

What is Success? Evaluating S'COOL, an Educational Outreach Project Focused on NASA's CERES Program

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What is S'COOL?

The Students' Cloud Observations On-Line (S'COOL) Project involves students in K-16 as ground truth observers for a NASA Earth-Observing satellite instrument. The Clouds and the Earth's Radiant Energy System (CERES) instrument allows scientists to study the Earth's energy budget and how clouds affect it. Student reports of cloud conditions help scientists verify their algorithms and allow students to be involved in obtaining and analyzing real scientific data.

Why Evaluate?

The S'COOL project began in early 1997 with 3 participating teachers acting as test sites. In the nearly 4 years since then, S'COOL has grown by leaps and bounds. As of November 30, 2000, 662 sites in 46 countries are registered to participate. On the face of it, this seems like a huge success. However, following the recent celebration of S'COOL's 500th registration, it seemed a good time to do some more in-depth evaluation of the project's impact on education.

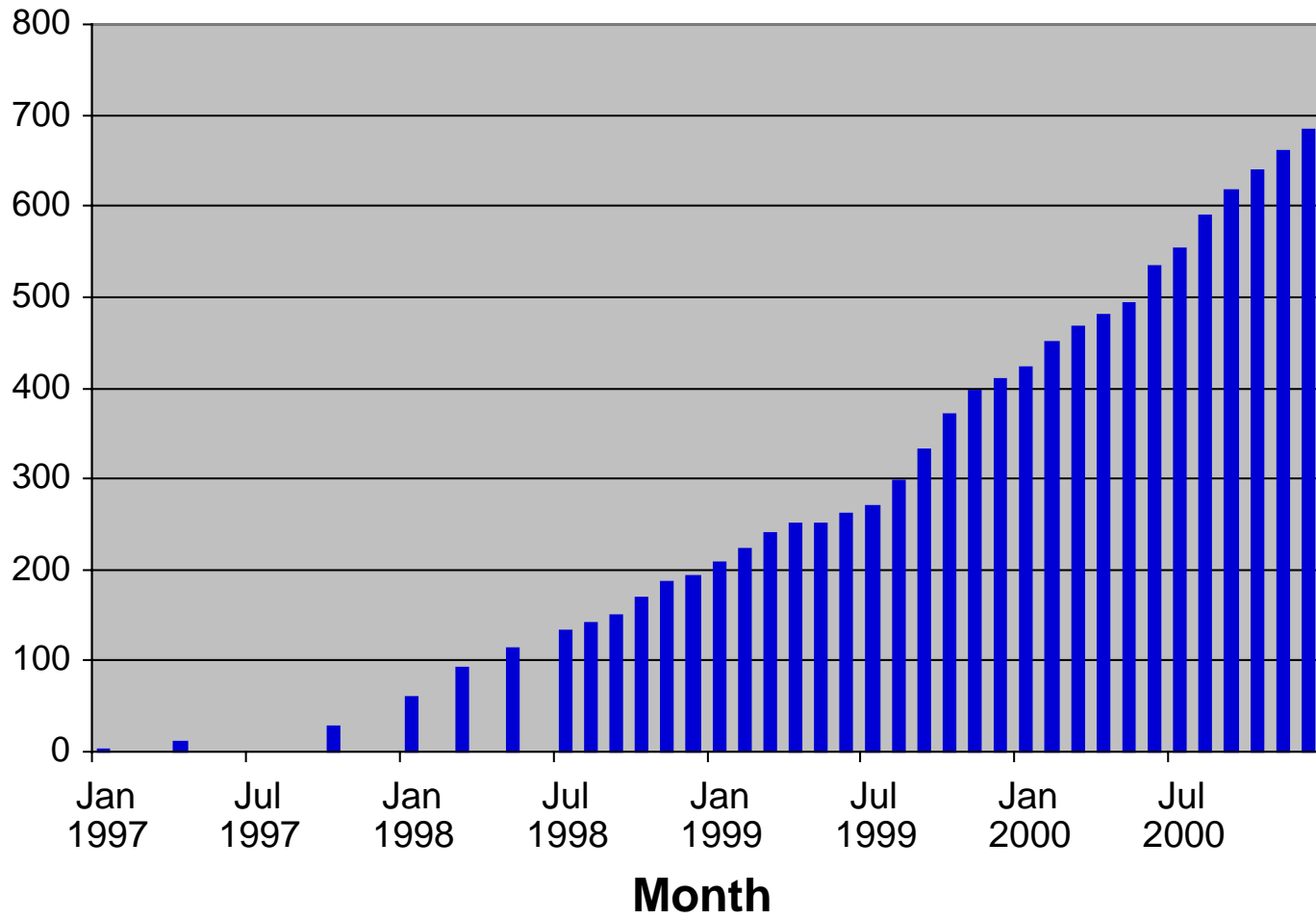
The context:

