Inspiring Climate Action Now

Primary Grade Science to Investigate Understand, & Respond to Climate Change

Year 1 Summary

OCTOBER 2024

In the context of climate change, understanding and application of science skills and habits of mind are crucial. Primary-level science education in particular builds an equitable base of knowledge, skills and attitudes that support broad understanding of and resilient responses to climate and environmental changes, and the development of empowered, climate-adapted citizens.

These foundational skills are not currently emphasized in most education systems in low and middle income countries, but they represent a gap that urgently needs to be filled.

EDC's Inspiring Climate Action Now (ICAN) primary science pilot is demonstrating the power of attention to science skills and habits of mind as foundational skills in low-resource contexts. ICAN leverages the environment and the daily lives of students and their communities, prepares teachers to serve as skilled guides for students engaging with science, and taps into and promotes curiosity and meaning-making that drive and result from learning.

Although science and climate are often key topics in national development plans, they can seem unrelated to daily life, relegated to the purview of professional scientists and policymakers. If young children are not encouraged to take notice of the changes in climate they and their communities are experiencing, solutions will continue to be divorced from those most affected by climate change. Preparing children and their teachers to participate in learning about and addressing climate science is an investment in finding solutions for their future.

ICAN is providing proof of concept for the integration of climate change themes into primary education, furthering critical thinking skills and science knowledge, building cross-curricular math and literacy skills, and infusing practical steps to understand and take action to mitigate local climate effects. Students and teachers

participating in ICAN both explore and respond to the effects of climate change in their own ecosystems. At the same time, they are introduced to examples of children and communities in other parts of the world who are facing similar climate issues, underlining the fact that climate change is both a local and a global challenge.

ICAN builds on countries' long-term investments in literacy and math, and supports cross-curricular skill building by using science activities to engage with the language skills of reading, listening, and speaking, and with mathematical concepts such as number sense, calculations, patterns, relationships and analysis of change. Primary science in the ICAN mode completes the foundational skills puzzle for learners, ensuring that not only do they master the mechanics of literacy and numeracy, but that they also have the habits of mind and hand to put those skills to use for themselves and for their communities. ICAN is also a natural precursor to EDC's Our World, Our Work initiative, building an equitable foundation of skills and habits of mind to help youth succeed in the green and blue economies.

What is ICAN?

ICAN draws on EDC's more than sixty years of innovation in science education and on evidence-based STEM practices with which EDC's history is deeply entwined. Using the successful design principles of the African Primary Science Program—which built teacher capacity through participatory training and collaborative unit development—ICAN operates within the boundaries of the nature of science to decolonize science education production and include different ways of knowing.

ICAN consists of self-contained teacher education and student resource modules for grades 2 and 5 built upon three universal principles of science: Change, Data and Design.

- **Change** addresses how change is built into the natural world and how it affects both the natural and the built environment.
- **Data** addresses what is considered data, how we informally and formally collect data, how to read data and what can be considered reliable data.
- **Design** combines what students have learned in the Change and Data units to solve a problem. Learners think creatively to plan and implement a climate-related solution that has immediate impact in their community.

These three core principles are leveraged during instruction and action to activate and develop nine critical habits of mind:

Curiosity	Critical thinking	Creativity
Openness to new ideas	Responsibility and self-direction	Humor
Flexibility	Metacognition	Perseverance

ICAN modules are workshopped with participating educators, building on locally relevant climate issues and on questions that come from teachers and the local community. Content in each country is aligned with existing curricula and instruction in science, literacy, and mathematics and reinforces official learning expectations for those subjects.

All lessons follow the evidence-based 5E[1] structure of Engage, Explore, Explain, Elaborate, and Evaluate. Grade 2 and Grade 5 modules echo each other, with Grade 5 including more complex content and tasks for learners. Pilot teachers co-develop lessons on climate-related themes and then use them with learners to generate feedback and opportunities for refinement. Teachers participate in an ICAN learning community mediated via WhatsApp to share challenges, lessons learned, and examples of their work.

