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Policy Brief

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Small Intervention, Big Impact: Experimental Evidence on Behavioral Change Towards Rational Use of Water and Energy in Uzbekistan

KEY MESSAGE

- Despite the urgency of water and energy issues in Uzbekistan, a lack of public awareness about environmental challenges and resource conservation remains a significant obstacle.
- Current green transition initiatives mostly adopt a top-down approach, focusing on producers (supply side) rather than addressing resource inefficiencies at the household level, representing the largest consumer group.
- School-based educational programs integrating behavioral interventions and interactive teaching methods significantly improve students' water and energy-saving behaviors, with a spillover effect on households.
- Educational interventions based on behavioral change methods are scalable. They can provide a practical pathway to complement Uzbekistan's national sustainability goals by addressing resource inefficiencies at the household and community level.

INTRODUCTION

Climate change and resource scarcity are among the most pressing challenges of our time, with developing countries like Uzbekistan expecting to face disproportionate risks due to their vulnerability and limited adaptive capacity. Globally, households account for approximately 12% of total freshwater use, with a significant portion wasted due to inefficient practices such as leaky faucets, over-irrigation, and low awareness of conservation strategies[1]. Raising public awareness of efficient energy use is essential for achieving sustainability goals in Uzbekistan, where energy systems heavily rely on outdated technologies and centralized grid systems.

Similarly, energy inefficiencies at the household level present a significant opportunity for improvement. Behavioral changes—such as unplugging unused appliances, optimizing heating and cooling, and adopting energy-efficient technolo-

[1] United Nations (2024). *World Water Development Report: Leveraging Water for Peace and Prosperity*. UN Water.

gies—have been shown to reduce household energy consumption by 5-20% globally[2]. In Uzbekistan, where energy systems heavily rely on outdated technologies and centralized grid systems, raising public awareness of efficient energy use is essential for achieving sustainability goals.

Despite the urgency, current policies in Uzbekistan mainly prioritize supply-side solutions such as infrastructure and industrial upgrades, leaving a critical gap in addressing wasteful consumption patterns at the household level. In this Policy Brief, we present the new model on how to change the behavior of individuals towards becoming more rational in consuming water and energy resources at the household level. Specifically, we've designed and implemented a school experiment on behavioral change. Our experimental design is based on a Randomized Controlled Trial (RCT), where we've randomly divided 9th-grade pupils from the public school in the Sergeli district of Tashkent city into the treatment and control groups. In our experiment, we've designed and tested a new method for integrating behavioral nudges and interactive teaching methods into school curricula. Our design improves not only students' knowledge and rational behavior but also creates a spillover effect, influencing their families and communities. These findings suggest that educational interventions offer a scalable and cost-effective approach to addressing resource inefficiencies, fostering a culture of sustainability at the grassroots level.

Overview of the problem and its significance

Uzbekistan is one of the most water-stressed countries globally, with 90% of its water used for agriculture and 36% lost due to leaks[3]. While the National Water Management Program (2017-2030) aims to modernize irrigation systems, behavior-focused interventions are needed to address household-level waste. A significant portion of households are unaware of the environmental and economic costs of water waste, and local cultural practices like long showers, frequent handwashing, or maintaining lush gardens contribute to overconsumption, even in areas with limited water availability.

In addition to water scarcity, Uzbekistan's energy sector faces significant inefficiencies. The country relies heavily on fossil fuels, particularly natural gas, and energy losses in the electricity grid exceed 15% annually. The residential sector, accounting for 40% of total energy consumption, represents a key opportunity for improvement. However, a lack of awareness and education on climate issues hinders the adoption of energy - and water-saving behaviors[4/5]. With 50% of the population under 30, Uzbekistan's