S'COOL is a modest outreach effort within the CERES project. S'COOL involves the part-time efforts of 2-3 scientists, 1-2 web and database specialists, and a full-time former classroom teacher. Total funding for the project has never exceeded \$300,000 per year, including everyone's time. A part-time teacher consultant position was recently added to focus on interaction with the Spanish-speaking audience.

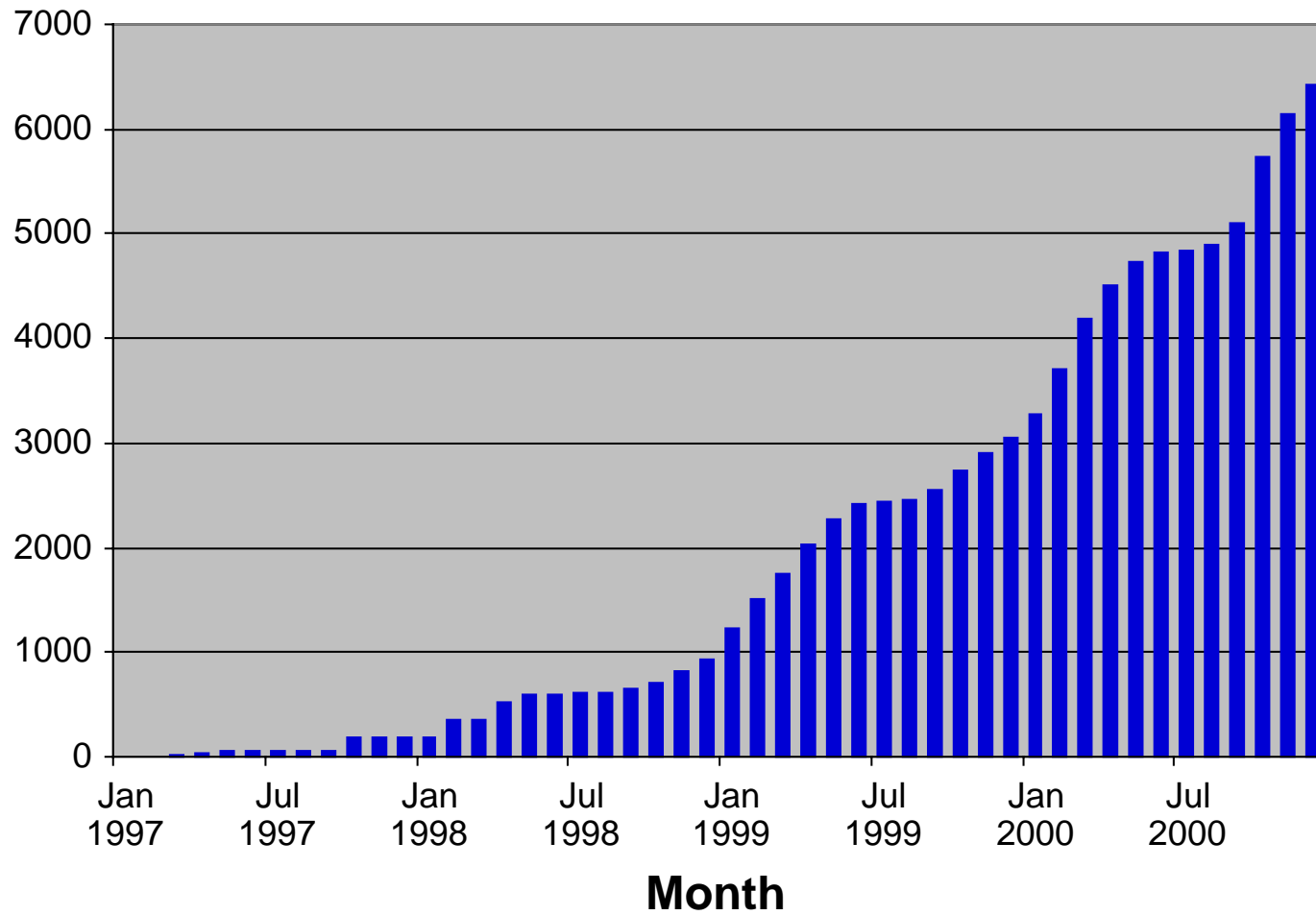
Growth:

Recruitment for S'COOL began by word of mouth. We sought widely geographically dispersed initial participants to prove data could be obtained globally. More recently, teachers have learned about the program at conferences (NSTA, regional teacher conferences, NASA workshops, etc), by word of mouth, and while surfing the web. S'COOL participation has always been at the discretion of the teacher; we do not require a set number of observations.

Growth of S'COOL Participation



Growth of S'COOL Observations



Web Statistics:

	ASDC¹: 10 months	AtSC²: 6 months
Visits	20,733	148,677
Pages per Visit	6.92	4.1
Time/kb per Visit	1.12 minutes	120.2 kb
Distinct visitors	5,492	22,111 99 countries!
Linked from	106 sites	151 sites

¹The Atmospheric Sciences Data Center (ASDC) hosts S'COOL forms and databases.

²An Atmospheric Sciences (AtSC) computer hosts explanatory and background material for S'COOL.

Satellite matches:

Due to the complexity of deriving cloud properties from research instruments, as well as delays in receiving the large volumes of data required, only **99 satellite matches** to the S'COOL observations are currently in the S'COOL database. These are mainly from 1998, when only a few schools were participating. However, examination of these matches has already provided some useful information about the problem of cloud detection from space. The level of agreement is typical when comparing two sources of data.

Cloud cover from satellite vs. ground observers:

		Ground			
		Clear	Partly	Mostly	Overcast
S	Clear	27	2	2	1
	Partly	7	10	2	1
T	Mostly	5	3	12	7
	Overcast	0	1	8	11

60 out of 99 totally agree (60.6% agreement)

Summary of Errors

Agree	60
1-class	29
2-class	9
3-class	1

Cloud levels from satellite vs. ground observers:

		Ground		
		Clear	Single	Multi
S	Clear	14	9	0
	Single	3	29	3
T	Multi	3	29	9

52 out of 99 totally agree (52.5% agreement)

Summary of Errors

Agree	52
1-class	44
2-class	3

In 8 of 9 reports of a single layer from the ground and no clouds from the satellite, the clouds reported by the ground were translucent or transparent high clouds that covered 0-5% of the sky. The satellite was expected to have difficulty detecting clouds such as these, and the S'COOL data confirm that theory.




In the 3 cases where the ground records clear and the satellite records a single layer, the satellite reports a very small cloud fraction. Thus it is likely the clouds were not seen from the ground due to field of view issues.

In the 29 cases where the ground reports a single layer and the satellite sees multiple layers, no obvious trend exists. However a number of explanations apply. If there is an opaque and overcast layer of low cloud the ground observer will not see through it while the satellite may see layers above. If there is a thick lower layer, the satellite will classify its upper portion as mid and/or high level clouds. Finally, partially filled pixels may get misclassified because the satellite sees part ground and part cloud and misinterprets the cloud altitude.

