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RESEARCH REPORT

Sciencing Out, an informal STEM education program in Madagascar: A case-study

Susan Dorsey[1a], Tsiory Andrianavalona[b], Niaina Ramihangihajason[b], Aina Brias-Guinart[c]

[a]*Miami University, USA;* [b]*ExplorerHome Madagascar Science Center, Madagascar;* [c]*University of Helsinki, Finland*

Abstract: *Sciencing Out (SciOut) facilitated by Explorer Home Madagascar Science Center, a Malagasy NGO, is an innovative STEM (Science, Technology, Engineering, and Math) education program because it incorporates out-of-school education, student and scientist collaborations, local and international partnerships, and arts education. This case-study describes the program's unique educational components alongside evaluation data to understand: How does a field program like SciOut help students engage with STEM topics? The results demonstrate that out-of-school, field-based experiences that connect students to local experts and biodiversity topics are important for increasing access to STEM knowledge and careers.*

Keywords: *STEM education; STEAM education; Madagascar; informal education; field-based experiences*

Science, Technology, Engineering, and Mathematics (STEM) education is critical for empowering humankind to address big challenges such as climate change, pollution, and disease. STEM education is an important foundation for innovation especially when paired with creativity. If utilized responsibly and conscientiously, knowledge of STEM subjects can help us understand, adapt, restore, discover, and care for the abundant life around us. To accomplish this, increasing STEM access is paramount as the global challenges of the present and future require solutions that incorporate STEM knowledge (Marrero et al., 2014). As such, student interest and access to STEM is essential. To promote broader access amongst student populations, a variety of pedagogical approaches like the ones described below are needed in conjunction with in-school curriculum.

[1] Corresponding Author: 17 Bridgelake Circle, Apartment J, Cockeysville, MD 21030, USA. Email: susan.jennifer.dorsey@gmail.com

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To ignite student curiosity in STEM fields, *out-of-school learning* experiences are encouraged. This approach provides space for students to explore, fail, and create without the pressure of assessment (Bamberger & Tal, 2008; Stevens et al., 2016). In-school education builds knowledge over time, while out-of-school learning fosters prolonged interest in a subject through social interaction and experiences (Berry, 1998). In out-of-school settings, students are often encouraged to use inquiry to spark curiosity about the world around them. These experiential learning opportunities can lead to transformational encounters that spark deeper engagement with an academic subject (Houseal et al., 2014).

Another pedagogical approach is to encourage authentic learning experiences with field practitioners, which can provide students with a hands-on understanding of research processes, as well as access to the scientific community (Houseal et al. 2014). Allowing students to understand the intersections of different subjects through exposure to professionals through *student and scientist collaborations*, increases engagement. This can expand positive attitudes and interests in academic subjects, field professionals, and content knowledge (Houseal et al., 2014).

Cross-cultural exchange through *local and international partnerships* is an additional pedagogical approach that can foster respect for and wonder about the world, build relationships, and inspire continued learning among adults and students (Duraisingh, 2018). Opportunities to exchange ideas regionally and globally provides adults and students with the communication and critical thinking skills to collaborate across local territories and national borders, while solving the global challenges of the future and present (Mansilla & Jackson, 2013). These opportunities enable all involved to consider the viewpoints of others, while critically examining their own to learn the importance of multiple worldviews (Mansilla & Jackson, 2013). This approach builds a broader understanding of local and global narratives while developing respect for its complexity, and personal meaning to human communities around the world, including one's own (Duraisingh, 2018; Project Zero, 2016).

Arts education (drawing, painting, storytelling, videography, photography, music, poetry, etc.) is the final approach introduced here for increasing access to STEM knowledge because of its ability to engage multiple learning styles. This method can create gateways to knowledge for students because of the unique ability of the arts to foster deep engagement, increased retention, and perseverance (Holmes, 2002; Sally Ride Science, 2017). In fact, there is a correlation between arts education and high performing science students (Dhanapal et al., 2014; Holmes, 2002; Peppler & Wohlwend, 2017). To be successful in STEM fields, students will not only require an understanding of STEM, but also curiosity and a creative drive to spark inquiry and seek multiple perspectives (Mansilla & Jackson, 2013; Stevens et al., 2016).

Madagascar is a unique context for innovative STEM education because of its vast array of endemic biodiversity found nowhere else on Earth (Dolins et al., 2009). The education system

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in Madagascar focuses primarily on direct instructional techniques such as rote memorization and book learning in formal classroom settings with little focus on the unique biodiversity of the island (Dolins et al., 2009; Venart & Reuter, 2014; Wills et al., 2014). This makes Madagascar an interesting context for outdoor STEM programs that can be paired with and diverge from the direct instruction students receive in school.

Within the current educational model, the number of Malagasy students that pursue a career in scientific fields is low. According to the Ministry of National Education in Madagascar (The Ministry of National Education in Madagascar, 2016; Ministère de l'Enseignement National, 2017), only 3% of young students chose to pursue a career in scientific fields. In addition, data from UNESCO (2018), revealed that the rate of female employment in STEM fields in Madagascar is also low. This is likely because barriers to access persist among low-income communities, students who do not speak colonial languages, special needs communities, people of color, and women (English, 2017; Marrero et al., 2014; Sally Ride Science, 2017). In many countries, including Madagascar, formal education is taught through colonial languages, such as French, which may differ from native Malagasy languages spoken at home causing additional barriers (Wills et al., 2014). Barriers like this are problematic because access assists communities with far-reaching decisions that affect their wellbeing, making obstacles discriminatory acts (Marrero et al., 2014). Increased STEM access through education models that integrate a variety of pedagogical approaches such as the ones described below will positively impact the global community, as diverse global perspectives are crucial for increased knowledge and innovation (Marrero et al., 2014).

It is essential to understand the impacts and benefits of combining a variety of pedagogical approaches in STEM education, as it may provide additional insight on how to create access to STEM fields through real-world and hands-on experiences. While evaluation of STEM interventions may be common for programs implemented in formal schooling (Aslan Efe & Hanas, 2022; George-Jackson & Rincon 2012; Katzenmeyer & Lawrenz 2006), there is generally a lack of evaluation pertaining to education programs conducted outside of the formal school system, especially among countries in the Global South. For this reason, we embrace this challenge in this article as we evaluate Sciencing Out (SciOut) an innovative education program in Madagascar that incorporates the 4 pedagogical components described above: out-of-school STEM learning experiences, student and scientist collaborations, local and international partnerships, and art education. Our aim is to answer the following research question: How does a field program like SciOut help students engage with STEM topics?

