S'COOL User Experience Evaluation - 2015

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Introduction

The Students' Cloud Observations On-Line, or S'COOL, Project connects educators and students with authentic NASA scientific research. Students observe clouds in their own school environment during a NASA satellite overpass, and report cloud properties through a standardized form. This data is then matched to the satellite data from the same time and location, and the students and teacher receive a "match" report. Additionally, S'COOL offers classroom activities, lesson plans, and other resources for classroom use. S'COOL also offers the ROVER activity, which invites citizen scientists to collect and contribute their cloud observation data. In both cases, S'COOL promotes scientific literacy and skills including observing, reporting, and interpreting data, while authentically engaging participants in NASA's Earth science mission.

In the spring of 2015, the S'COOL team and their internal evaluator began the process of designing and carrying out a study focused on the user experience of S'COOL and ROVER participants. The team was interested in learning about the observation and reporting process, any barrier or enabling factors, and the value, interest, and motivation behind use of S'COOL or ROVER. An additional evaluation question was motivated by S'COOL's nascent strong partnership with The GLOBE Program. Findings from the evaluation would be used to improve the ongoing S'COOL activity while planning the path forward as S'COOL and GLOBE plan their future together. These evaluation questions and interests drove the planned evaluation.

After data had already been collected, the S'COOL team made a significant change to their offerings by adding a new geostationary data matching option. This affects not only matching but the timing of observations, as participants are no longer restricted to selecting a specific CERES overpass time around which to observe. S'COOL and ROVER participants who responded to the evaluation were not aware of this upcoming change, and thus their comments and concerns could not take this option into account. In a few cases, recommendations made by participants and listed within this report have been partially addressed by this new capability.

Evaluation Context

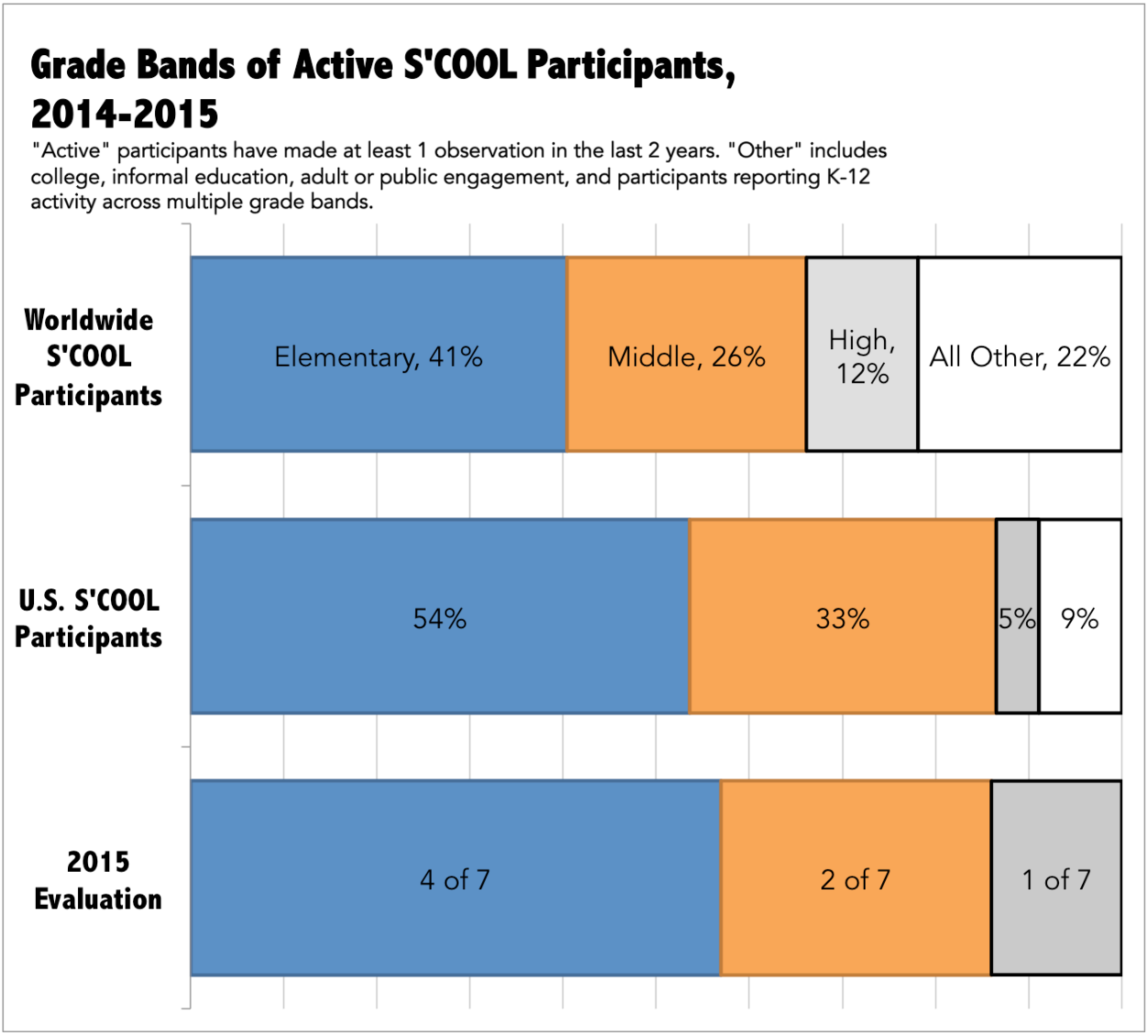
Due to the constraints of the Paperwork Reduction Act, this evaluation was limited to the following options: in-depth data may be collected from very small numbers of respondents (9 or fewer individuals) or a very broad question may be asked of larger numbers of respondents (e.g., a completely general and open solicitation for feedback and comments). To cope with these restrictions, the evaluation was designed to make use of in-depth qualitative data collection with a small number of individuals. The validity of findings was strengthened by triangulating with previous evaluation findings and the open-ended feedback data. Additionally, the evaluation approach was focused on utilization and the S'COOL team's interest in actionable findings related to the experience of S'COOL users primarily and ROVER participants secondarily.