ICAN Implementation Strategy

ICAN teachers undergo training in science instruction and climate education using the 5E instructional model and the ICAN principles of Change, Data, and Design, in a sequence of knowledge → methods → practice, first learning basic facts about climate, then learning methodologies for teaching science critically and inclusively, then learning how to conduct investigations with all students. Training includes a climate change related field experience and an opportunity to work with students to trial the lessons and the methodology. Participants do not receive training on a "turnkey EDC curriculum." Rather, lessons are hyper-local and collaboratively designed. Teachers build the local ICAN lessons together based on the module outlines and walk through investigations as teams and with groups of students.

The ICAN training is led by EDC education specialists, in collaboration with local climate specialists in the pilot countries, and lasts 10 days. Representatives from the Ministry of Education and Ministry of Environment in each country are present to endorse and learn from the training activities. Subsequently, teachers implement ICAN lessons over a period of at least 6 weeks, periodically monitored and coached by local technical support.

ICAN Beneficiaries

The pilot program is being implemented in three countries: Mali, Zambia, and Antigua and Barbuda. These countries offer a range of implementation environments and climate challenges for testing the ICAN approach.

1 Bybee, R., & Landes, N. M. (1990). Science for life and living: An elementary school science program from the Biological Sciences Improvement Study (BSCS). *The American Biology Teacher*, 52(2), 92-98; Duran, L, and Duran, E. (2004). The 5E Instructional Model: A Learning Cycle Approach for Inquiry-Based Science Teaching. *Science Education Review*, 3(2), 49-58.

In Mali, education and environment representatives participating included: 2 pedagogical advisors from district-level Ministry of Education (MoE) offices; one district-level MoE office head; the head of the regional MoE office; one officer from the central MoE (regional and central personnel were not trained but are engaged in an advisory capacity); the Head of the Environmental Education Section of the Agency for Environment and Sustainable Development in the Ministry of Environment, Sanitation, and Sustainable Development; and a prominent Malian climate change and environmental education expert affiliated with the Mali Folkcenter Nyetaa.

In Zambia, education and environment representatives participating included: two Educational Services Officers; one Senior Education Standards Officer; the Assistant Director, Directorate of Open and Distance Education (senior ESO and AD were not trained but are engaged in an advisory capacity); a representative from the Ministry of the Green Environment; and a representative from the Zambia Climate Change Network.

In Antigua & Barbuda, education and environment representatives participating included: four Education Officers and the Assistant Director of Education for Planning, Training, Research and Educational Services; a representative from the Ministry of the Environment; and representatives from Environmental Awareness Group, Antigua & Barbuda's oldest environmental NGO.

Post-training implementation in Mali proceeded as planned. Teachers completed the intended six weeks of piloting and continued to use the lessons and develop additional content thereafter.

Post-training implementation in Zambia was slightly delayed due to lengthy approval processes for ICAN materials at the national Curriculum Development Center. Some teachers were reassigned during the delay, increasing the pool of participating schools from 10 to 13. The six-week piloting process was completed in September 2024.

Post-training implementation in Antigua & Barbuda is in process as of September 2024.

Table 1 : ICAN Pilot Participants, Round 1

	Mali	Zambia	Antigua & Barbuda
Schools	10	13	10
Teachers	20 (10 W ; 10 M)	16 (15 W ; 1 M)	16 (15 W ; 1 M) including the Antiguan School for the Deaf
Students	1,376	740	350
Education officials	5	4	5
Environment officials	1	1	1
Other (civil society)	1	1	3

ICAN Year 1 Evaluation Design

The year 1 evaluation addressed the following questions:

- How does teachers' capacity to teach climate change and science change when they participate in ICAN?
- How do teachers' knowledge, attitudes, and practices (KAP) regarding climate change and science instruction change when they participate in ICAN?
- How do students' knowledge, attitudes, and practices (KAP) regarding climate change and science change when they participate in ICAN?

ICAN personnel conducted focus groups with parents of participating students; monitored fidelity of ICAN implementation in each classroom once a week using a classroom observation tool aligned with the ICAN model; and administered a pre- and post-intervention knowledge, attitudes, and practices (KAP) tool with students, teachers, and educational supervisors.