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Methodology

Case Study

In this article, we present an education program titled SciOut. This program is an initiative of ExploreHome Madagascar, a Malagasy owned, and operated NGO founded in 2018 by by Tsiory Andrianavalona and Niaina Ramihangihajason to link STEM fields with the general public. SciOut is an immersive science education program that incorporates a week-long in-field camping and data collection experience with scientists (Tables 1&2). It creates bridges between skilled practitioners and high school students through field-based experiences. The goal of the program is to introduce students to Madagascar's unique biodiversity and promote continued science learning, while building off of the direct instruction students receive in school (Dolins et al., 2009) (see Appendix A1 for detailed program overview).

Sample Group

Program applications were advertised on social media and in schools throughout and near Antananarivo. 66 applications were submitted. 21 student applicants from 12 public and private schools were selected to participate in one of two program cohorts. There were a majority of female (68.2%) versus male applicants (31.8%). Among the 21 participants selected for the program, 16 were girls (76.2%) and 5 boys (23.8%) (Table 1).

Table 1.
SciOut1 (first cohort) & SciOut2 (second cohort) Descriptions

	Duration	Students	Facilitators & Scientists	Partner	Location
SciOut1	9 days (4 days in Antananarivo for orientation, 5 days engaged with hands-on learning in entomology and primatology alongside scientists while camping in the field)	10 malagasy students (7 girls, 3 boys) 14-18 years old from 5 different schools (private and public)	9 malagasy facilitators & scientists (primatology, entomology, & paleontology) 1 international collaborator (art & science educator, USA)	SADABE (non-governmental organization & local partner)	Mahatsinjo forest (Tsinjoarivo-Ambalaomby New Protected Area). High altitude rainforest near the Betsimisaraka and Merina Malagasy communities. Home to a diverse range of wildlife including 10 species of lemurs like the critically endangered diademed sifaka, *Propithecus diadema* (Behrens & Barnes, 2016; Irwin, 2013a; Irwin, 2013b).

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SciOut2	12 days (5 days in Analavory for orientation & paleontological fieldwork, 7 days engaged with hands-on learning in primatology, ornithology, botany & ethnobotany alongside scientists while camping in the field)	11 malagasy students (9 girls, 2 boys) 15-17 years old from 8 different schools (public and private)	10 malagasy facilitators & scientists (paleontology, ornithology, botany, & primatology) 2 international collaborators (videographer from South Africa, educator from Finland)	GERP (non-governmental organization & local partner)	Maromizaha forest-eastern highland rainforest that exists within the Ankeniheny-Zahamena forest corridor. Home to 12 lemur species including the greater bamboo lemur, *Prolemur simus*, and Madagascar's largest lemur species, the *Indri indri* (Sipa, 2020).

Notes. Descriptions of Program Length, Activities, Students, Facilitators & Scientists, Partners, & Locations.

Program Curriculum

The field sites added to the authenticity of the experience as students adapted to the changing weather patterns, participated in hikes through different terrain, and followed the movements of the species they observed (Houseal et al., 2014).

Table 2.
SciOut1&2 Curriculum Description

	Pre-field: Facilitators & Scientists	**Pre-field: Students**	**SciOut1&2: Field Work**	**Post-field:**
SciOut1 &2	Knowledge exchange workshop (1 month prior to the program). 3 days at field sites (learning campsite, species, & developing activities). 1 day participating in a sciencetelling workshop in	Orientation meeting for students & parents (1 week prior). Pre-field orientation (during program): lectures about STEM career fields, art education & science learning	The outdoor out-of-school learning setting provided opportunities for students to experience science in the field alongside skilled practitioners through student & scientist collaborations. Participatory learning and inquiry-based education methods were used to spark curiosity. Field courses enabled students to learn about science methodology through authentic data collection as they	Students' sciencetelling videos were edited and finalized post-field by program staff. The results are 22 videos (20 individual student videos and 2 group videos). Some were aired during the final gathering for the

	Antananarivo (discussions about engaging high school learners).	(creative process and scientific method), field life, videography, & photography	contributed to ongoing research while studying Madagascar's endemic flora and fauna. Each session included education about reforestation, biodiversity monitoring, primate behavior, habitat threats, data collection techniques, studies of past environments and extinct animals- such as the pygmy hippopotamus (lalomena in malagasy), *Hippopotamus lemerlei*, a focal point of malagasy tales. Participants had the opportunity to dig, touch, and see paleontological field work first hand. Students were also involved in inquiry among the local people through ethnobotany. Using project-based learning, both cohorts applied the storytelling techniques taught during the orientation to document their experience in the forest. They created short videos to broadcast the value of science from their perspective.	first cohort. All were aired online using ExplorerHome's website and social media platforms (Instagram, Facebook, & Youtube). The videos were also aired during an international event, PaleoFest 2020 (Burpee, Illinois, 2020).

Notes. Descriptions of Pre-field work, Field work, & Post-field work.

Activity Description: A typical SciOut field-day

Students, facilitators, and scientists wake-up in their tents after camping in the forest for the night. Everyone prepares for the day as breakfast is served. After breakfast, students are divided into teams. Each team is paired with a scientist and participates in different activities while hiking and exploring the natural area. During SciOut1, those activities included radio tracking, observing lemurs with ethnographic/animal behavior charts, transect studies, and identifying insects. During SciOut2, those activities included a paleontology dig-digging a field plot, safely uncovering subfossils, cleaning, and protecting the found fossils. SciOut2 teams also observed lemurs in the wild and participated in "botanical plot" methodology using decameters, compasses, and measuring instruments to develop quadrants. Students used dictaphones and binoculars to assist with their ornithology studies of bird behavior while creating Mckinnon's lists. They conducted interviews with local people and learned about ethnobotany and medicinal plants.

Each team returned to camp for lunch. Afterwards students had free time to work on their video projects, journal, sketch, and get to know one-another. Presentations from facilitators and scientists commence in the afternoon as they share relevant topics related to the morning's field observations and camplife topics-how to live with mosquitoes in the field, life as a woman doing scientific field work, and/or updates about their video projects and next day schedules. At night, the group participates in night hikes, campfire activities-games, songs, and skits-before going to sleep in their tents and beginning a similar schedule the next day.

Data Collection

We developed an evaluation study to gather quantitative data to understand how a field program like SciOut helps students engage with STEM/STEAM topics. We used three data collection tools: pre & post-program student questionnaires, student video evaluations, and facilitator & scientist post-program evaluations. Both the questionnaires and the video evaluations were structured to understand how SciOut helped students engage with STEM topics. For that, we measured three aspects: i. student interest, ii. academic achievement, and iii. understanding of STEM/STEAM topics. The qualitative feedback from open-ended responses was used to emphasize and explain different quantitative data points.