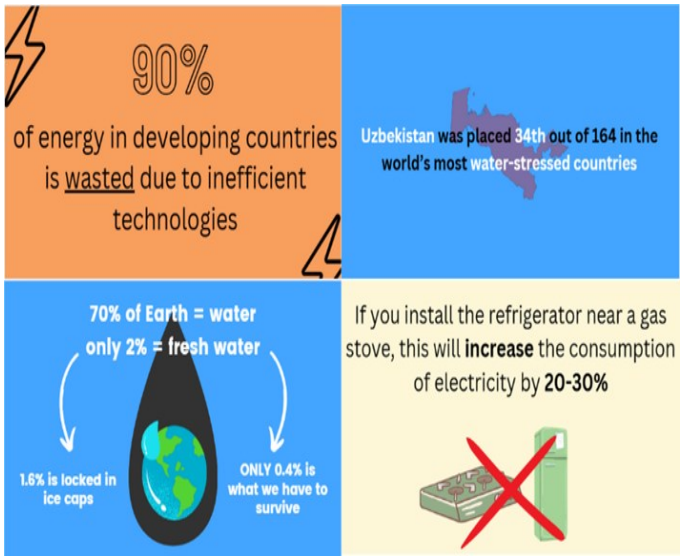
[2] International Energy Agency (2023). ***Energy Efficiency and Behaviour***: International Energy Agency, Paris.

[3] Tashkent Times. (2023, July 18). ***36% of water in agriculture is lost in earthen canals, says Mirziyoyev***. Available at: https://www.tashkenttimes.uz/national/11887-36-of-water-in-agriculture-is-lost-in-earthen-canals-says-mirziyoyev

[4] United Nations Economic Commission for Europe (UNECE) (n.d.) ***Environmental Performance Review: Uzbekistan***. Available at: https://unece.org/DAM/env/epr/epr_studies/Synopsis/Uzbekistan%20ECE.CEP.156%20synopsis%20english.pdf

young demographic offers a unique opportunity to drive behavioral change and foster sustainable development[6].

Figure 1. Water and energy issues in the world and Uzbekistan



Source: authors' development based on training materials of the experiment.

Educational interventions, particularly those involving hands-on, interactive learning, have proven effective in promoting sustainable behaviors among students. Studies show that school-based programs not only improve students' energy-saving practices but also create a spillover effect, influencing their families and communities[7/8]. In Uzbekistan, where a gap remains between awareness and action, this policy brief presents evidence from a Randomized Controlled Trial (RCT) that demonstrates the potential of school-based training programs to drive meaningful behavioral change, offering a scalable approach to achieving national sustainability goals.

Methodology: experimental design and the theory of change

Our RCT experiment was conducted among 9th-grade pupils of the public school No. 351 in the Sergeli district of Tashkent. The experiment lasted five weeks from April to May 2023. The school was selected due to its representative public-school environment in Uzbekistan, making it a favorable setting for evaluating scalable and contextually relevant interventions. Located in Sergeli, a suburban district of Tashkent with a population exceeding 105,700 (2021), the school was strategically chosen for its demographic alignment with national trends. We have started testing our theory and the experimental design based on one school in Tashkent capital, as the pilot project. We recommend testing interventions across a more diverse school sample for further replications of the given experiment in other regions of Uzbekistan and international settings.

A key factor influencing the choice of this school was its high proportion of students living in detached houses rather than apartments, with 94% of participants residing in houses. This distinction is par-

[5] United Nations (2024). ***World Water Development Report: Leveraging Water for Peace and Prosperity***. UN Water.

[6] Statistics Committee (2025). Open data, ***Demography***. Available at: https://stat.uz/en/official-statistics/demography

[7] Christensen, R. and Knezek, G. (2018). Impact of middle school student energy monitoring activities on climate change beliefs and intentions. ***School Science and Mathematics***, 118(1-2), pp. 43-52.

[8] Cornelius, M., Armel, K., Hoffman, K., Allen, L., Bryson, S., Desai, M. and Robinson, T. (2013). Increasing energy- and greenhouse gas-saving behaviors among adolescents: a school-based cluster-randomized controlled trial. ***Energy Efficiency***, 7(2), pp. 217-242.

ticularly relevant as houses in suburban or rural areas typically have higher water and energy consumption due to outdoor irrigation needs, inefficient household appliances, and individual heating systems. Compared to urban apartment dwellers, these students are more directly responsible for household-level resource management, making them an important target group for behavioral change interventions.

