, students completed an evaluation form to measure their satisfaction with the activity (Table 2). Responses were assessed using a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicating stronger agreement.

Specially, in 2025, an additional activity was introduced to assess students’ knowledge of citizen science and biodiversity through a pre-test and post-test consisting of six questions, including images of animals and plants observed at KVIS (as the example in Figure 2).

Data analysis

All observational data from KVIS Biodiversity Project in iNaturalist were then downloaded in the .csv format. Then count the number of active users and number of observations each year. All data uploaded by students during the activities on May 8, 2024, and May 9, 2025, were sorted and categorized into groups—vertebrate animals, invertebrate animals, plants, and fungi—and further classified by observation type: research grade, casual grade, and needs ID.

Satisfaction scores, as well as pre-test and post-test scores, were analyzed using the mean and standard deviation, and differences between pre-test and post-test scores were assessed using a paired-sample t-test with a 99% confidence level.

Furthermore, the list of participants from both 2024 and 2025 was sorted to identify additional observations recorded after the events, both within KVIS and outside, to measure student engagement following the activities.

Results and Discussion

1. Observational data from the KVIS explorer activities

All the observational results from KVIS Explorer activities 2024 and 2025 classified by group of organisms and type of observation were described in Figure 3 and 4, respectively.

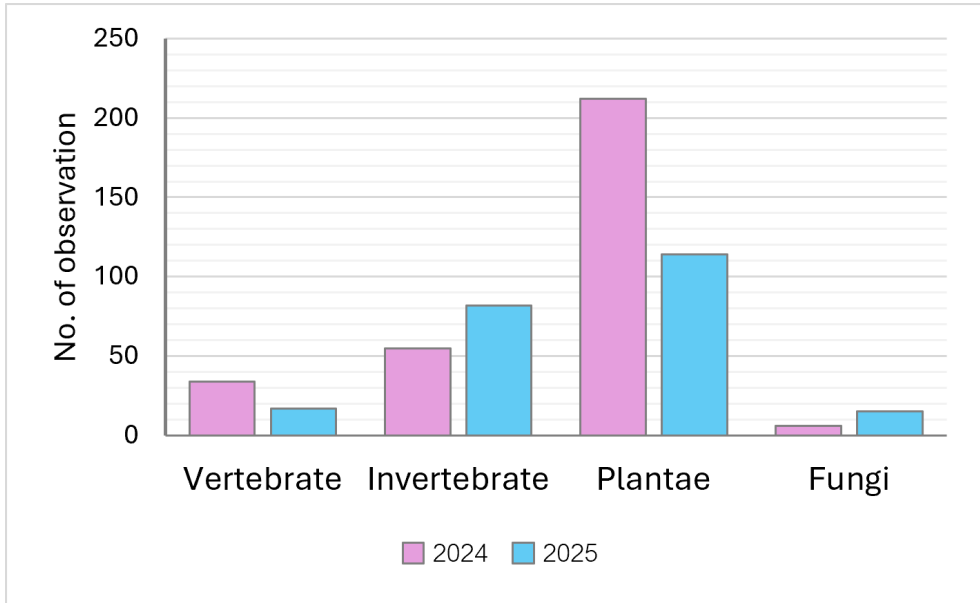


Figure 3. Number of observations recorded during the KVIS Explorer Activity (May 8, 2024, and May 9, 2025), classified by organisms groups (vertebrates, invertebrates, plants, and fungi) from 56 and 67 students, respectively.

