

## ARTICLE OPEN



# Educating for variability and climate change in Uruguay, a case study

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Among the possible actions to face climate change, education has a central role, great hopes have been deposited in its potential to contribute to the construction of a sustainable world. However, although there are global climate change education initiatives, they still do not generate a significant impact, especially at the local level. The deepening of the location of educational actions is key to reaching the public. It is necessary to permeate the national educational systems and non-formal education generated by local civil society. For this reason, it is important to learn about successful local initiatives that can enrich and strengthen future practices at all levels. In Uruguay, initiatives have been developed that can serve as case studies that contribute to collecting lessons learned and areas of opportunity. This paper includes three experiences developed by multidisciplinary teams from the Centre for Response to Variability and Climate Change of the University of the Republic in conjunction with key local government actors and local civil society. It is about the process of elaboration and implementation of an audio-visual educational resource for adolescents, a cycle of workshops for young people and a multimodal online course for professional adults and teachers. The experiences demonstrate the relevance of generating locally contextualized educational resources and actions to contribute to the achievement of global objectives of sustainable development. Likewise, they present some lessons learned in terms of theoretical approaches, methods and practices of education for climate change.

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## INTRODUCTION

Within the framework of the Sustainable Development Goals (SDGs), education is one of the key tools. SDG 13 "Climate Action" establishes as a goal: "13.3 Improve education, awareness and human and institutional capacity regarding climate change mitigation, adaptation to it, reduction of its effects and early warning". While SDG 4 has been proposed to "guarantee inclusive, equitable and quality education and promote lifelong learning opportunities for all"<sup>1</sup>.

However, achieving these objectives is still a long way off, UNESCO recognized that the climate change education is a weakness worldwide. The global survey of young people<sup>2</sup> revealed widespread ignorance about climate change in almost the entire world, showing the weakness of education, although it also showed the interest and concern of youth to get training on the subject.

This weakness had previously been identified from the United Nations Framework Convention on Climate Change and for this reason it promotes various initiatives such as the Action for Climate Empowerment (ACE) that addresses article 6 of said convention and article 12 of the Paris Agreement, which highlight the central relevance of education to address climate change.

Currently, the challenge of locating these objectives remains and it is essential to develop local initiatives that make it possible to implement, monitor and follow up.

Uruguay is a country that is facing challenges imposed by climate change. Its economy is based on agro-industrial production and tourism, which are being affected, and will be even more so in the future. Changes in the rainfall regime, increase in average temperature, drought events and heat waves have been identified<sup>3</sup> variation in extreme temperatures<sup>4</sup> and changes in

frost events conditions<sup>5</sup>. Its population is vulnerable since it is mostly urban and concentrated in cities, largely coastal, that are not prepared for the increase in the occurrence of intense rain events. The country also faces challenges relates to the conservation of its biodiversity and ecosystems, under these circumstances.

Also, it is a signatory to the Paris Agreement and has submitted two National Determined Contribution (CND) reports. It has a National Climate Change Response System (SRCC) that coordinates government actions on the matter, a National Climate Change Policy and several National Adaptation Plans, as well as a Long-Term National Climate Strategy, among other actions developed at the national level. All the mentioned documents include education as a fundamental tool to achieve these objectives. There is no specific plan dedicated exclusively to education for climate change in Uruguay, but it is noteworthy that there is the National Plan for Environmental Education (PLANEA)<sup>6</sup> that identifies climate change as one of the main environmental problems in the country.

In Uruguay, a similar situation to that of the aforementioned global survey from UNESCO has been identified, since a recent national perception survey on climate change identified that the population shows low knowledge on the subject of climate change and at the same time, shows interest in having more information and knowledge<sup>7</sup>. Both globally and in this local case, the impediments to the development of climate change education do not seem to come from the aptitudes or attitudes of the target public, but from other factors involved.

Studies have identified some factors<sup>8</sup> such as scarce teacher training on climate change at all levels of formal education, lack of environmental education and education for climate change in the school curriculum, scarcity of educational contextualized

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resources on climate change and little participation of the stakeholders involved. It is also possible that other factors are also relevant, such as lobbying of stakeholders and/or political factors that impede or hinder the educational task on the subject.

Education for climate change is still a new area and although the actions coming from international institutions are key from the point of view of international cooperation and enable numerous activities around the world, the truth is that the education of populations it is defined and executed locally. Formal education is developed in the national educational systems and non-formal education activities promoted by local civil society. It is in these areas that education for climate change is inserted and it is where it can reach the public.

This paper analyses the results of three activities that are different from each other and aimed at different audiences, the experiences developed may be useful for other countries and regions with similar educational and social challenges.

### Theoretical framework

For the analysis of the selected case studies it is necessary to identify theoretical lines of reference. It is relevant to start from the consideration that educating for climate change has particular educational implications that several authors have identified. The difficulty of educating about a phenomenon in which a direct cause-effect relationship does not operate but rather a multiplicity of causes has been described, framed in the global crisis of the capitalist model based on fossil fuels.