The RCT included a balanced distribution of students across the control and treatment groups, ensuring a fair comparison of intervention effects. The average age of participants was 15.2 years, with over 70% of students being 15 years old at the time of the study. Regarding gender distribution, female students were slightly overrepresented, constituting 60% of the control and 59% of the treatment groups. This reflects broader enrollment patterns in Uzbekistani public schools at this level. Regarding household composition, most students (approximately 95%) reside in detached houses, which aligns with the broader rural and suburban nature of the study location. While this may limit the generalizability of findings to strictly urban school settings, the results remain highly relevant to Uzbekistan's educational landscape, given that 62% of schools in the country are located in rural areas[9]. A minor but notable demographic difference was observed in household size, with families in the treatment group having slightly larger households on average (5.85 members) compared to the control group (5.70 members). This difference, although small, is consistent with broader

demographic trends in rural Uzbekistan, where extended family structures are more common. Establishing this demographic profile provides a crucial foundation for interpreting behavioral shifts and intervention effectiveness within the appropriate socio-economic and geographic context. Understanding these factors is essential for evaluating the success of educational interventions and their potential for scaling to other regions with similar socio-economic characteristics.

Our leading theory of change towards becoming a more rational user is based on the four-step intervention. Specifically, we mapped that the shift in human behavior could be changed following this sequence of interrelated activities:

Step 1. Raising awareness about natural resource scarcity. This is done by providing engaging presentations, sharing key facts, and holding discussions.

Step 2. From knowledge progresses to actions. This is done by conducting good and bad deeds on water and energy use, such as sorting, misuse of electric appliances.

Step 3. From simple actions to modelling rational use. This is done by using kinesthetic classroom activities, such as distributing a fixed amount of water to complete household chores, using house

[9] Statistics Committee (2025). Open data, ***General Secondary Education.*** Available at: https://stat.uz/en/official-statistics/social-protection

models to plan energy-saving practices for an interactive and memorable learning experience. Using actual water and real electrical appliances ensured deep learning instead of surface learning.

Step 4. Changed behavior is shared and contaminated with others, generating positive spillover effects and leading to sustainability. Students share the acquired knowledge and practices at home, encouraging family members and neighbors to adopt behaviors, creating a ripple effect within the community.

This four-step intervention was tested in the treatment group. In contrast, students in the control group were given traditional lectures and practice activities on water and energy topics in a parallel manner. In our RCT, we've randomly selected 60 9th graders: from class "9A" with 31 students shaping our Control Group and from "9B" with 29 students– Experimental Group, ensuring a balanced mix of genders, family sizes, and academic performance. Treatment and Control group activities were designed so that the two groups are identical and differ only by the behavioral change experimental sessions done in the Treatment group. This is important in ensuring the experimental effect's proper measurement, not the teaching instructions.

Before experimental intervention, our team conducted a baseline questionnaire to assess participants' initial knowledge of water and energy efficiency, understand participants' confidence levels in their eco-awareness, and establish academic parity between groups by recording their quarterly grades in English and other subjects. Baseline data showed no significant differences in grades or general knowledge between the control and treatment groups, validating the randomization process.

Implementation of the intervention lasted for 3 weeks, during which our team delivered 2 lessons focusing on water scarcity (SDG 6) and 2 lessons on energy (SDG 12) to both groups using relevant methodologies.

The Control Group's Week 1 and Week 2 included teaching about the same water and energy scarcity concepts using a traditional lecture-based method and handouts. Throughout the two weeks, groups were given homework assignments encouraging students to monitor household practices, such as tracking water usage or identifying energy-efficient appliances. Also, the classroom activities were recorded for later observation to identify and validate self-reported behavioral changes. In Week 3, we conducted a final questionnaire mirroring the baseline survey to measure changes in knowledge, a closing ceremony, focus group discussions, and semi-structured interviews to collect qualitative feedback from students, teachers, and parents.