Themes covered by the KAP tools included:

- Knowledge of primary natural phenomena (K)
- Recognition of the existence of climate change (A)
- Identification of causes and actors responsible for climate change (K)
- Understanding of the impacts of climate change (K)
- Perceptions regarding the urgency and seriousness of climate change (A)
- Capacities for action (A) and practices to mitigate climate change (P)
- Beliefs regarding how to teach science (A)
- Instructional practices for science instruction (P)

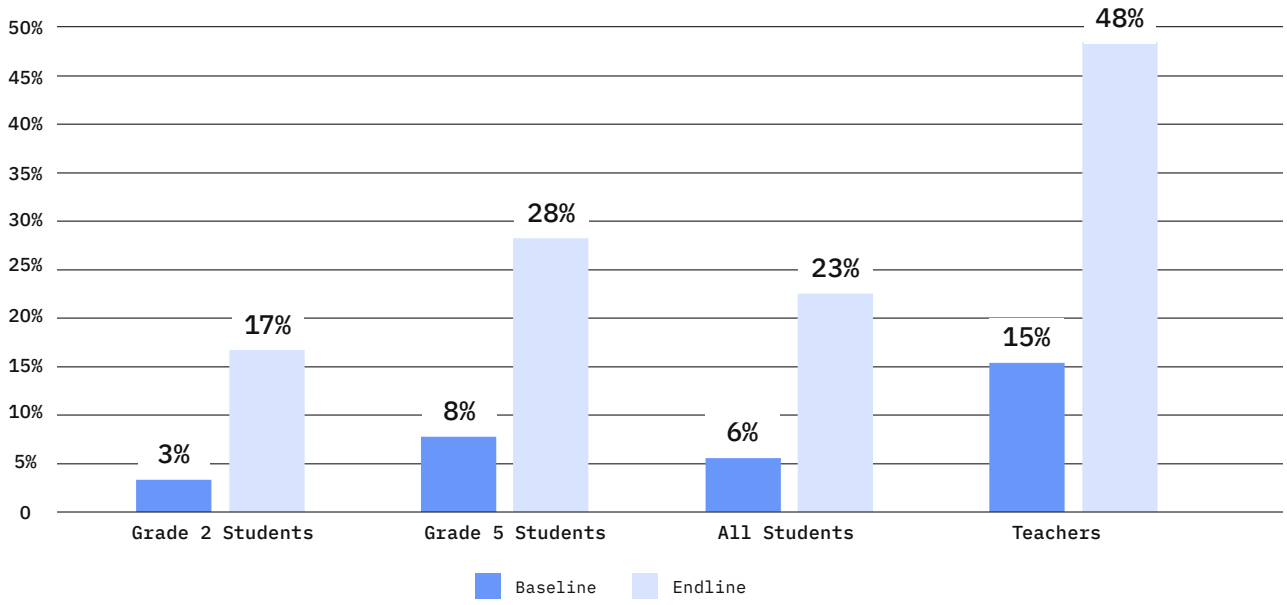
Post-implementation data were collected only in Mali, as the staggered rollout in Zambia and Antigua & Barbuda means that teachers in Zambia have just completed lesson implementation (in September 2024) and those in Antigua & Barbuda have not yet done so. Data from those countries, along with second-year implementation data from Mali, will be available in Fall 2024.

ICAN Year 1 Summary Results (Mali)

Knowledge Results

Both teachers and students demonstrated an improvement in their knowledge about science and climate change concepts over the course of the pilot, as shown in *Figure 1*.

Figure 1: Improvements in science and climate change knowledge, 6 week intervention, summary score



Attitude and Belief Results

In seven out of the nine areas in which a change in attitude was desired over the 6-week pilot, students demonstrated the desired changes (changes were similar in both Grade 2 and Grade 5 students so can be reported in aggregate). For example, at endline, 84% of students agreed that human activity is responsible for global warming, compared to only 40% at baseline.

Students also better identified existing impacts of climate change in Mali, including the following:

Table 2: Climate Change Effects in Mali, Student-generated at endline

Heat wave	75%	Food shortage	10%	Species extinction	2%	Migration	15%
Less rain	49%	Cold snap	8%	Water shortage	1%	Deforestation	10%
Drought	36%	Flooding	4%	Poverty	1%	More rain	2%
Diseases/virus	25%	Death	4%	Conflict/ Insecurity	1%	Power shortage	1%

In the two other areas, where no significant improvements were demonstrated, the baseline level was already very high. 97% of students agreed at baseline that climate change must be taught at school, and 94% of students reported being committed/motivated to act to protect the environment.