The study received approval from The Ethical Board of Miami University of Ohio. Parental consent was obtained for SciOut students. Participants were given the option to answer or opt out of each survey question. As a result, some students choose not to answer all of the questions. A potential limitation of the study may be social desirability bias. Students may have altered their responses to satisfy program facilitators and scientists, which could have impacted how they responded to particular questions. For this reason, we used different tools such as anonymous pre and post-surveys and a video evaluation to test the same criteria.

To ensure the validity and reliability of this study, we embraced some of the strategies advocated for by Shenton (2004). The pre and post-program evaluation questions were modeled after well-established methods and previous studies with modifications to match the unique characteristics of the SciOut program (RK&A Learn With Us, 2018). The co-authors and founders of SciOut were familiar with the program as its creators as well as the learning context the program was facilitated in. They provided input and feedback as the evaluation tools were developed. We utilized triangulation by using different evaluation methods such as student pre & post-program evaluations, facilitator post-program evaluations, and video evaluations. To encourage honest responses from participants, the evaluations were anonymous. This study is not measuring for or demonstrating academic success, but instead seeking to understand the impacts of the program on students, and how it helped students engage in STEM topics. We described the program and study in detail so it can be replicated.

Student Pre/Post-Questionnaires n=21

The SciOut1 program and evaluation was conducted in April 2019, and SciOut2 in September 2019. The pre and post-program evaluations were identical and included 17 Likert scale questions that asked students to rate their responses to question as 1-Strongly disagree, 2-Disagree, 3-Slightly disagree, 4-Undecided, 5-Slightly agree, 6-Agree, 7-Strongly agree. The pre-program written evaluations were facilitated on the first day of each program before students engaged in STEM activities. Post-program evaluations were implemented on the final day of each program. Of the 21 students that participated in total, 21 completed the written survey (100% response rate), however some chose not to answer every question. The pre and post-program surveys were unpaired to maintain anonymity among the research participants. As a result, only the mean and standard deviation could be calculated as statistical tests. The pre and post-program evaluation questions focused on the following topics:

(1) *Interest:* Defined as a. active learning: discussion and/or physical engagement with a learning activity, b. student driven work: project driven by a student question or curiosity, and c. collaboration: peer discussion and or combined work/research (Lai, 2018; Mansilla & Jackson, 2013; Paris et al., 1998; Stevens et al., 2016).

(2) *Academic Achievement:* Defined as a. analysis: comparing and contrasting, b. comprehension: application of knowledge, c. critical thinking: questioning and criticizing information, d. knowledge: finding important points (Lai, 2018; Mansilla & Jackson, 2013; Paris et al., 1998; RK&A Learn With Us, 2018).

(3) *Understanding of STEM/STEAM topics:* Defined as a. interdisciplinary learning: connecting different subject matter and/or combining different processes (ex: creative and scientific process) (Lai, 2018; Mansilla, 2016).

The open-ended question asked students to explain their response after selecting how likely they are to recommend this program to their peers (see Appendix A2 for evaluations).

Percentages were calculated for the response rates for each question to show the comparisons between pre and post-program survey responses. Means were calculated to measure the differences from pre and post-program survey results. The standard deviation (STDV) was calculated to measure how people naturally vary from each other from pre to post-program results. All open-ended responses were categorized using the study domains.

Student Videos n=20

Participants were equipped with smartphones, selfie sticks, microphones, basic free editing software (Adobe Clip), and instruction to create 1–2-minute videos using artistic skills in storytelling, videography, and photography. This project was student-directed and incorporated participatory learning methods by emphasizing student voice as they described a science theme of interest from their field experience to share with their communities. During SciOut1, the instruction focused heavily on field work over storytelling and videography. Students recorded their footage in the field and ExplorerHome staff completed the video editing post-program. During SciOut2, the students' time was equally divided between field work and storytelling and included the assistance and instruction from a professional storyteller and videographer. The students recorded their footage and completed the editing process in the field. ExplorerHome staff added only subtitles, background music, logos, and lighting adjustments (see Appendix A3 for video playlists). Of the 21 students, 20 completed the requirements for the video project.

An evaluation rubric was used to assess the student videos (see Appendix A4 for rubric). The rubric included 3 domains: i. student interest, ii. academic achievement, iii. understanding of STEM/STEAM topics. Each domain has 4 areas of measurement, and each area is valued on a scale of 4 in terms of performance. 2 evaluators evaluated each video separately and compared their results to ensure accuracy. The evaluators collaboratively re-evaluated any score that resulted in a 3-point difference for the same area of measurement in a domain. The rubric assessed the following qualities:

(1) *Interest:* Defined as, a. wonder, b. imagines or envisions possibilities, c. encourages the audience to wonder about a STEM/STEAM topic.

(2) *Academic Achievement:* Defined using the same indicators as the student pre/post-questionnaires with the addition of, a. uses evidential reasoning.

(3) *Understanding of STEM/STEAM topics:* Defined using the same indicators as the student pre/post-questionnaires with the addition of, a. connects program experience to interdisciplinary learning in school, b. connects the interdisciplinary knowledge learned to daily life.

A percentage was calculated using both sets of scoring from the evaluators for each area of measurement in a domain.

Facilitator & Scientists Post-Program Evaluations n=12

Post-program written evaluations were administered on the final day of each program to gather feedback from the facilitators and scientists (see Appendix A5 for evaluations). This survey included 9 Likert scale questions, and 7 open-ended questions to uncover the facilitator and scientist objectives for student learning, methods of student engagement, program impacts, their favorite aspects of the program, challenges, and recommendations. Of the 12 facilitators and scientists, 12 completed the written survey (100% response rate).

The median response scores from the facilitator and scientist Likert scale questions were calculated and summarized. All open-ended responses were categorized using the study

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domains i. interest, ii. academic achievement, iii. understanding of STEM/STEAM topics. The open-ended responses from facilitators were used to enrich the results of the student evaluations in this report. The rest of the data can be found in the Appendix B.

Results

The evaluation results are structured to help us learn how SciOut helped students engage with STEM/STEAM topics by measuring student interest, academic achievement, and understanding of STEM/STEAM topics. For each of these three aspects measured, we present the results relating to the pre/post-questionnaire and the video evaluation. Additionally, we introduce at the end some responses from the student and facilitator evaluations.

Student Interest

Table 3 shows a general trend in the mean which increases from pre to post-test except for Question 4, “I am bored when I study science”. Question 4 is reversed in comparison with the other questions meaning a decreased mean from pre to post-test indicates that some students determined they were not bored when studying science during the program.

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Table 3.