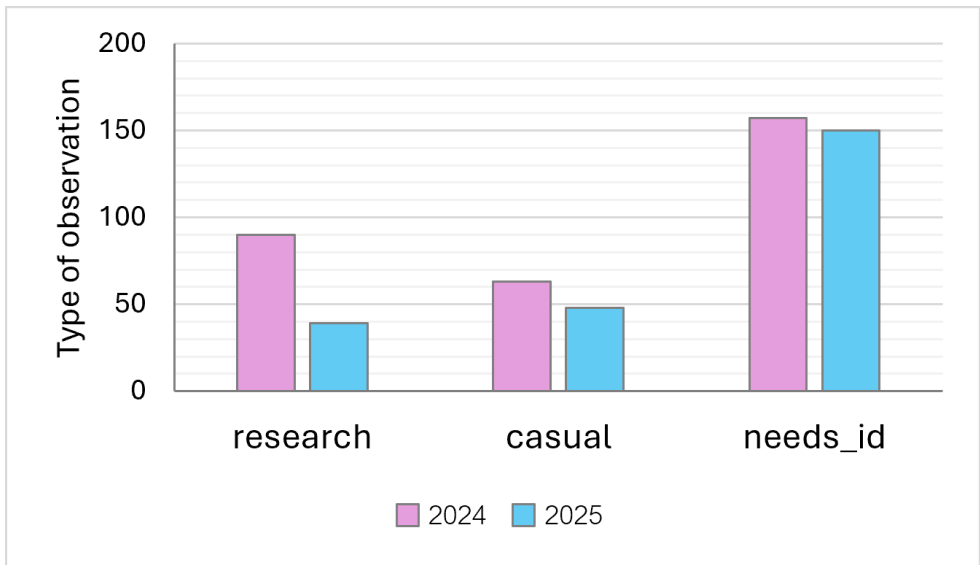


Figure 4. Number of observations recorded during the KVIS Explorer Activity (May 8, 2024, and May 9, 2025), classified by type of observation (research grade, casual grade, and need id) from 56 and 67 students, respectively.

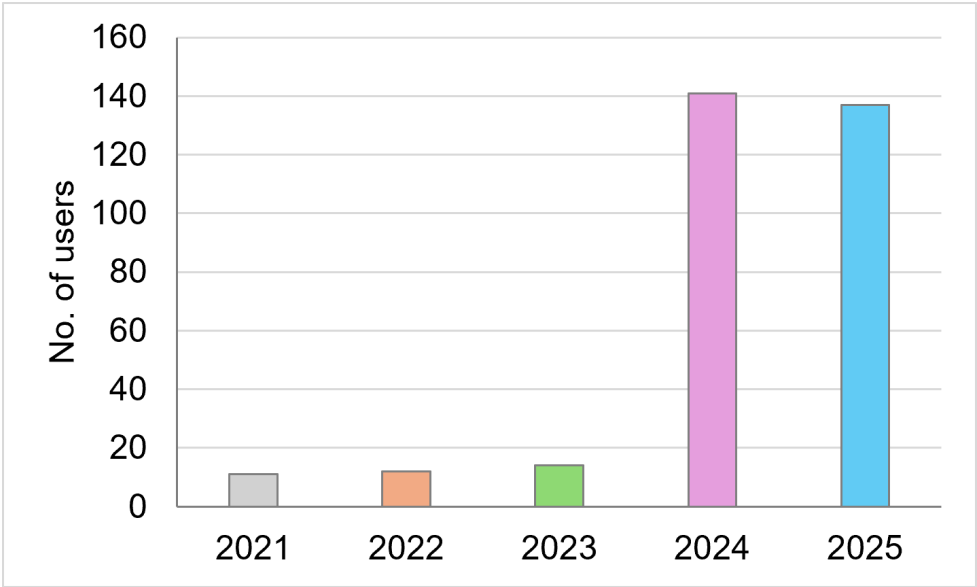


Figure 5. Numbers of active users in iNaturalist each year (October 29, 2021 to August 26, 2025)