Teachers did not demonstrate significant changes in their beliefs and attitudes over the 6 weeks of the pilot, but they began with much more positive scores in the assessed areas and stronger intra-group agreement at baseline than students. The small sample of teachers (20) also makes it challenging to demonstrate significant changes among individuals, even if such changes do exist.

Personal/External Action Results

95% of teachers reported taking personal action to respond to climate change or protect the environment (outside their instructional practice) at endline, as compared to 75% at baseline. Most common responses included planting trees and sensitizing others to climate change issues. Students reported little engagement other than their ICAN projects and being more attentive to waste in the short timeframe of the pilot.

Changes in Science Instructional Practices

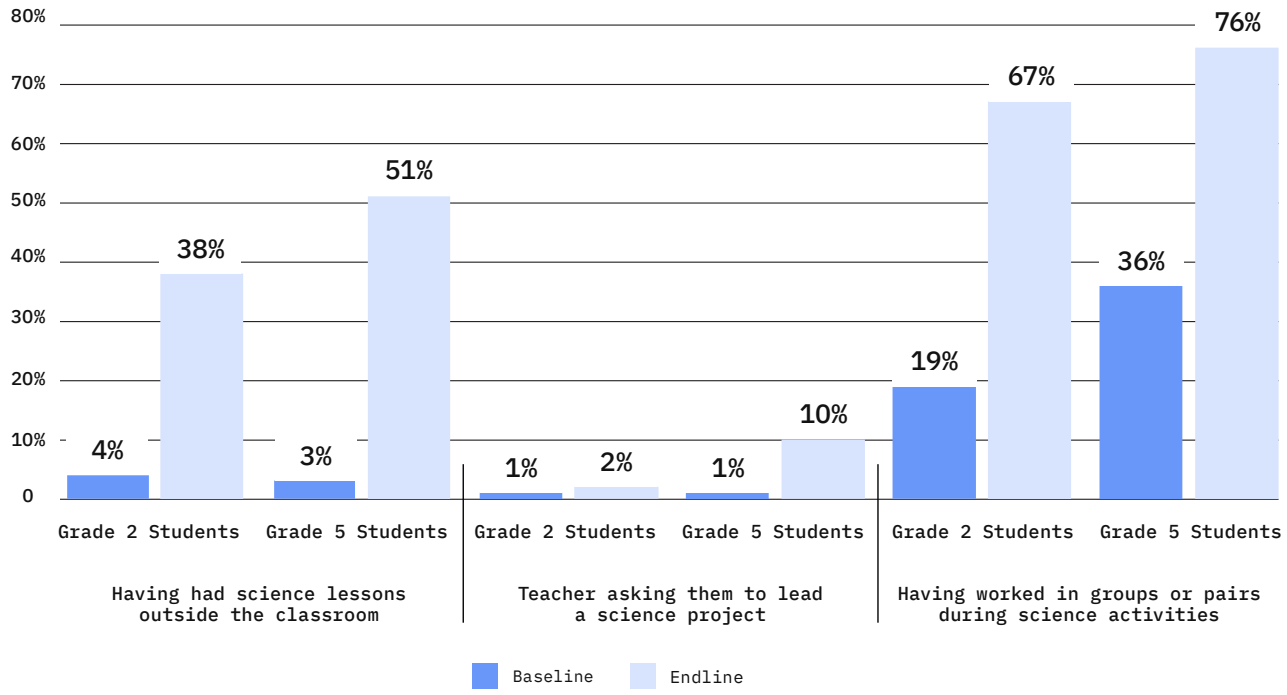
All but one of the Malian teachers used the ICAN approach in their classrooms and developed and delivered additional lessons. Teachers reported a range of challenges and successes in doing so, as shown in ***Table 3***.