Program Objective 1. Interest

Student Questions	**Mean**		**SD**		**Strongly Disagree** 1		**2**		**3**		**4**		**5**		**6**		**Strongly Agree** 7	
	pre	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**
Q3: Science is interesting.	6.3	6.8	.49	.35	-	-	-	-	-	-	-	-	-	-	61	14	38	85
Q4: I am bored when I study science.	1.5	1.4	.87	.74	52	66	33	28	4	-	4	4	-	-	-	-	-	-
Q5: Science is hands-on.	5.9	6.7	.97	.43	-	-	-	-	-	-	9	-	19	-	38	23	33	76
Q6: I use science every day.	6	6.5	.77	.51	-	-	-	-	-	-	-	-	28	-	42	47	28	52
Q7: I have completed science projects with other students.	4	5.3	1.8	1.7	4	-	33	14	-	-	14	14	23	9	14	28	9	33
Q8: I can learn more about my classmates and science by listening to them talk about it.	6	6.3	1.2	.85	-	-	4	-	-	-	4	4	4	9	42	33	42	52
Q9: Science can help me understand myself better.	5.7	6.5	1.6	.59	-	-	-	-	-	-	9	-	14	4	38	33	33	61
Q10: To understand more about science, it is better to have someone tell me.	6.1	6.1	1	.98	-	-	-	-	-	-	14	9	4	9	33	33	47	47
Q11: I am interested in a science or STEM/STEAM career	6.4	6.6	.67	.57	-	-	-	-	-	-	-	-	9	4	33	23	57	71

	Mean		**SD**		**I will not** 1		**I may** 2		**Neutral** 3		**I will** 4		**I will highly** 5	
	pre	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**	**pre**	**post**
Q19: How likely are you to recommend this program to your peers?	4.4	4.7	.67	.56	-	-	-	-	9	4	38	19	52	76

Note. Mean, STDV, and Percentage Response Scores For SciOut1&2 Student Pre & Post-Program Evaluation Questions 3-11&19 On A 7- Point Likert Scale

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Table 4.
Program Objective 1. Interest

Measuring Student Interest	1	2	3	4
	No Achievement	**Emerging**	**Developing**	**Accomplished**
Wonders: The student describes facts and observations related to a topic of interest and includes the who, what, when, where, and why. (**SciOut1/SciOut2**)	-	22% / 18%	33% / 27%	44% / 54%
Imagines or envisions possibilities: The student demonstrates how they imagined/or thought up possible solutions to the concept in question by describing their thought process. Videos and photographs not included in this section, only descriptions. (**SciOut1/SciOut 2**)	83% / 27%	16% / 22%	0% / 4%	0% / 45%
Encourages the audience to wonder about a STEM/STEAM topic: The student uses dynamic storytelling to present a STEM/STEAM topic to spark interest and wonder. (**SciOut1/SciOut 2**)	0% / 0%	16% / 9%	61% / 22%	22% / 68%
The student is involved in, or describes a physical action related to the topics discussed: The student clearly describes a methodology or subject. Or the student shows a physical action related to the methodology or subject described. (**SciOut1/SciOut2**)	61% / 22%	11% / 13%	27% / 13%	0% / 50%

Note. Percentage of Evaluator Scores For SciOut1&2 Student Videos.

Table 4 reveals a high percentage of performance on the value scale, accomplished (44%/54%) in the area measuring for "wonder". It also identified a high percentage of performance on the value scale, developing (61%/22%) and accomplished (22%/68%) in the area measuring for, "encourages the audience to wonder about a STEM/STEAM topic". In general SciOut2 students scored higher percentage points on the value scale, accomplished in comparison to SciOut1 students. SciOut1 students scored higher percentage points on the value scale, no achievement in comparison to SciOut2 students.

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Academic Achievement

Table 5.
Program Objective 2. Academic Achievement

Student Questions	Mean		SD		Strongly Disagree 1		2		3		4		5		6		Strongly Agree 7	
	Pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
Q12: Science can help me understand what life was like a long time ago.	5.9	6.6	1.4	.49	-	-	-	-	-	-	-	-	9	-	57	38	28	61
Q13: Science can help me understand life today.	6.2	6.5	.76	.51	-	-	-	-	-	-	4	-	4	-	52	47	38	52
Q14: All people should understand science in the same way.	3.5	4.5	1.8	2.1	4	9	28	14	9	14	9	4	33	9	4	23	4	23
Q15: Science can help me see something familiar in a new way.	5.9	6.7	.97	.43	-	-	-	-	-	-	9	-	19	-	38	23	33	76

Note. Mean, STDV, and Percentage Response Scores For SciOut1&2 Student Pre & Post-Program Evaluation Questions 12-15 On A 7- Point Likert Scale.

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Table 6.
Program Objective 2. Academic Achievement

Measuring Academic Achievement	1 No Achievement	2 Emerging	3 Developing	4 Accomplished
Uses evidential reasoning: The student describes, demonstrates, or shows the evidence they used to come to their reasoned conclusion. Include the use of photos and videos as evidential reasoning. (**SciOut1/SciOut2**)	-	16% / 4%	55% / 22%	27% / 72%
Comparing and contrasting: The student compares and contrasts different information. The scale depends on how much comparing and contrasting is accomplished in comparison with other videos. (**SciOut1/SciOut2**)	27% /9%	38% / 27%	22% / 22%	11% / 40%
Application of knowledge: The student applies the new knowledge that they learned from SciOut by describing it in the video. (**SciOut1/SciOut2**)	83% / 31%	16% / 18%	- / 9%	- / 40%
Questioning and criticizing information: The student delves deeper into the content by asking questions like: "Why is that? Where is the evidence? How good is that evidence? Is this a good argument? Is it biased? Is it verifiable? What are the alternative explanations?" (**SciOut1/SciOut2**)	100% / 81%	- / 4%	- / 13%	-

Note. Percentage of Evaluator Scores For SciOut1&2 Student Videos.

Table 6 reveals a high percentage of performance on the value scales developing (55%/22%) and accomplished (27%/72%) in the area measuring for, "uses evidential reasoning". The video evaluation showcased a high percentage of no achievement (83%/31%) in the area measuring for "application of knowledge". It also revealed a high percentage of no achievement (100%/81%) in the area measuring for "questioning and criticizing information" (Table 6). In general SciOut2 students scored higher percentage points on the value scale, accomplished in comparison to SciOut1 students. SciOut1 students scored higher percentage points on the value scale, no achievement in comparison to SciOut2 students.

Understanding of STEM/STEAM Topics

Table 7.
Program Objective 3. Understanding of STEM/STEAM Topics

Student Questions	Mean		SD		1 Strongly Disagree		2		3		4		5		6		7 Strongly Agree	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
Q16: Science problems that are complicated make me nervous.	4.2	3.2	1.9	2	4	19	14	33	-	4	28	14	9	9	33	9	4	9
Q17: Science can give me new ideas.	6.5	6.6	.6	.58	-	-	-	-	-	-	-	-	4	4	38	28	57	66
Q18: I use different subjects (math, technology, art) when learning science.	5.9	6.2	1.1	1.2	-	-	4	4	-	-	-	4	23	-	38	33	33	57

Note. Mean, STDV, and Percentage Response Scores For SciOut1&2 Student Pre & Post-Program Evaluation Questions 16 & 18 On A 7- Point Likert Scale.