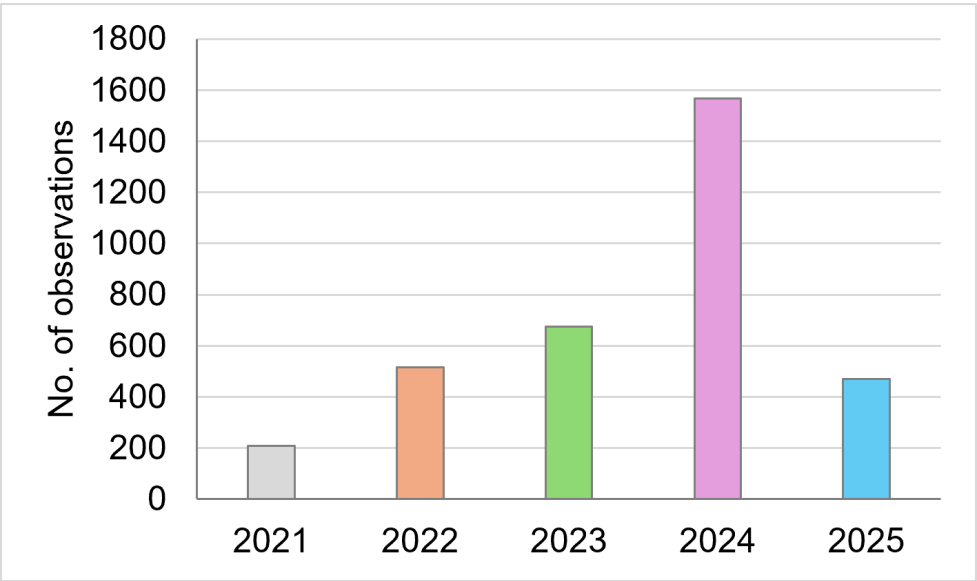


Figure 6. Number of observations for each year (October 29, 2021 - August 26, 2025).

The results from the first-time KVIS Explorer activities show a total of 310 observations on May 8, 2024, of which 307 were classified: 212 plants (68%), 55 invertebrate animals (18%), 34 vertebrate animals (11%), and 6 fungi (2%), with 3 unclassified entries. Additionally, the data were categorized into 90 entries (29%) as research-grade, 63 entries (20%) as casual grade, and 157 entries (51%) as need ID. In addition, the results from the second activity on May 9, 2025, show a total of 237 observations, of which 233 were classified: 114 plants (48%), 82 invertebrate animals (35%), 17 vertebrate animals (7%), and 15 fungi (6%), with 4 unclassified entries. Among these, 39 entries (16%) achieved research-grade, 48 entries (20%) were casual grades, and 150 entries (63%) needed ID. The top five most observed organisms in the 2024 and 2025 events were a plant in the class Magnoliopsida 23 records, Banana trees (*Musa* ssp.) 13 records, Tokay gecko (*Gekko gekko*) 13 records, Tridax daisy (*Tridax procumbens*) 13 records, and Swan goose (*Anser cygnoides domesticus*) 10 records which are kept as pets in the school.

The results from the two events show that the citizen science project can help to increase the observational data for 547 observations which is 15% of the total observations in this project from October 29, 2021 - August 26, 2025. The results show that the KVIS Explorer activities helped increase biodiversity data within the school. This finding is consistent with previous research that used iNaturalist in BioBlitz events organized by the Natural History Museum of Los Angeles and the California Academy of Sciences, which also demonstrated an increase in the number of observations in those areas (Asisteidou et al., 2021). In addition, the results indicate that the proportion of research-grade data declined from 20% in 2024 to 16% in 2025, likely due to the time required for expert verification of species identifications, a factor beyond our control. Moreover, the number of plant observations in these activities was higher than that of animals, as plants are generally easier to photograph. However, most plant observations were identified only at the class level, as accurate plant identification often requires reproductive structures. Furthermore, the most frequently recorded plant and animal species were commonly found within the school area. Students tended to recognize and record these familiar species based on prior knowledge, rather than selecting unfamiliar species.

2. Students' satisfaction and knowledge gained from the KVIS explorer activities

Our results show a positive outcome from students in two-year events. In the 2024 event, 57 students responded to the survey. They gave an average satisfaction score of 4.56 ± 0.76 (91.23%) and reported an increase in knowledge about citizen science, with an average score of 4.61 ± 0.73 (92.28%). In the 2025 event, 67 students responded to the questionnaire, giving an average satisfaction score of 4.26 ± 0.88 (85.20%) and an average score of 4.43 ± 0.72 (88.60%) for increased knowledge about citizen science, as shown in Table 1.

Moreover, in the 2025 event, we conducted pre- and post-tests (6 points in total) to evaluate biodiversity knowledge of 67 students before and after the activity. The average pre-test score is 4.21 ± 1.14 and the average post-test score is 5.81 ± 0.43 . From the paired sample t-test analysis shows the highly significant between pre-test and post-test score ($t = 11.19, p < 0.01$) as shown in Table 3. This result shows that students gain knowledge in biodiversity from the activity.