Engagement: 100% of teachers were observed **structuring their lessons to engage learners** at endline. Teachers and students agreed on a 15% self-reported increase in the **engagement of community members or other outside resource persons in classroom science activities**. Students **asking questions in class** also increased by about 15% over the life of the pilot, and all teachers and students reported increased **encouragement of questioning** in class.

Exploration: 90% of teachers were observed creating time and opportunities for students to explore during ICAN lessons. Half of the teachers organized group work, and 85% of them reported asking students to **work in pairs, groups, or to discuss science topics together** during every science lesson. At baseline, 19% of grade 2 students and 36% of grade 5 students reported working in groups or pairs during science activities, but by endline, these percentages increased to 67% and 76%, respectively. 45% of teachers were observed conducted **activities outside the classroom**, and 80% reported doing so at endline (70% reported doing this for every lesson) as compared to 40% at baseline. Student responses confirmed this: at baseline, only 3% of students reported conducting activities outside the classroom during science lessons, but by endline, 45% of them reported doing so (38% of grade 2 students and 51% of grade 5 students). 40% of teachers were observed asking students **to model a natural phenomenon**, with 65% stating they did so every lesson. Grade 2 students modeled phenomena more often than grade 5 students (73% of grade 2 students and 44% of grade 5 students modeled the water cycle; 47% of grade 2 and 27% of grade 5 students modeled climate change). The percentage of **teachers who modeled these phenomena** themselves is similar to the percentage of students who did: 52% for the water cycle and 34% for climate change. At baseline, 1% of students reported their teachers **asked them to lead a science project**. By endline, 6% of students (2% of grade 2 students and 10% of grade 5 students) reported the same.

95% of teachers reported taking personal action to respond to climate change or protect the environment (outside their instructional practice) at endline.

Figure 2: Exploration as reported by students at endline



Explanation: 85% of observed teachers **explained the new concepts** in the ICAN lessons to students, and all of them did so clearly. 80% of teachers seemed to have understood these concepts, meaning they did not simply read or recite them but **explained them in their own words or way**. Most teachers (12 out of 20) present scientific concepts in both French and Bamanankan (five teachers present scientific concepts only in French, while three presented them only in Bamanankan).