Data Collection

Data & insights were collected from multiple sources:

[1] SciGirls evaluation report from the S'COOL pilot (no raw data) shared by Multimedia Research, Bellport, NY (156 5th grade students from the west coast, east coast, and southeast).
[2] Open-ended S'COOL and ROVER feedback in response to an email prompt (45 responses submitted).
[3] In-depth interviews with S'COOL participant teachers (6 teachers from the U.S. and other countries; 1 additional teacher who participates in both S'COOL and GLOBE; interviews with Spanish-speaking teachers were conducted in writing).
[4] Written questionnaires to ROVER participants (3 participants).
[5] Written questionnaires to educators who signed up with S'COOL but had not participated within 3 months of first registration (7 non-participants).
[6] Discussions with members of the S'COOL/ROVER and SD/EPO teams at LaRC.

The teachers (S'COOL) who participated in the in-depth interviewing process represented elementary, middle, and high school classrooms. The figure below demonstrates that the respondents selected for interviews roughly correspond to the overall pool of teachers in each grade band participating in S'COOL activities. Within the U.S., almost all S'COOL activity takes place in the elementary, middle, or high school setting. In other countries, it's more common for S'COOL to be part of a community organization or for a school-based initiative to include students across many grade bands. For the purposes of this evaluation, S'COOL responses were drawn from the K-12 spectrum. Other environments were addressed by the inclusion of ROVER participants.



Analysis & Findings

After reviewing all of the input data, qualitative analyses were performed to identify emerging themes and recommendations.

Evaluation findings are summarized on the next pages, organized by key themes and evaluation questions. The report closes with a list of suggested improvement strategies.

Participants value that . . .