There are also difficulties related to its impacts, since it is challenging to educate about effects that are diverse and sometimes contradictory<sup>9</sup>, for example, climate change can trigger droughts and also floods. In turn, it appears deferred in time, this implies cognitive barriers, since our senses capture the immediate environment and periods of time close to the present, but we have difficulty capturing long periods.

Perception difficulties have also been identified, for example, the critical point to collapse many ecosystems is to increase the global average temperature by two degrees, however, intuitively we do not consider this a clear danger. Likewise, climate change is often not easily associated with the individual sphere or basic needs, but with problems on a global scale that people perceive as remote from their daily lives.

Also, is needed to use climate information, which is generally difficult for the general public to understand. In turn, various criteria for the preparation and communication of this information coexist<sup>10</sup>.

UNESCO<sup>11</sup> proposes a definition: *"Education for climate change (...) highlights the importance of participatory and solution-oriented learning that encourages critical and systemic thinking committed to complexity and uncertainty and that instils in students their cognitive, affective potential and practice"*.

The constructivist approach is currently the most widespread in environmental education, it promotes the shared creation of knowledge and practical learning<sup>12</sup>. Also, is a reference the meaningful learning stream, which states that it is relevant to generate meaningful and contextualized learning<sup>13</sup>. Some authors propose overcoming the difficulties of education for climate change by "anchoring" new knowledge to pre-existing knowledge and everyday cases<sup>14</sup>. Also, it is relevant to develop educational practices that consider causes and consequences of climate change, identify knowledge gaps and promote novel alternatives<sup>15</sup>. Likewise, to consider the dialogue with popular knowledge and adapt to various audiences from interdisciplinary approaches.

Within this framework, the critical perspective of Paulo Freire's Popular Education and the viewpoint of social participation of Orlando Fals Borda's Participatory Action Research<sup>16</sup> are also unavoidable contributions. Given the aforementioned characteristics of the climate change phenomenon, the approach must also

be multidisciplinary, complex and systemic. In the case of Uruguay, these approaches are included in the National Environmental Education Plan, which provides a definition of environmental education: *"is a pedagogical, ethical and political tool aimed at building values, knowledge and attitudes that make it possible to move towards a sustainable development and a better quality of life based on equity and social justice and respect for biological and cultural diversity. (...). It entails a nourished pedagogy of Popular Education, in which learning is forged from the experience of the subjects of the educational process in their daily environment and proposes a comprehensive vision of its historical genesis, its characteristics and its biophysical, economic, social potentials and cultural"*.

This plan, arose as a proposal from the Directorate of Education of the Ministry of Education and Culture to the National Network of Environmental Education for Sustainable Human Development (RENEA) in 2011. For its preparation, this network developed a process participatory and horizontal, under the modality of workshops, with delegates from more than 60 organizations, belonging to civil society, the public and private spheres, from all over the country. The plan was approved by consensus in 2013, this document reflects the essence of environmental education supported by almost all of the Uruguayan educators, therefore, it is a reference document.

Taking environmental education as a framework, education for climate change is presented as a useful tool for localizing policies, linking global and local scales. The localization process in the territories has been defined as one that implies *"adapting, implementing and monitoring the SDGs at the local level"*<sup>17</sup>. According to Stuhldreher<sup>18</sup> *"The concept of 'localization' refers to the process that takes subnational contexts into account in achieving the 2030 Agenda, understanding that said localization refers to the way in which local and regional governments can provide support for achieving the SDGs through action 'from below', as well as the framework that the SDGs can provide for local development policy."*

The role of educational initiatives is mentioned as fundamental for localization, this as an important means to communicate the SDGs and promote critical understanding, especially among youth, at the local level<sup>19</sup>.

The importance of taking into account local participatory processes, called "bottom-up", has also been highlighted. In the case of Uruguay, it has been underlined that the environmental issue and especially the climate agenda has progressively entered the path of localization, according to Freigedo *"The number of plans linked to SDGs referring to the environmental dimension should also be highlighted, such as SDG 13 for climate action"*.

It is also necessary to take into account the role of other social actors, particularly we highlight the contribution that the academy can make, according to Tosun<sup>20</sup> *"Equally, important for Climate Action is to establish a constructive exchange between academics and professionals to anticipate the next themes, developing a sense of different perceptions of the problem, and offering an intellectually stimulating and scientifically sound analysis of climate action"*.

These references support the contribution of initiatives between social actors related to education for climate change and linked in the territories, as well as their relevance for the localization of the SDGs.

## RESULTS

### Three experiences of climate change education

This work evaluates the results of three experiences of climate change education developed by research and teaching teams of the Interdisciplinary Centre for Response to Climate Change and Variability (CIRCVC) of the University of the Republic (UDELAR). This Centre, since 2010, has brought together academics generating interdisciplinary responses to the problem of variability

and climate change and has developed an educational approach by conducting theoretical and practical research.

### Audio-visual creation process

In all cases they were original creations, since "ad hoc" solutions were developed. As a first case study, we propose to consider the production process of the audio-visual: "*Rodríguez y el Cambio Climático*"<sup>21</sup>, which aimed to identify social myths and essential concepts to educate in climate change.