Table 7 presents a general trend in the mean which increases from pre to post-test except for Question 16, "Science problems that are complicated make me nervous". Question 16 is reversed in comparison with the other questions meaning a decreased mean from pre to post-test indicates that some students determined that complicated science problems did not make them nervous after participating in the program.

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Table 8.
Program Objective 3. Understanding of STEM/STEAM Topics

Measuring student understanding of STEM/STEAM topics	1	2	3	4
	No Achievement	Emerging	Developing	Accomplished
Connects different subject matter: Example: The student discusses a connection between human anatomy and primate anatomy. But if the student had compared different types of primate anatomy, it would not count as connecting different subject matter. (**SciOut1/SciOut2**)	50% / 59%	38% / 9%	11% / 13%	- / 18%
Combines different processes (ex: creative and scientific process): A process is the different steps that a scientist, engineer, artist, or mathematician uses to arrive at a goal. The student combines different processes to reach a conclusion. (**SciOut1/SciOut2**)	94% / 54%	5% / 22%	-	- / 22%
Connects program experience to interdisciplinary learning in school: Example: The student makes direct connections to subjects taught in school by explicitly stating something like, "we learned about this in school, but while observing it in the wild, we learned more about it." (**SciOut1/SciOut2**)	100% / 100%	-	-	-
Connects the interdisciplinary knowledge learned to daily life: The student explains how this knowledge connects to daily life and describes why it is important to know, and care about it. (**SciOut1/SciOut2**)	27% / 18%	61% / 36%	11% / 18%	- /27%

Note. Percentage of evaluator scores for SciOut1&2 student videos.

Table 8 revealed a high percentage of no achievement (94%/54%) in the area measuring for, "combines different processes", as well as a high percentage of no achievement (100%/100%) in the area measuring for "connects program experience to interdisciplinary learning in school" (Table 8). In general SciOut2 students scored higher percentage points on the value scale, accomplished in comparison to SciOut1 students. Both SciOut1 and SciOut2 students scored high percentage points on the value scales measuring for, no achievement and emerging.

ISSN: 2149-8504 (online)

Student & Facilitator Open-ended Responses:

Some of the student open-ended responses are paraphrased below:

The program helps teens follow their dreams and provides direction for future career paths. SciOut teaches science that is not taught in classrooms, offers opportunities to interact with others and embark on new experiences. It changes one's thinking process and inspires participants to share the importance of scientific subjects with friends.

The students learned that science can help them understand things more deeply. Some understood more about living forms on earth and how to protect them as a result of the program. The students indicated that the program enabled them to see life in a different way. Participants learned that science helps them understand life from the past, the present, and the future. The students were able to understand science better through fieldwork.

Some of the facilitator open-ended responses are paraphrased below:

A facilitator/scientist explained the importance of exposure to hands-on field work, alongside experts, by explaining how this increased their own interest in STEM as a young student. They go on to explain how this enables participants to visualize themselves in STEM career fields.

The facilitators and scientists describe how they noticed students change throughout the program. The student participants became more curious, asked more questions, and noticed more as their observation and critical thinking skills developed.

The opinions of youth enabled them to think about their own learning methods. The facilitators and scientists transmitted their knowledge, but also learned much from the students.

Increasing the visibility and accessibility of STEM careers to school children is of the utmost importance. SciOut impacts not only the intellectual behavior but also the mindset of the participant through deep skill exchange between the students and the rest of the team. Many students remarked on what a great experience it was to actually be with scientists in the field, to see what their daily activities consist of instead of just learning about it in a classroom. SciOut allows students to discover the unique biodiversity of their country and be proud of it.

Discussion

Our results illustrate how a field program like SciOut helps students engage with STEM topics. In general, we found an increase in the metrics that were measured for related to the three topics: i. Student interest, ii. Academic achievement and, iii. Understanding of STEM/STEAM topics. Next, we discuss to what extent these results may be connected to the pedagogical approaches used in SciOut.

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Some students indicated that they were less bored with science topics and understood how science is used in daily life after participation. This may be a result of the *experiential out-of-school learning environment* which gave students first-hand encounters with the theoretical concepts they learn in school. Evidence of experiential learning may be seen in the increase of students that strongly agreed with the statement, "science is hands-on", from the pre-test (percentage: 28%; mean: 6; STDV: .70) to the post-test (percentage: 61%; mean: 6.7; STDV: .43) (Table 3). This experiential component may have increased the number of students that strongly agreed with the statement, "I am interested in a science or STEM/STEAM career", from the pre-test (percentage: 57%; mean: 6.6; STDV: .57) to the post-test (percentage: 71%; mean: 6.6; STDV: .57) (Table 3). These outcomes may reveal that access to out-of-school learning environments can provide important experiential, and hands-on encounters with theoretical concepts to nurture interest in STEM topics. These results support previous studies that describe how out-of-school learning and experiential learning are linked to increased student motivation for learning science (Paris et al., 1998; Yildirim 2020). The video evaluation revealed a high percentage of performance on the value scale, accomplished (44%/54%) in the area measuring for "wonder" (Table 4). Inquiry education methods tied to experiential learning were used to spark curiosity among students throughout the program. This may have impacted their ability to wonder about a subject and encourage others to do the same through their sciencetelling videos.

In their open-ended responses, participants mentioned the significance of *student and scientist collaboration* by noting how thrilled they were to learn from scientists in the field and emphasized the impact of observing and partaking in the daily activities of a field scientist as opposed to classroom learning only. Additional evaluation studies of education programs have identified a correlation between out-of-school experiences, mentorship/interaction with experts, and increased student interest in STEM topics (Houseal et al., 2014; Stevens et al., 2016). The student's open-ended responses indicated that opportunities to interact with others while learning was important, which is connected to increased understanding and knowledge retention (Alters & Nelson, 2002). This may also explain why students indicated that they were less intimidated by complicated science problems after participation.

SciOut was developed and facilitated by Malagasy science professionals and taught in Malagasy language. Throughout the program, Malagasy science experts mentor Malagasy students. This enabled participants to see themselves represented in STEM careers, which can increase engagement (Sally Ride Science, 2017). Implementing culturally responsive programs, like SciOut, that are connected to local partnerships, experts and biodiversity topics is likely to increase global STEM access which is essential for the sustainability of human communities and natural ecosystems (Kant & Burckhard, 2018; Stevens et al., 2016). The international partnerships provided opportunities for an exchange of knowledge, culture, and language.