- S'COOL is hands-on and interesting for students.
- S'COOL is completely free, flexible, relevant to any environment, and doesn't require complex instruments.
- S'COOL's data collection process is simple and straightforward. Students in elementary grades can understand what's being asked of them and follow through with set tasks consistently. The S'COOL process doesn't "talk down" to them.

> *"Students like to compare their data with NASA's observations. It generates keen interest and excitement in the students." - educator*

- Students at the targeted grade band(s) for S'COOL have competency and skills to carry out the data collection. S'COOL helps kids feel that they are capable of contributing to science themselves. While S'COOL may consider that a citizen science outcome, [1] notes that 67% of 5th graders surveyed did not know the term "citizen science."

> *"[S'COOL connects classroom learning] to a real-world laboratory – the Earth and sky." - educator*

- S'COOL is a wonderful fit for weather, clouds, and classification elements of the K-12 curriculum that fits the needs of younger grades.
- S'COOL ties in so well to these major curriculum elements, so that teachers can use it flexibly and tie it into many kinds of activities.
- S'COOL also fits science practice elements of the K-12 curriculum and allows teachers to work with their students on developing these skills.
- S'COOL gets kids outside!
- NASA really needs their data! Helping NASA is a major motivator for student participants in S'COOL and ROVER. They're excited and take their role as "helpers" seriously. In particular, they love hearing from NASA personnel and appreciate any opportunity to interact with NASA.

> *"My students don't always have a lot of opportunity to feel important, so this project does that." - educator*

"[I contacted the team] a few times to ask for info [or] report a bug . . . The response was quick and helpful in all cases." – ROVER participant

- They can get help from the NASA team when needed, and have a sense that the team is there for them. This is cited as a motivator for continued participation.
- S'COOL has an easy registration process and the automated emails allow them to get started right away.

S'COOL's greatest strength is that it is interesting and motivating to students, while also meeting the needs (standards, curriculum, performance assessment) of their teachers. Students are driven and motivated by the idea that they are contributing to NASA and filling an unmet need.

Participants build skills in . . .

- cloud identification, classification and developing a more finely-tuned sense of variation and meaning
- careful observation
- detailed recording
- learning from mistakes
- classification (including dichotomous keys)
- critical thinking (when using matches)
- relationship between science and mathematics (variables, statistics, interpretation)
- 24 hour clock and time zones
- responsibility and punctuality (for collecting data at the appropriate time and uploading it to S'COOL)
- Awareness of the natural world/their surroundings

"We want them to think like scientists and use the process skills of observation, questioning, inferring, recording, analyzing and concluding. S'COOL fits into that perfectly!" - educator

"We do a lot of math using our cloud data." - educator

"Whenever I'm out, and I look at the sky, I automatically associate [clouds] with their classification." – ROVER participant

Because the S'COOL process is relatively simple, its cognitive load on students is low, and teachers are able to apply and focus learning in many different ways. S'COOL provides a basic foundation that educators are happy to build upon.

Participants have trouble with . . .

- Empowering or facilitating students to independently carry out parts of the S'COOL process. In particular, teachers noted that students rarely carried out the preliminary steps to plan the observation (requesting overpass times and selecting an observation time). Teachers typically take on those responsibilities. This is due both to classroom management concerns and to technological concerns (e.g., S'COOL logins, computer access).
- Fitting the overpass schedule into their daily class responsibilities (especially schools/grade bands that are departmentalized, with students changing classes); note that this has been, in part, addressed by the new geostationary data option, although legacy participants may not yet be aware of this.
- Determining whether they can or should still bother participating if they can't observe during the overpass time.
- Encouraging student motivation if they live in an area without much variation in clouds or weather.
- Keeping track of match emails, and which reports they have already submitted, if they have submitted multiple observations.
- Seeing the value of receiving and commenting on a match, or using the match in the classroom, especially because classroom curriculum has often moved on from the clouds or weather unit by that time.
- Helping their students understand how the satellite determines cloud height and thickness.
- Realizing that the S'COOL team is there and available for help, resources, and follow-up.
- Knowing about the potential for NASA virtual visits via the DLN, and knowing that these opportunities are provided to schools at no cost.
- A disconnect or missing link between their contributed ground truthing data and the eventual scientific outputs and products (science team research findings and publications).