A list of activities in the treatment and control groups is presented in the table below:

Table 1. Treatment and Control group activities

Treatment group activities:	Control group activities:
Week 1 activities:	Week 1 activities:
Key facts on water scarcity in the global and local context relevant to Uzbekistan	Lecture and seminar activities about water scarcity in the global and local levels context relevant to Uzbekistan
Good & bad deeds activity that incorporated real-life scenarios	Lecture and seminar activities on water scarcity
Board game "Save the Water", where players engage in activities like answering quiz questions, segregating trash, and learning about rainwater harvesting to earn "water droplets" (1 droplet equal to 1000 UZS), while actions that waste or pollute water result in penalties	
Kinesthetic game during which students allocate 1.5 liters of drinkable water to complete five household tasks: showering a baby, watering a plant, rinsing glasses, washing a car, and washing hands	
Week 2 activities:	Week 2 activities:
Key facts on electricity usage, inefficiencies, and potential areas for improvement	Lecture and seminar activities about energy scarcity in the global and local levels context relevant to Uzbekistan
Good & bad deeds activity	Lecture and seminar activities on energy scarcity
Matching words activity designed to enhance students' understanding of energy concepts	
Board game "Save the Energy" to encourage students to brainstorm ways to save electricity for each home appliance	
Week 3: Final evaluations	Week 3: Final evaluations
Final test	Final test
Feedback on the experiment	Feedback on classes
Award ceremony	Award ceremony
Sustainability effect: passing further on rational use of water and energy	

Source: authors' development.

Results and Findings

We have used mixed research methods for the analysis of experimental intervention. The quantitative data collected from all stages of the experiment were thoroughly analyzed. Paired t-tests were used to compare pre- and post-intervention scores for treatment and control groups. At the same time, regression analysis accounted for baseline differences to ensure an accurate evaluation of the intervention's impact. The results showed that the experimental group showed statistically significant improvements in knowledge and behavior compared to the control group, underscoring the potential of interactive and behaviorally informed teaching methods. Regarding qualitative insights, FGDs revealed that students in the treatment group engaged their families in discussions about resource efficiency, demonstrating an apparent spillover effect. Observations from homework noted visible changes in household practices, such as reduced water usage and increased energy-saving practices.

The baseline survey also revealed a significant disparity between students' self-assessed knowledge and their understanding of environmental and resource efficiency issues. While students rated their knowledge of environmental problems, water efficiency, and energy efficiency highly (averages of 4.3, 4.2, and 4.1 out of 5, respectively), their objective test scores indicated gaps in factual understanding. For instance, the treatment group scored 3.77 out of 6 on the water efficiency test, and the control group scored 3.25. Similarly, the treatment group scored 3.60 in the energy efficiency test, while the control group scored 3.10. These modest scores on the preliminary knowledge assessment tests suggest that, despite confidence in their abilities, students lacked critical knowledge in key areas.

Qualitative responses reinforced these findings. While students frequently identified surface-level issues, such as "pollution in the streets" or "turning off taps to save water," their deeper comprehension of systemic challenges, such as water wastage through outdated infrastructure or the implications of energy inefficiencies, was limited. Some responses, however, showcased practical awareness, such as recognizing the benefits of reusing water or unplugging devices when not in use, though these insights were not consistently reflected across the cohort.

These findings underscore the necessity of targeted educational interventions to bridge this gap. By offering a deeper grasp of environmental (water and energy) issues and suggesting actionable solutions to students, such school-level programs can address foundational knowledge gaps while empowering students to adopt sustainable behaviors in the long run. Quantitative results of the behavioral changes are presented in Table 2.

Table 2. Paired t-test results for Treatment and Control groups

Group:	Variables:	t-statistic	p-value	Interpretation:
Control group	Correct responses in the quiz on "Water use"	-2.15	0.039**	Modest improvement (with 51.33% of correct responses in Baseline and 54.17% - Final), possibly due to natural exposure to information or external
	Correct responses in the quiz on "Energy use"	-1.98	0.055*	No improvements in energy knowledge, meaning that passive exposure (without an intervention) is not enough.
Treat-ment Group	Correct responses in the quiz on "Water use"	-3.65	0.001**	Statistically significant improvement (+6.34%) with 69.17% correct responses - Final.
	Correct responses in the quiz on "Energy use"	-4.12	0.000***	Largest improvement observed, with a 7.50% increase in correct responses, confirming the positive impact of the intervention.