SciOut incorporated arts with the use of sciencetelling videos that were created to instill a broader interest in STEM beyond program participants. Storytelling was used to broadcast the value of science from the student's perspectives as they shared their stories using their native Malagasy language (translated to English subtitles). This included the use of videography, photography, and in some cases drawing to portray a dynamic STEM story of personal interest to share with their communities. Thanks to those videos, students not only understood how *arts education* is beneficial to STEM learning, but implemented the concept within their sciencetelling video projects. The inclusion of arts education in STEM offers far-reaching implications for global sustainability by empowering students to think beyond limiting societal structures towards out-of-the-box solutions, which they will be required to do in order to solve the challenges of their future (Bequette & Bequette, 2012).

In this sense, the video analysis uncovered an increased percentage of accomplishment in the areas that were evaluated among SciOut2 participants. This may indicate that the different instructional approaches between SciOut1 (increased instructional focus on fieldwork over storytelling/videography) and SciOut2 (equal instructional focus between fieldwork and storytelling/videography) impacted the video products. Future programs could incorporate equal instruction to create impactful videos that not only engage student participants, but also their surrounding communities.

The general increasing trend that can be seen in the mean on the student pre & post-program evaluations with support from the student, facilitator and scientist open-ended response comments seem to indicate that the experiential out-of-school learning, student and scientist collaborations, connection to local biodiversity and expertise, and art (videography, photography, and storytelling) components of SciOut helped students engage with STEM topics. However, we would also like to acknowledge that the data shows that pretest numbers in the questionnaire were already high. This could indicate that the SciOut program attracted students who had a strong interest in STEM prior to participating.

Study limitations & Future Recommendations

We acknowledge some limitations in the design of the video evaluation rubric. The video evaluation showcased a high percentage of no achievement (83%/31%) in the area measuring for "application of knowledge". It also revealed a high percentage of no achievement (100%/81%) in the area measuring for "questioning and criticizing information" (Table 6). The SciOut1/SciOut2 video evaluation also revealed a high percentage of no achievement (94%/54%) in the area measuring for, "combines different processes", as well as a high percentage of no achievement (100%/100%) in the area measuring for "connects program experience to interdisciplinary learning in school" (Table 8). This indicates a weakness in the evaluation tool as these aspects were not a part of the project goals or instruction, which likely explains these results.

Recommendations for future studies include in-person interviews with students' months after the program to understand the long-term benefits of SciOut. Future evaluation methods could incorporate paired pre and post-program evaluations to track individual student progress and identify significant results through statistical tests.

Recommendations for Education Models

Both the students, facilitators, and scientists indicated that programs like SciOut have lasting impacts and assist participants with achieving their professional career goals. Incorporating these four innovative pedagogical approaches is likely to foster motivation and perseverance within students to pursue STEM careers and contribute to a sustainable world (Paris et *al*., 1998; Stevens et *al*., 2016). We next provide further recommendations on how these pedagogical approaches could be incorporated in future STEM projects.

Out-of-school learning can be applied to multiple education settings by assessing what alternative learning environments exist nearby. Incorporating this component may include field trips to established informal education institutions like museums, science centers, and parks. However this component can also be meaningfully crafted through alternative resources like empty lots, open outdoor spaces, or even imaginary field trips that involve conscientious role play and transforming the classroom into another environment.

The facilitators and scientists indicated that SciOut allowed students to discover the unique biodiversity of their country and be proud of it. STEM education programs should be tailored to fit the cultural context that students identify with and include similar representation among STEM teaching professionals. *Student and scientist collaborations* and *local and international partnerships* can be applied to multiple education settings through networking and inquiries with informal STEM education institutions, local grass-roots environmental justice groups, artist activists, and STEM facilities. Also, consider researching STEM professionals on National Geographic's Explorer Directory and networking on LinkedIn and social media. Proposals could include approaching science professionals about presenting as guest speakers, participation in citizen science, or deeper collaborations where scientists participate as research advisors/mentors to student work.

Existing challenges to incorporating *arts education* into different learning environments may include budgets, supplies, and time. Consider using these constraints as opportunities for creative thinking and innovation. What can students create with what they have, and what will they learn in the process?

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Human Subject Research: This study was approved by Miami University's Human Subjects Internal Review Board. It is in compliance with ethical standards.

Conflict of interest: 2 authors are the co-founders of ExplorerHome Madagascar Science Center and the creators of Sciencing Out. 1 author assisted with the development of Sciencing Out. As a result, we could be more inclined to explain the positive results of the program.

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Appendix A

A1. Detailed Program Overview of SciOut1&2:

- Scientifiques en herbe avec le programme « Sciencing Out » – ExplorerHome Madagascar Science Center

A2. Student Pre and Post-Evaluation:

The purpose of this research is to examine the student impacts of immersive STEM/STEAM (Science, Technology, Engineering, Art, and Engineering) education programs. This research is being conducted as part of the graduate degree program of Susan Dorsey and the Principal Investigator of "Sciencing Out", Tsiory Andrianavalona, PhD.

Products from the event such as student evaluations, observations, and videos from "Sciencing Out" will be analyzed. Students will work with a videographer and produce a 2-minute video of their experiences to be shared through the ExploreHome website and social media. The researchers will review the video and take notes about how the students react to the activities. Evaluative data from the videos will not be linked to individual identities. Only the researcher, principal investigator, and faculty advisor will have access to individual responses and results of the survey will only be presented publicly as aggregate summaries.

What are your feelings about science (circle one):
Fascinated, Good, Bored, Uncomfortable
Have you taken a science class in school in the past 2 years (circle one):
Yes, No, Unsure
Circle your responses to the statements below on a 7-point scale:
(1)Strongly disagree, (2)Disagree, (3)Slightly disagree, (4)Undecided, (5)Slightly agree, (6)Agree, (7)Strongly agree
Science is interesting.
I am bored when I study science.
Science is hands-on.
I use science every day.
I have completed science projects with other students.
I can learn more about my classmates and science by listening to them talk about it.
Science can help me understand myself better.
To understand more about science, it is better to have someone tell me.
I am interested in a science or STEM/STEAM career.