S'COOL Database Output

Latitude	36.57	Longitude	-79.44
Danville , VA		USA	

Date: 1998-04-09

Surface: 13:15			Satellite: 13:29				
Opacity	Cloud Cover	Type	Cloud Height	Optical Depth (km)	Cloud Cover (%)	Particle Phase (%)	Temp (K)
							
							
Opaque	95% - 100%	Nimbostratus		6.29	34.66	100	ice 245.66
Temperature 20 C Pressure 997.80 Relative Humidity 58 Snow: Water: Y Mud: Dry: Leaves: Y Contrails: Satellite: Comments 2 Types of clouds- mid and low			Satellite Name: TRMM Top Latitude 37.00 Bottom Latitude 36.00 West Longitude -80.00 East Longitude -79.00				

Why is there a difference?

This is the type of disagreement that one would expect for a Nimbostratus. The satellite is observing a very thick (optical depth of 34.66) cloud that very well could have its base in the low layer. A cloud that thick would almost certainly look dark gray to the surface observer and they would therefore call it a Nimbostratus.

Survey says: EDCATS

NASA Headquarters maintains on-line surveys and an associated database of responses on all NASA outreach programs. We ask our teachers to fill out a shortened, S'COOL-specific survey annually. Very few teachers in such a distributed and unscheduled program actually respond (29 did so in FY 2000), but their comments are informative. Overall ratings for S'COOL range from **4.7 to 4.9 out of 5**. Some sample comments:

“Students became very independent and responsible at doing the tasks.”

“A comment from my students sums up the involvement and attitude of the participants. ‘This project was awesome, I wish we could do it over the summer! We really learned about the clouds in a way that was important, we helped NASA and in the end they'll help us’.”

“My students were so excited about collecting the data that if I forgot to post the collector for the day, they were immediately on me to find out who it was. The ones who were trained in it were also very eager to show others how to collect the data and enter it.”

“This past year, a student in my class who was falling behind academically and socially due to problems in the home suddenly became my star student when I allowed him to be the recorder of cloud information. He was responsible to check the class data and put it into the form on the internet. This new experience made him feel successful and important! He now wants to become an astronaut and study weather patterns on other planets! Thank you for your help.”

“This is a great project to get children interested in Science!”

Survey: Workshop

Week-long teacher workshops have been held each summer since 1999. Thirty-three teachers have attended so far. Teachers are asked to rate and comment on each segment of the workshop as the week progresses.

Objective ratings for the entire week were **4.42 +/- 0.26 out of 5** for 27 different agenda items.

We also received positive comments on the content, approach, and workshop design.

Some sample comments:

“I love/appreciate all the tie-ins to math, language arts, and geography. My school, school system, and co-workers will be thrilled at the interdisciplinary possibilities.”

“I can never get enough of these guys explaining the science behind the experiments.”

“I have had a wonderful week. This has been the best workshop I have ever attended.”

“Fantastic! The week flew by!”

“I have so many ideas to take back to my children.”