S'COOL's greatest areas of difficulty are overpass times (both interpreting them and then meeting the deadlines) and the expectation that NASA scientists are using S'COOL data to ground truth satellite observations.

Participants would like to see . . .

- More information about how scientists use S'COOL-collected data in research.
- Ways to delegate cloud reporting to their students without needing access to the school login or the teachers' registered email address.
- Easier ways to access and interact with their own reported and matched data.
- Short videos that are less dry, more personable and personal, intended for elementary students to introduce them to some of the more abstract topics (like ground truthing, view from space vs. the ground, etc.).

S'COOL could better motivate and enable participation by focusing on the relationship between S'COOL students as contributors and NASA as both a source and a recipient of data.

Teachers who don't go on to observe and participate report that . . .

- Life frequently intervenes! Plans to use S'COOL in a classroom may not materialize even with the best of intentions and the most robust of plans. After not following through, teachers may forget to return to S'COOL.
- Teachers may register with S'COOL well in advance, even though they don't plan to use the activities until later in the year (or even the next year).
- Teachers who are initially enthusiastic about S'COOL's potential may not be able to find a way to make the overpass schedule work with their classroom.

Once participants have registered with S'COOL, they may still need or benefit from assistance, help, and encouragement to take the next steps and move toward implementation.

Participants suggested that S'COOL activities could be successfully implemented by . . .

- Teachers who have been introduced to S'COOL by an expert in a venue like a workshop, training session, or long-term experience; schools with "NASA champions" on board.
- Teachers whose classrooms are self-contained, with the same students in class all day. Since S'COOL match observations need to be taken during specific overpass times, participation can be difficult in classrooms where students change classes. Note that the geostationary option has partially addressed this concern.
- A facilitator (usually a teacher) who works closely with students to help them understand the procedure and the motivation behind gathering data during satellite overpasses. Teachers interviewed in [3] reported that, early on, students are building basic skills and their collected reports will be far from perfect; this reflects the findings presented in [1]. When students are given the chance to stick with it over the longer term, they become invested and develop stronger skills and consistency.

> *"The child who is not a traditional paper/pencil/book learner is usually a star with S'COOL." - educator*

- Creating a station (in the classroom, or a large laminated printout of the reporting form) to make data collection and reporting easier and more routine.
- Having more experienced students help out students who are younger or newer to S'COOL.
- Incorporating literacy activities, like myths and legends related to clouds, picture books, and poetry, to tie cloud activities into language arts standards.
- Using S'COOL data collection and investigation as a lead-in activity to introduce problem based learning (PBL).
- Taking photographs during overpass times, then reporting and discussing during appropriate class times.

S'COOL benefits from the long-term participation of teachers who have tested and refined their methods of implementation. These participant insights can help new teachers get up to speed and know what to expect from S'COOL.

S'COOL's potential future with GLOBE is . . .

- Complicated! There is a concern that S'COOL is small, warm, friendly, and easy, while GLOBE is larger, more distant, and more complex. In some areas, S'COOL's approach is seen as superior and there's a concern about losing that.

> *"Comparing both, S'COOL is better." - educator*

- Likely to cause some confusion among teachers who are not already aware of GLOBE. In addition, there is a great deal of content and activity on GLOBE, so for new users S'COOL could get "lost."
- Influenced by S'COOL's strong fit for elementary grades (in terms of both skill and curriculum standards), while GLOBE's more complicated and rigorous protocol approach is a better fit for older students.
    - Potentially solved by a "Venn diagram" approach where S'COOL maintains its identity and programming but incorporates the advantages of GLOBE (larger, worldwide presence, ability to observe in mid-day, visualization tools, other parameters, student logins).

> *"By teaming up with GLOBE, both systems can gain and become better." - educator*

- Problematic for ROVERs, since GLOBE doesn't currently have a way for them to become involved and submit data.