Source: authors' calculations based on the data from the experiment. *, **, *** denotes statistical significance at 1%, 5% and 10%. The negative t-statistics indicate that the post-test (final) scores were

Qualitative analysis findings are summarized in Figure 2. Specifically, we have documented exactly how rational use takes place in the mind and human behavior.

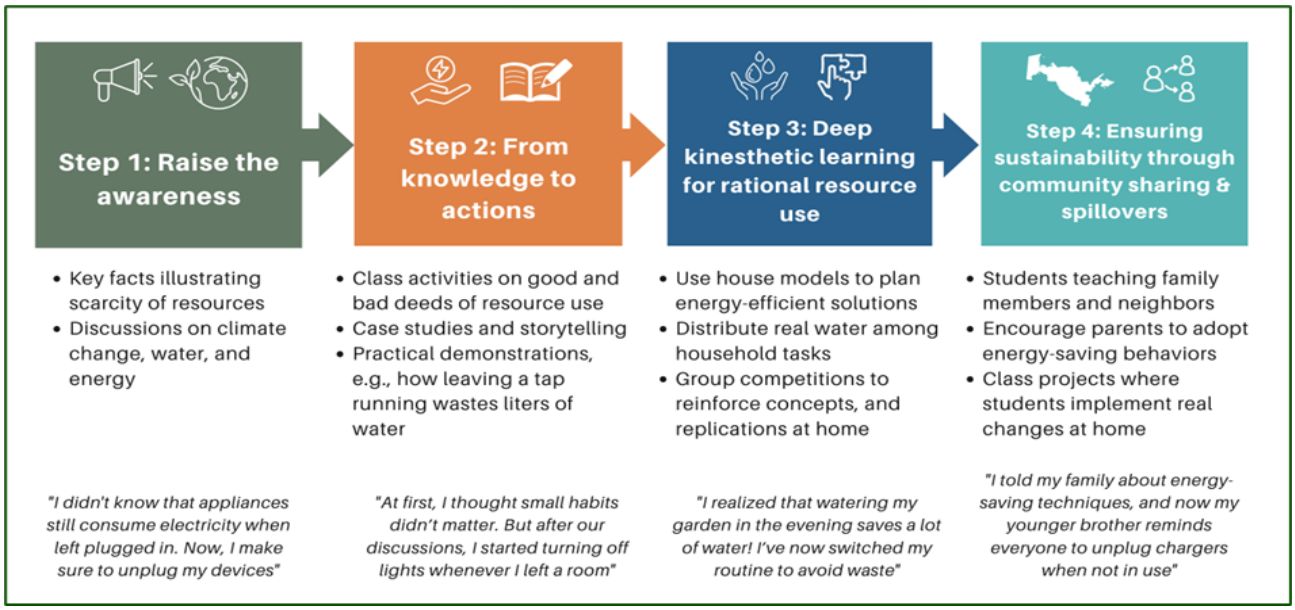


Figure 2. Behavioral Changes: qualitative insights into the rational use of natural resources

1. Water Usage: Participants in the treatment group demonstrated significant changes in their water usage habits. One student shared, "I realized that small activities I would do every day, like watering my garden and plants, led to much water loss. Now I have made it a habit to water the garden and plants not with a hose, but with a measured amount of bucket water. And of course... I water my garden in the evening or early morning so that the humidity stays." During the classroom activities, students began connecting their personal routines to broader environmental impacts. For instance, they enthusiastically shared their strategies for saving water at home, such as turning off taps while brushing their teeth and fixing leaking faucets.

2. Electricity Usage: The treatment group showed a marked improvement in their understanding of energy-saving practices. One notable realization came when students learned that "technical appliances still waste electricity even if switched off but not unplugged." This knowledge resonated with many, as they began discussing energy-saving techniques practiced at home, such as unplugging chargers and turning off lights when leaving rooms. In one group-based activity, students brainstormed ways to conserve household electricity. A student explained, "At home, we started using a heated kazan (a large cooking pot) for two meals instead of one to save energy." These practical discussions highlighted existing habits and encouraged others to adopt similar behaviors.