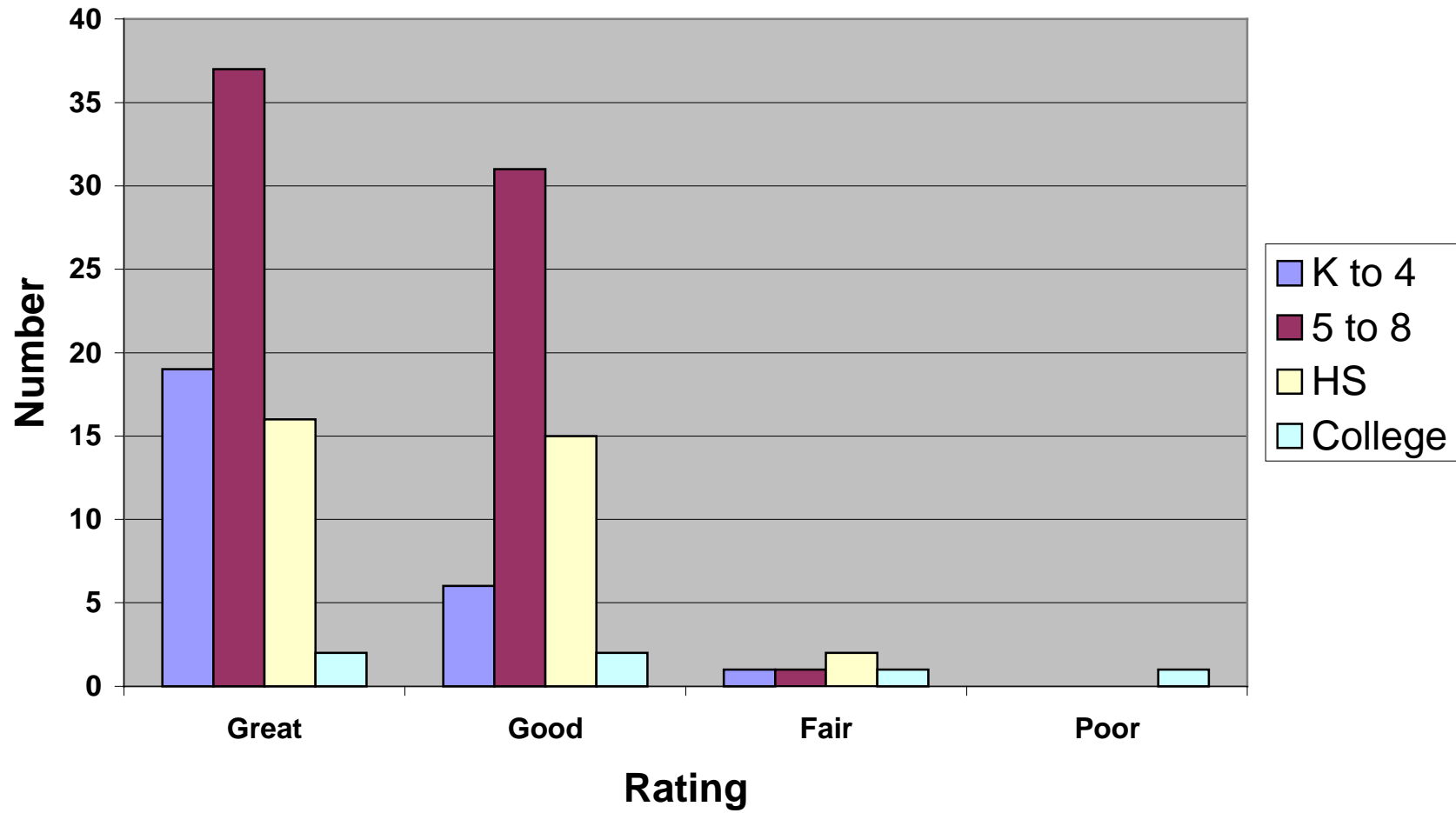
“The information presented was tremendous. Although I may not use all the resources given to me , I now know where to guide other teachers, parents, students, etc... You’ve given me a reason to look up into the sky.”