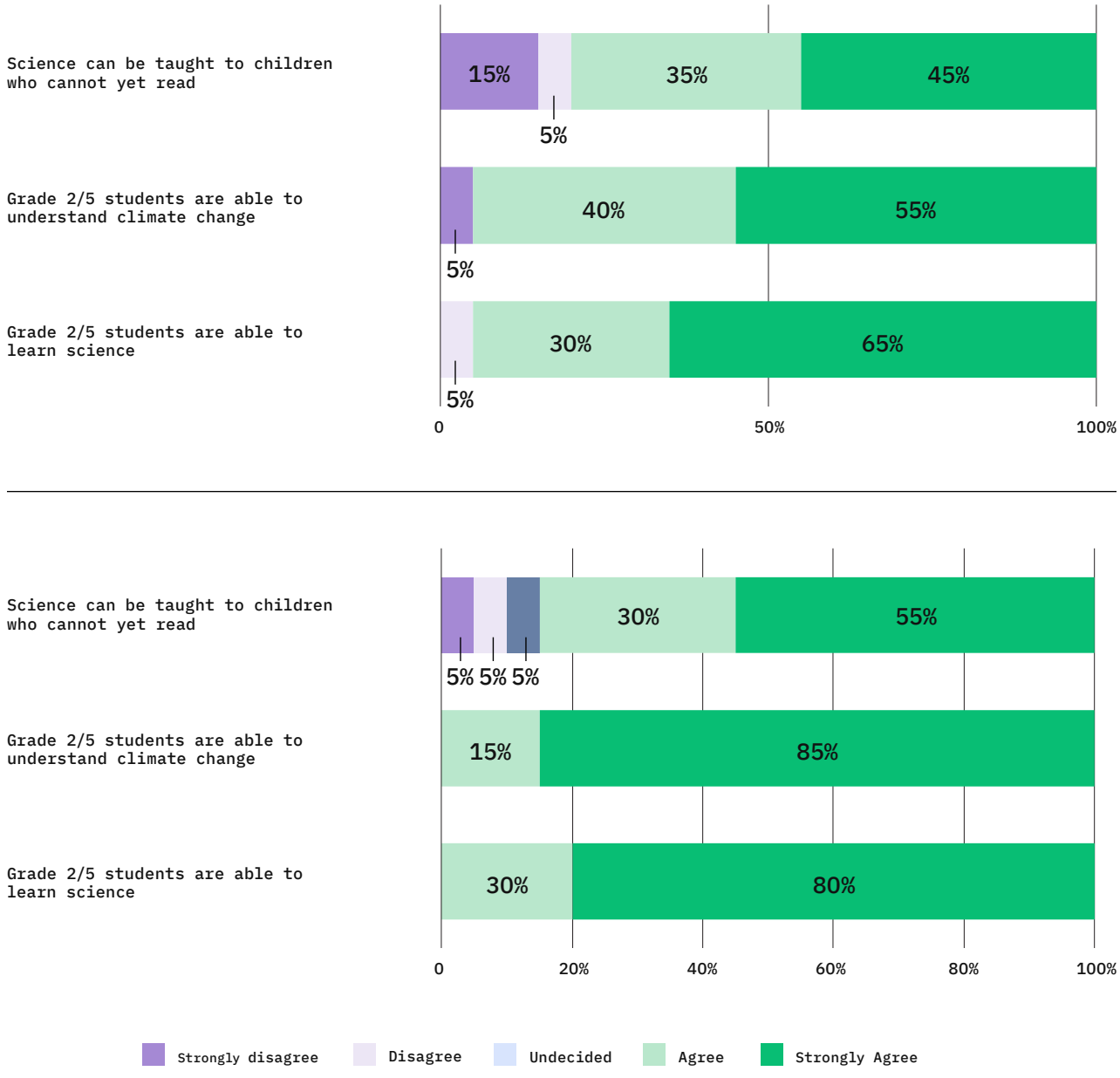
Elaboration: During the observed lessons, 55% of teachers **organized an activity for elaboration**. **Students drew conclusions based on their exploration and understanding**, but it is unclear whether they drew these conclusions themselves or if the teachers facilitated this process. All teachers who reported conducting such activities over the life of the project also reported using elaboration time to **assist students experiencing difficulties** in understanding.

Evaluation: During the observed lessons, 60% of teachers **organized an activity to assess students**, and in all cases, this activity allowed the teacher to **assess understanding rather than simple memorization**. Fifty percent of teachers assessed students individually.

Integration: At baseline, 55% of teachers reported **integrating climate-related themes into reading-writing lessons or humanities lessons**. At endline, 100% of teachers reported integrating climate-related themes into reading-writing lessons, and 95% reported integrating them into humanities.

Expectations: The proportion of teachers who **believe their students are capable** of learning science, understanding climate change, or grasping scientific concepts even if they cannot read increased over the duration of the pilot. However, teachers' expectations regarding student learning did not increase at the same rate (***see Figure 3***).

Figure 3: Teacher expectations of learners at baseline (top) and endline (bottom)



Parent and Community Engagement Results

The percentage of both students and teachers **participating in community-based events related to climate change** during science lessons increased over the 6 weeks of implementation. By endline, there was a 40% increase in teachers reporting involvement in such events. While proportions were lower for students, they also significantly increased (***see Figure 4***).

Figure 4: % teachers and students reporting participation in community-based events related to climate change during ICAN pilot