The intervention successfully heightened students' awareness of broader environmental challenges as well. Early in the program, some students could already list renewable energy sources like solar and wind power, while others began to grasp the importance of non-renewable energy sources. This foundational knowledge laid the groundwork for deeper engagement in class discussions. One student observed, "I used to think my daily actions didn't matter, but now I see how they connect to bigger environmental issues, like the Aral Sea drying up or water pollution in our canals." This shift in perspective was evident in their increased participation and curiosity during lessons.

We have also observed the progress in engagement and participation in the classroom itself. Initially, some students seemed distracted during lessons, often focusing on their phones. However, as the intervention progressed, they became more engaged in discussions and activities. They began asking thoughtful questions, raising their hands to share opinions, and relating the material to their daily lives. One facilitator noted, "By the end of the sessions, students who were once disengaged were the first to participate and share their insights."

This Policy Brief presents mainly methodological design and first evidence on achieved behavioral changes, capturing the short-term effects. The long-term effects are also being measured, and all participants of the experiments are being revisited and asked about the long-term effects. For this purpose, we've created two dedicated Telegram group channels where the participants from the Treatment and Control groups share their achievements.

Key Conclusions

- Educational interventions are effective: The treatment group's significant improvements in knowledge and behavior highlight the potential of interactive and behaviorally informed teaching methods.
- Scalability and spillover effects: The intervention's impact extended beyond the classroom, with families adopting more resource-efficient behaviors, demonstrating the potential for community-wide change. 9th-grade students were intentionally chosen for this intervention as they are at a formative stage of developing lifelong habits. This method provides an opportunity to shape behavior before students transition into adulthood, ensuring a lasting impact on sustainability practices.
- The key insights mentioned led us to broader policy recommendations and scaling up to other regions of the country.

Policy Implications

1. Integrating environmental education into school curricula: Integrating such scalable and cost-effective environmental programs into regular school curricula can complement existing policies, address resource inefficiencies at the grassroots level, and help Uzbekistan achieve its sustainable development goals. Introduce environmental education courses focusing on practical topics like climate change, renewable vs. non-renewable energy sources, and daily conservation practices. Include interactive, team-based activities to increase engagement and a helpful application.

2. Behavioral change programs for youth: The qualitative evidence of students changing their daily habits (e.g., using a bucket instead of a hose to water gardens, and unplugging devices) highlights the potential for youth-driven behavioral shifts to contribute to environmental sustainability. Expand youth-targeted behavioral change programs through partnerships between schools, local governments, and NGOs. Programs should include incentives such as competitions, rewards, and community recognition for adopting sustainable practices.

3. Localized awareness campaigns on resource efficiency: The study shows that linking environmental topics to local realities–bringing up issues like the Aral Sea crisis or instances from students' daily household activities and chores–drastically shifts the students' perception

of the environmental problems. Policymakers should design localized public awareness campaigns that tie global ecological problems to specific, relatable examples in communities (water scarcity and household energy waste). Campaigns could include visual materials, community workshops, and social media engagement.

4. Household-level energy and water conservation initiatives: Students' reports of implementing and motivating family members to implement changes at home, such as reducing energy use by unplugging appliances and using measured amounts of water, suggest the potential for school-to-household knowledge transfer. Policymakers should incentivise households to adopt energy- and water-efficient technologies (e.g., subsidized LED bulbs and low-flow showerheads). Also, we should encourage schools to play a role in educating families by involving parents in projects or workshops.

5. Scalability of educational interventions: The positive outcomes of this pilot intervention suggest that similar programs could be scaled to other schools and regions. It's recommended that nationwide educational pilot programs be implemented to test scalability and effectiveness in diverse settings, using a phased approach, starting with areas most affected by environmental issues.

6. Focus on experiential and interactive learning: We should promote experiential learning methods in environmental education, such as hands-on activities, behavioral nudges that include incentives, role-playing, and field trips to local ecological sites (e.g., reservoirs, renewable energy plants) to foster greater interest and engagement among students in the treatment group.

DISCLAIMER

The study's findings, interpretations, views, conclusions, and recommendations, as contained in this publication, reflect the authors' and do not necessarily reflect the official opinion of WIUT or CPRO.

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