Survey: Fall 2000

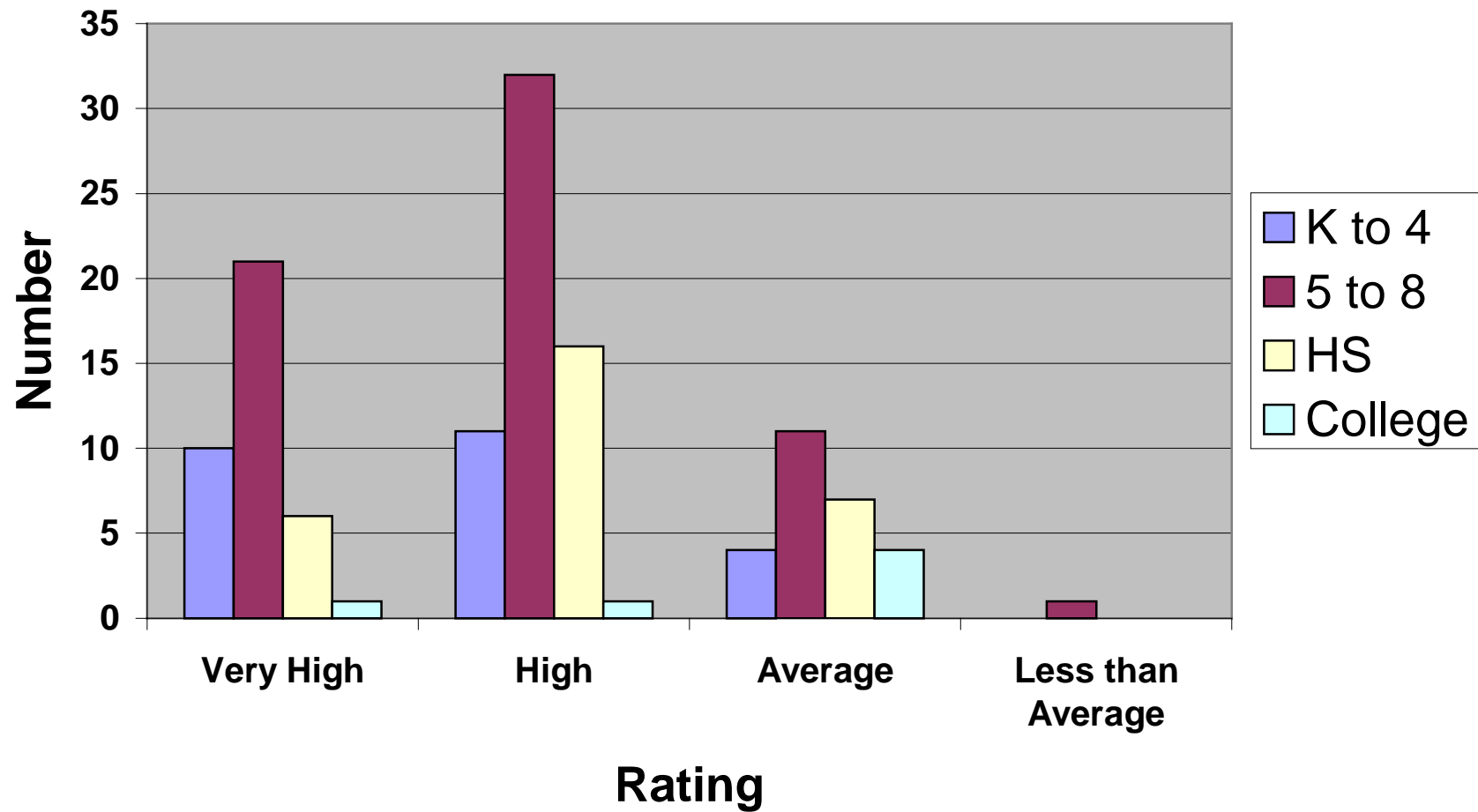
For the first time since January 1998, a participant survey was carried out this fall. The survey had a 20% response rate (134 respondents), and provided objective data as well as room for comments. See following charts.

With only $\frac{1}{4}$ of teachers giving an answer, their responses show **557 students with an increased interest in a science career** after participation in S'COOL. The remainder said it was too soon to tell.

Educational Usefulness



Student Interest/Learning



Challenges:

- Develop more subject materials
- Explain the accuracy requirements (done)
- Explain/simplify overpass schedule (in work)
- More materials to help teachers
- Rewards for students
- Satellite data to compare with
- Turn all registrants into active participants
- Survey:

http://asd-www.larc.nasa.gov/SCOOL/survey_fall_2000.cgi

Conclusions:

- 95% of respondents rate the educational usefulness of S'COOL as “great” or “good”.
- 73% rate student interest/learning as “very high” or “high” with S'COOL relative to other science lessons.
- 95% of respondents recommend S'COOL to other teachers.
- 33 teachers reported an average 11% of their students showing increased interest in science as a career.

- 99 satellite matches so far available have provided useful insight into CERES cloud algorithm.
- Web materials are being used by others
- Teacher comments report positive effects on the students.
- Teacher workshop is highly rated
- Teachers care enough to provide feedback and suggestions to improve the project.

S'COOL IS A SUCCESS!

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