Teachers recognize the value of GLOBE and the new opportunities that it will bring to S'COOL, but hope to maintain S'COOL's unique strengths (which are particularly relevant at elementary levels).

The S'COOL Team could consider multiple improvement strategies . . .

Reducing Barriers for Teacher Participation

- Follow up with previously-registered teachers to help motivate them, to emphasize S'COOL's flexible implementation options, to highlight the new geostationary data option, and to reiterate S'COOL's helpful and engaging staff presence.
- Emphasize and expand upon the Helpful Tips section of the website, highlighting teachers' "lessons learned" and classroom management ideas (see implementation ideas shared above).
- Include testimonials from teachers in a variety of school settings.
- Consider a "subscription" model for the regular receipt of overpass times.
- Review the glossary for reading level and try to simplify.

Leveraging and Increasing Participant Engagement and Motivation

- Increase S'COOL team's focus on use of data and helping both ROVER and S'COOL participants see the effect of their participation.
- Provide alternative modes of participating in S'COOL that do not require matches or observations during overpasses. In this case, S'COOL would need to implement strategies to highlight the value of science skills and of participation, as opposed to using the motivational factor of "helping NASA."
- Continue taking advantage of the "helping NASA" and "observe at the same time as a satellite" themes and tying into Earth Right Now from that perspective.
- If interested in increasing ROVER/citizen scientist participation, promote and recruit in venues that citizen scientists may already be participating in – national parks and other environmental education venues; scientific and technical websites for hobbyist astronomers, sailing enthusiasts, etc.
- Create some short videos to help students "see" the NASA staff behind the program and help them understand the connection to NASA. This would tap into student motivations without creating the need for more digital connections with classrooms.
- Include more opportunities for students to feel connected to S'COOL, NASA, and scientists as individuals:
    - NASA stickers are great incentives!
    - Physical letters are very meaningful to young students.
    - Notes/letters from scientists could have a more personal touch with a focus on careers and SciGirls role model strategies.
    - "Video postcards" with a simple greeting and specific mention of the school by name.

- Online recognition of classes throughout the year.
- Other ideas gathered during the evaluation include scientist playing cards, "autographed photo" lithographs with science content on the back, and "letters" from different scientists/members of the team corresponding to benchmarks in class participation.

Providing New Resources for Classroom Use

- Add support and resources for the use of science notebooks. One example of support would be a version of the observation form that is intended for a composition notebook size or a "foldable."
- Create more ties into literacy/language arts and math at the elementary level, which are such important focus areas (and often the only way elementary teachers can fit science into their required curriculum).

Encourage Use of Matches in New Ways

- More strongly highlight the ways that the S'COOL process and activities align with and reflect the science practices approach in NGSS. Focus in particular on those science practices related to the later steps in S'COOL, and encourage use of match emails. (Reviewing your findings, drawing conclusions, comparing, and discussing are major elements of the science practices and S'COOL process).
- Use some of the strategies in "Increasing Participant Engagement and Motivation" to increase likelihood of teachers/students using the match.

Streamlining & Simplifying Technological Interaction

- Send an automatic follow-up email if there isn't a match, or if a match isn't available within a reasonable time frame, to ensure users hear something from NASA and understand their status.
- Make it easier for teachers to log in to their school account, download their data, see their matches and submit their reports in a "one-stop shopping" view.
- Develop a spreadsheet upload, app, or other streamlined way for teachers to enter data. In classrooms with computers, this isn't always a problem. In many areas, though, computers and even Internet access aren't as easy to come by. S'COOL participant teachers who need to upload data from home or during brief periods of internet access run into difficulties.

Expanding Optional Ways of Participating in S'COOL

- Consider adding observed movement of clouds to the protocol.
- Point students to data from geographically/climatologically different parts of the world.
- Connect S'COOL classrooms with other students from around the world. Consider online summits, virtual poster sessions, cloud "photo contest" campaigns, or simple pen-pal arrangements.