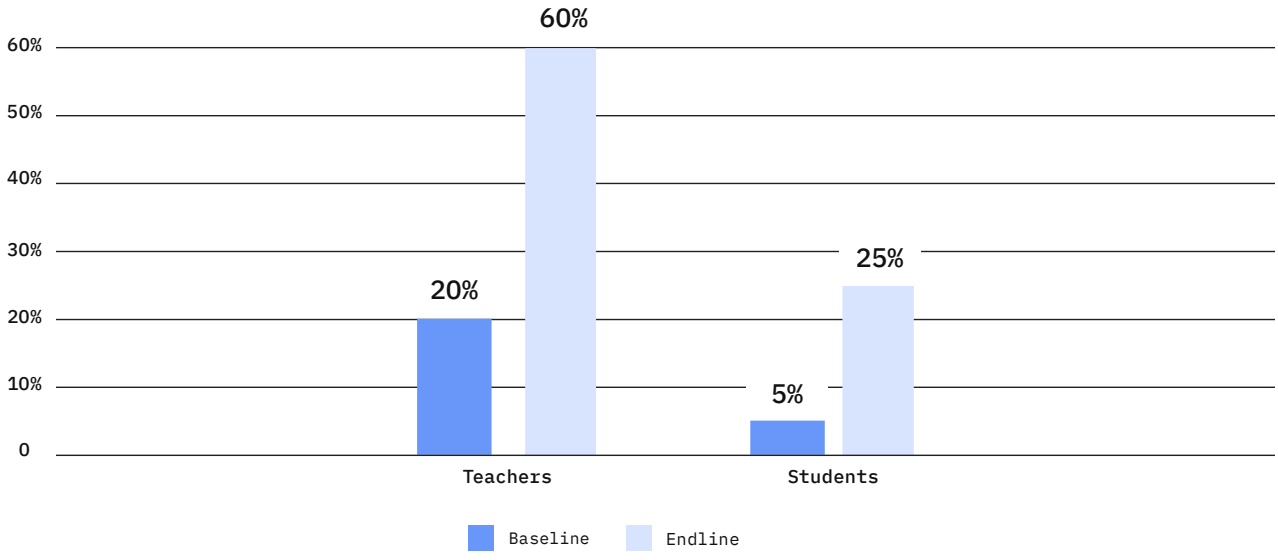


Table 3: Teacher self-report of ICAN impact on science and climate education (post-implementation)

	Great challenge	Minor challenge	Success	Great success
Gaining students' interest, engaging them	5%	15%	80%	0%
Integrating the theme of climate change into reading lessons	10%	10%	75%	5%
Encouraging students to observe and manipulate	15%	10%	65%	10%
Understanding the 5 Es	5%	20%	55%	20%
Understanding the ICAN lesson plan	5%	20%	60%	15%
Sharing your experience with colleagues from other classes	5%	20%	65%	10%
Using national curriculum contents to teach climate change	15%	20%	55%	10%
Drawing diagrams	10%	25%	55%	10%
Designing new science lesson plans following the 5 Es, on other themes	10%	25%	65%	0%
Integrating lessons into my schedule	20%	20%	60%	0%
Finding illustrations	30%	15%	55%	0%
Explaining scientific phenomena and concepts	25%	25%	40%	10%
Finding recycled materials	30%	25%	45%	0%
Using technical scientific terms in local language	45%	30%	25%	0%
Engaging parents in the issue of climate change	60%	15%	20%	5%
Engaging parents in science education	50%	30%	15%	5%
Engaging the community in exchanges or activities related to climate change	60%	25%	10%	5%
Having access to an adequate quantity of science textbooks	85%	15%	0%	0%

ICAN Year 2 Adaptations

Adaptations to the design for Year 2 (2025) include the addition of a comparison group in each country, to enable us to examine progress by ICAN participants against those who have not been exposed to the approach; more focused attention to disability inclusion in the training and in implementation, in partnership with country-level Disabled People's Organizations (DPOs); attention— through enrichment training and coaching—to elements of the instructional approach and to content that teachers and students found more challenging, including engineering design; and the clarification of expectations for and expansion of community action efforts as teacher familiarity with the approach increases.

ICAN evaluation additions and adaptations that parallel these changes include:

- Comparison of participant results against those of non-participating peers
- Direct assessment of changes in a refined subset of students' climate-smart science skills and habits of mind (problem-solving, critical thinking, and creativity). Change is likely to be small given the implementation timeframe but not impossible to measure given the observed changes in year 1.
- Examination of change in attitudes of parents and communities regarding climate change and science instruction. This data collection will be focused on longer-term outcomes among parents and in communities where children were engaged in year 1, not 6-week outcomes immediately post-implementation.
- Increase in civic/community engagement in resolving problems posed by climate change (qualitative documentation of community action activities developed and implemented by students and teachers in collaboration with communities).
- Examination of improvement of inclusivity in science instruction.

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