Furthermore, several previous studies have reported that using iNaturalist significantly enhances biodiversity learning in both secondary school and undergraduate students. For example, a study at the University of Georgia successfully integrated iNaturalist into a plant taxonomy course during the COVID-19 pandemic (McNair et al., 2023). Similarly, a study at Davidson College combined citizen science with traditional insect collection in an entomology course, where students were highly engaged in collection activities and achieved learning

outcomes (Paradise & Bartkovich, 2021). Additionally, research in Spain reported positive evaluations of using iNaturalist for classroom activities on plant biodiversity among secondary school students (Echeverria et al., 2021). These findings demonstrate that iNaturalist is an effective tool for engaging students in discovery-based learning activities and citizen science.

3. Contributions of the KVIS explorer activities to KVIS biodiversity data and student engagement after the event

The results from iNaturalist show that the number of active users increased significantly after the KVIS Explorer activity on May 8, 2024, rising from 11 to 14 users during 2021–2023 to 141 users in 2024 and 137 users in 2025. This represents an increase of approximately 9.70 and 8.79 times the number of active users in 2023. All the number of active users each year shows in Figure 5.

Moreover, the number of observations throughout the year also increased significantly after the KVIS Explorer activity on May 8, 2024. The graph in Figure 6 shows the increase

Table 2. Evaluation results of the KVIS Explorer Activity (2024 and 2025) using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Data presented in form of mean ± standard deviation.

Questionnaire items	2024	2025
1) I am satisfied with this activity.	4.56 ± 0.76	4.26 ± 0.88
2) I have gained more knowledge about the concept of citizen science.	4.61 ± 0.73	4.43 ± 0.72

Table 3. Statistical analysis of pre-test and post-test scores during the KVIS Explorer Activity in 2025 using a paired-sample t-test.

	N	Mean	SD	Mean diff.	t-value	Sig.(p)
Pre-test	67	4.21	1.14	1.6	*** 11.19	0.00
Post-test	67	5.81	0.43			

N = 67, ****p* < 0.01

Table 4. Post-event iNaturalist data showing the number of active users recording observations within KVIS and outside the school.

	After event 2024	After event 2025
Participants remain active post-event	24	9
Total records from active participants	66	26
Records within KVIS	60	21
Records outside KVIS	6	5

in observations from 209 records in 2021 (starting from October), 516 records in 2022, and 674 records in 2023, to 1,567 records in 2024 (a 1.32-fold increase from 2023), the year we launched the event. However, the number of observations in 2025 is only 469 records, as data collection was limited to August 2025.

Furthermore, we collected post-event data from iNaturalist to assess students' contributions after the KVIS Explorer, as shown in Table 4. The results indicate that 24 of the 59 students who participated in the 2024 event and 9 of the 67 students who participated in the 2025 event continued using iNaturalist to record biodiversity data. The total records from students who participated in the event in 2024 are 66 records (60 within KVIS and 6 outside the school), while those from 2025 totaled 26 records (21 within KVIS and 5 outside the school). In total 33 students from the two events, the average number of uploaded records was 2.79 ± 3.71 . The student with the highest contribution uploaded 21 records, and 16 students uploaded only 1 record each after the events.

These results correspond well with a study on BioBlitz events organized by the Natural History Museum of Los Angeles and the California Academy of Sciences, which found that young volunteers who participated in the activity and were introduced to iNaturalist continued to contribute data for 8 years and 7 months after the event. The median number of daily contributions per volunteer was 1.99 ± 10.29 , with participants contributing an average of 0 to 48 observations per day (Asisteidou et al., 2021).

Summary

In conclusion, the results indicate that the KVIS Explorer activities conducted over two years successfully enhanced the data in KVIS Biodiversity Project by adding 537 new observations from a total of 126 students. Additionally, the activities promoted the concept of citizen science among Grade 10 students, as indicated by the evaluation results, which showed high satisfaction (overall score of 4.41 out of 5) and increased knowledge about biodiversity (overall score of 4.52 out of 5), along with improved post-test scores. Moreover, these activities inspired 33 students to continue using iNaturalist to record biodiversity data after the events. We expect that this initiative will not only foster students' learning but also cultivate biodiversity awareness, contributing to the protection of nature and the environment. This activity can serve as a model for teaching biodiversity to students in other schools using iNaturalist as a tool.

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