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Science can help me understand what life was like a long time ago.
Science can help me understand life today.
All people should understand science in the same way.
Science can help me see something familiar in a new way.
Science problems that are complicated make me nervous.
Science can give me new ideas.
I use different subjects (math, technology, art) when learning science.
How likely are you to recommend this program to your peers?
(1)I will not recommend, (2)I may recommend, (3)Neutral, (4)I will recommend, (5)I will highly recommend
Please explain your response below:

A3. Video Playlists:

SciOut1 Youtube Playlist:
https://www.youtube.com/playlist?list=PLELP2HqoIAdWXwKAEIbU6kewYSl9HlYht
SciOut2 Youtube Playlist:
https://www.youtube.com/playlist?list=PLELP2HqoIAdUxagwQL-1ECd9-Se8Hdd-n

A4. Student Video Evaluation Rubric:

High school students who complete the "Sciencing Out" program will work with a videographer to develop scienctelling videos of their experience which will be shared with their communities. The student videos will be evaluated to determine if the program increased student interest, academic achievement, and understanding of STEM/STEAM topics. The four-level rubric below will be used to measure if student interest is reflected in the videos. Evaluators will record notes to identify what evidence was observed to justify ratings.

1=No Achievement:
- The student does not wonder about a STEM/STEAM subject.
- The student does not **envision possibilities**.
- The student does not encourage the **audience to wonder** about a STEM/STEAM topic.
- The student is not involved in a **physical action** related to the topics discussed.

2=Emerging:
- The student **wonders** minimally about a STEM/STEAM subject. Questions are mostly limited to who, what, when, or where and do not include why.
- The student shares a limited amount of information on **envisioned possibilities** without detail.
- The student briefly encourages the **audience to wonder** about a STEM/STEAM topic with little detail.

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- The student is briefly shown engaging with, or minimally describes a **physical action** related to the topic, but does not describe how the action relates to the STEM/STEAM topic discussed.

3=Developing:

- The student **wonders** moderately about a STEM/STEAM subject while exploring the "why" behind a topic, however the "why" questions don't connect to a central theme.
- The student shares a moderate amount of information pertaining to **envisioned possibilities**, but does not connect to a central theme.
- The student encourages the **audience to extensively wonder** about a STEM/STEAM topic through multiple questions or descriptions, but neglects to explain their significance to the subject.
- The student is shown engaging with, or describes a **physical action** related to the topics, but does not explain how it increased their understanding of STEM/STEAM topics.

4=Accomplished:

- The student **wonders** extensively about a STEM/STEAM subject while exploring the "why" behind a topic and connects it to a central theme.
- The student shares an extensive amount of information pertaining to **envisioned possibilities**, while connecting to a central theme.
- The student encourages the **audience to extensively wonder** about a STEM/STEAM topic through multiple questions or descriptions and explains its connection to the central theme.
- The student is shown engaging with, or extensively describes a **physical action related** to the topic and explains how it increased their understanding of STEM/STEAM topics.

Measuring Student Interest	1	2	3	4
Wonders: The student describes facts and observations related to a topic of interest and includes the who, what, when, where, and why. Example: The student explains reasons why humans and lemurs are similar (opposable thumb), and different (furry, face, feet), and explains what the adaptations help each to do. **Imagines or envisions possibilities:** The student demonstrates how they imagined/or thought up possible solutions to the concept in question by describing their thought process. Do not include videos and photographs in this section, only descriptions. Example: "I wondered why the bird was making that sound. I observed it doing...and based on my previous knowledge of this species, or the knowledge that the guide shared, I determined it made this sound because…" **Encourages the audience to wonder about a STEM/STEAM topic:** The student uses dynamic storytelling to present a STEM/STEAM topic to spark interest and wonder. Example: There is a clear guiding thread throughout the video. The student describes how muddy the path was allowing the audience to be part of the process.				

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The student is involved in, or describes a physical action related to the topics discussed: The student clearly describes a methodology or subject. Or the student shows a physical action related to the methodology or subject described. Example: The student describes the differences between lemurs and humans. We follow the student through all the steps as they physically do them while they describe the process. The student shows what it means to have an opposable thumb and a muzzle through body motions.

The four-level rubric below will be used to measure if student academic achievement is reflected in the videos. Evaluators will record notes to identify what evidence was observed to justify ratings.

1=No Achievement:
- The student provides no **evidential reasoning** to explain a claim.
- The student does not **compare and contrast** information.
- The student neglects to highlight important points or findings, and does not **apply new knowledge** to other knowledge.
- The student demonstrates no evidence of **critical thought** but accepts claims without **questioning**.

2=Emerging:
- The student provides a vague description of relevant **evidential reasoning** with little detail and no connection to a central theme.
- The student briefly **compares and contrasts** knowledge, while highlighting some important points, but offers little detail and no connection to a central theme.
- The student **applies some knowledge** to other knowledge, but neglects to describe how it connects in detail.
- The student demonstrates some **critical thought** by **questioning** new knowledge. Questions are mostly limited to who, what, when, or where and do not include why.

3=Developing:
- The student provides mostly relevant **evidential reasoning** to explain a claim, however the response lacks detail, is somewhat vague, and does not clearly describe its connection to a central theme.
- The student **compares and contrasts** knowledge, while highlighting important points using detail with a vague connection to a central theme.
- The student shows evidence of **applying knowledge** to other knowledge and vaguely describes how it connects.
- The student demonstrates **critical thought** by **questioning** new knowledge and exploring the "why" behind a claim, while vaguely explaining alternative possibilities.

4=Accomplished:
- The student provides relevant **evidential reasoning** to explain a claim in detail and clearly describes its connection to a central theme.
- The student **compares and contrasts** knowledge and highlights important points using detailed descriptions that clearly connect to a central theme.

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- The student demonstrates skill in **applying knowledge** to other knowledge, while clearly describing a connection.
- The student uses **critical thought** to **question** new knowledge and explores the "why" behind a claim, while clearly explaining alternative possibilities.

Measuring academic achievement	1	2	3	4
Uses evidential reasoning: The student describes, demonstrates, or shows the evidence they used to come to their reasoned conclusion. Include the use of photos and videos as evidential reasoning. Example: "The bird was building a nest. I concluded it was building a nest because I saw it flying around, gathering twigs, and bringing it back to add to its developing nest." The student uses some photos, but they are not examples of what the student explains (although that is probably because it is hard to find a photo or video of lemurs fighting). The student presents photos of the lemurs that support the statement that they are making, e.g. feet able to hold branches, but does not explain the process or reasoning.				
Comparing and contrasting: The student compares and contrasts different information. The scale depends on how much comparing and contrasting is accomplished in comparison with other videos. Example: The student compares and contrasts human anatomy with lemur anatomy. The student presents different explanations on why the male is dominant but does not compare it with the role of the female.				
Application of knowledge: The student applies the new knowledge that they learned from SciOut by describing it in the video. Example: "I learned how to conduct a scientific study of birds in the forest with a local guide and ornithologist during SciOut and saw…in the field as a result."				
Questioning and criticizing information: The student delves deeper into the content by asking questions like: "Why is that? Where is the evidence? How good is that evidence? Is this a good argument? Is it biased? Is it verifiable? What are the alternative explanations?"				

The four-level rubric below will be used to measure if student understanding of STEM/STEAM topics is reflected in the videos. Evaluators will record notes to identify what evidence was observed to justify ratings.

1=No Achievement:

- The student does not describe a **connection between different subject matter**, or apply knowledge from one discipline to another.
- The student does not describe a **connection between different subject areas or processes** (ex: creative and scientific processes).
- The student does not make a **connection between** the knowledge learned through participation in "Sciencing Out" and **different topics taught in school**.
- The student does not explain how the interdisciplinary knowledge learned through the program connects to **daily life**.

2=Emerging:
- The student describes some **connection between different subject matter**, but does not apply knowledge from one discipline to another.
- The student **describes different subjects and processes**, but does not describe a connection between them.
- The student describes a vague **connection between** the knowledge learned through participation in "Sciencing Out" and **different topics taught in school**, but provides little detail or context (ex: I used science).
- The student vaguely describes how the interdisciplinary knowledge learned through the program connects to **daily life**.

3=Developing:
- The student vaguely describes **connections between different subject matter**, and applies some knowledge from one discipline to another with some description on how the knowledge relates.
- The student describes **connections between different subject processes** with some description on how the knowledge relates.
- The student describes a **connection between** the knowledge learned through participation in "Sciencing Out" and **different topics taught in school** by providing vague details and context (ex: I used math to solve a science problem).
- The student describes how the interdisciplinary knowledge learned through the program connects to **daily life**, but neglects to explain why they connect.

4=Accomplished:
- The student clearly describes **connections between different subject matter**, and explains in detail how they applied knowledge from one discipline to another.
- The student describes **connections between different subject processes**, and explains in detail how they combined processes.
- The student clearly describes a **connection between** the knowledge learned through participation in "Sciencing Out" and **different subjects taught in school** by providing thorough descriptions, which include detail and context.
- The student clearly describes how the interdisciplinary knowledge learned through the program connects to **daily life** by providing robust descriptions of the connection.

Measuring student understanding of STEM/STEAM topics	1	2	3	4
Connects different subject matter: Example: The student discusses a connection between human anatomy and primate anatomy. But if the student had compared different types of primate anatomy, it would not count as connecting different subject matter.				
Combines different processes (ex: creative and scientific process): A process is the different steps that a scientist/engineer/artist/mathematician uses to arrive at a goal. The student combines different processes to reach a conclusion. Example: A student creates sketches to make scientific observations of a subject. A student builds/engineers a device to collect scientific data. The student has clearly made use of the arts (video skills) to explain the scientific process of data collection.				

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Connects program experience to interdisciplinary learning in school: Example: The student makes direct connections to subjects taught in school by explicitly stating something like, "we learned about this in school, but while observing it in the wild, we learned more about it."
Connects the interdisciplinary knowledge learned to daily life: The student explains how this knowledge connects to daily life and describes why it is important to know and care about this knowledge. Example: If a student says something like, "we should protect the forest," include this here and rate it based on if they described why and how it connects to daily life.

A5. Facilitator & Scientist Evaluations:

The purpose of this research is to examine the student impacts of immersive STEM/STEAM (Science, Technology, Engineering, Art, and Engineering) education programs. This research is being conducted as part of the graduate degree program of Susan Dorsey and the Principal Investigator of "Sciencing Out", Tsiory Andrianavalona, PhD. Only the researcher, principal investigator, and faculty advisor will have access to individual responses and results of the survey will only be presented publicly as aggregate summaries.

Rate the importance you place on each of the following possible student experiences through Sciencing Out using the 7-point scale:

(1) No importance, (2) Low importance, (3) Slightly important, (4) Neutral, (5) Important, (6) High importance, (7)Extremely important
Students have a hands-on, awe-inspiring experience that sparks curiosity during their participation in "Sciencing Out".
Students think critically during facilitated programming through "Sciencing Out".
Students connect with science techniques and learn how science can teach about the present and past.
Students develop knowledge/skills during the "Sciencing Out" experience related to school curriculum.
Students learn from experts about STEM topics.
Raise interest in STEM careers among students through "Sciencing Out".
Foster a connection between students and Madagascar's unique biodiversity.
Students are empowered to share their experiences with Madagascar's unique wildlife within their communities.
How likely are you to recommend this program to your peers?
(1)I will not recommend, (2)I may recommend, (3)Neutral, (4)I will recommend, (5)I will highly recommend
Please explain your response below:
Free-Response Questions:

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How many years of experience do you have educating high school students with in-field experiences involving STEM learning? Describe your experience. Do you think "Sciencing Out" was impactful for students? Why or why not? Do you think "Sciencing Out" was impactful for students? Why or why not? What did you enjoy most about working alongside students? What did you find challenging about working alongside students? Is there value in STEM education outside of the classroom? Why or why not? What did you enjoy the most about facilitating the "Sciencing Out" program with students?

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Table B1

Facilitator & Scientist Post-Program Evaluation Responses

Facilitator & Scientist Questions	**Mean**	**SD**	**Strongly Disagree** **1**	**2**	**3**	**4**	**5**	**6**	**Strongly Agree** **7**
	Post	**Post**	**Post**	**Post**	**Post**	**Post**	**Post**	**Post**	**Post**
Q1: Students have a hands-on, awe-inspiring experience that sparks curiosity during their participation in SciOut.	6.8	.38	-	-	-	-	-	16%	83%
Q2: Students think critically during facilitated programing through SciOut.	6.3	.65	-	-	-	-	8%	50%	41%
Q3: Students connect with science techniques and learn how science can teach about the present and past.	6.25	.75	-	-	-	-	16%	1%	41%
Q4: Students develop knowledge/skills during the SciOut experience related to school curriculum.	6.1	.93	-	-	-	-	33%	16%	50%
Q5: Students learn from experts about STEM topics.	6.25	.62	-	-	-	-	8%	58%	33%
Q6: Raise interest in STEM careers among students through SciOut.	6.25	.62	-	-	-	-	41%	58%	33%
Q7: Foster a connection between students and Madagascar's unique biodiversity.	6.75	.62	-	-	-	-	8%	8%	83%
Q8: Students are empowered to share about their experiences with Madagascar's unique wildlife within their communities.	6.9	.28	-	-	-	-	-	8%	91%

Facilitator & Scientist Questions	**Mean**	**SD**	**I will not** **1**	**I may** **2**	**Neutral** **3**	**I will** **4**	**I will highly** **5**
	Post	**Post**	**Post**	**Post**	**Post**	**Post**	**Post**
Q9: How likely are you to recommend this program to your peers.	4.91	.28	-	-	-	8%	91%

Note. Mean, STDV, and Percentage Response Scores For SciOut1&2 Facilitator Post-Program Evaluation Questions On A 7-Point Likert Scale.

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