It was carried out within the framework of the project "Demystifying knowledge about climate change in society" financed by the Program "University Fund for Public Understanding of Issues of General Interest" of the UDELAR Scientific Research Commission. It was led by two researchers from the CIRVCV and an audio-visual content production company, also, included the participation of other researchers from the Centre acting as a "panel of experts" contributing from disciplines such as agronomy, environmental engineering, economics, anthropology, sociology, among other.

Also, elementary education teachers participated who added the pedagogical and didactic perspective, and the vision of pre-adolescent children was incorporated in consultation with 6th grade students (11 and 12 years old). The central components of the audio-visual script were designed in participatory workshops. The teachers and students came from the Public Elementary School No. 88 located in Ciudad del Plata, Province of San José. This school was chosen because, in addition to having a previous history of working with UDELAR, it is located in a protected area of the Santa Lucía River Wetlands (Protected Area) and is also a highly industrialized area.

The filming location were in this area. It is also a place where environmental conflicts have taken place and where the impacts of climate change and variability have been suffered (floods, droughts, endangered biodiversity). It is also an area with organized civil society activity with several active local organizations, as well as joint work on environmental care, with local companies.

### Objectives

The main objective, was to identify myths or scientifically incorrect beliefs present in society and also essential useful concepts to educate on climate change. The filming process only started when the script structure was agreed by collaborative process. This allowed the exchange and "negotiation" of theoretical and epistemological frameworks among the workshop participants.

They also agreed on "languages" of researchers, teachers and audiovisual producers. The challenge was "what to communicate" and "how to communicate" in visual, spoken and animated language. Professional actors and 12 boys and girls from School No. 88 participated in the filming. As a result, an unprecedented audiovisual production was obtained that allows the public communication of local and contextualized scientific information, aimed at people aged 12 and over.

The resource obtained is accessible on the website of the financing organization; since it is an available resource, the information about its final use remains in the hands of the end users.

### Learned lessons

As lessons, the main one is learning about the relevance of taking care of the process of developing an educational resource on climate change. The experience generated learning about the importance of discussing epistemological and pedagogical frameworks within the groups in charge of an educational intervention.

In turn, the importance of the participation of key stakeholders. This allows planning and defining more precise and effective

approaches. This strategy has generated a useful, almost timeless, freely accessible resource that can be used as is, intervened or improved by the public. The proposal largely fulfilled its initial objective of identifying scientifically incorrect myths or beliefs and essential concepts to educate on climate change.

The contents were created from this identification of elements such as the relevance of clarifying and differentiating some key concepts such as change and climate variability and separating them from others (e.g. ozone layer) that were warned to generate confusion. Also, it was identified the relevance to the final script showed characters in a process of searching for information, doing this process together with the viewer of the audio-visual.

Priority was given to adequately communicate (providing image and sound) and to educate (providing scientific information) about the effects of climate change in Uruguay and giving examples. In addition to the content, the use of language (for audiences aged 12 and over) is mixed with people's speeches, animations and images of local territories. These strategies were selected to address the challenges of educating for climate change, from a local perspective.

As a weakness, this kind of initiatives, can be limited by its cost, due to the participation of audio-visual production professionals. Although this is not a limitation, since it is a free access resource, an approach for the general public was chosen. This can be seen as an advantage for reaching the general public, but as a weakness for not being focused on a specific audience sector (e.g. children).

### Workshops for Secondary Education students

Secondly, the "*Cycle of workshops for Secondary Education students: Agricultural Schools, Technical Schools and High Schools*" is proposed as a case, this was carried out with a project of the Ministry of Livestock, Agriculture and Fisheries (MGAP) and the United Nations Development Program (UNDP), with the aim of promoting reflection on adaptation to climate change in the territory. It included 13 workshops in 8 provinces of Uruguay (not belonging to the country's capital) and had the participation of 440 students between the ages of 15 and 19. All participating study centres have a close relationship with the rural environment, with some being agricultural training schools and other urban or suburban high schools in the interior of the country.

This initiative was contracted as part of the localization activities of Objective No. 13 by the government of Uruguay, as activity of the National Plan for Adaptation to Climate Variability and Change for the Agricultural Sector<sup>22</sup>. This is a strategic instrument to guide public policies with a long-term vision around the productive, environmental, social and institutional dimensions. It was led by the Agricultural Unit for Sustainability and Climate Change of the Office of Agricultural Programming and Policy (OPYPA), in coordination with the SRCC.

In this case study, its realization arises from stakeholders in the territories, since it was proposed by the Rural Development Tables of the MGAP. These "Tables" are groups of representatives of farmer organizations (mainly family farmers), rural workers, women and young people working with technicians from governmental organizations. Currently, there are 40 Rural Development Tables operating throughout Uruguay.

During 2017, in 7 provinces arose the need to promote training activities on climate change for young people and to do so in agricultural, technical and high schools. Based on the detected need, it was designed a program that included workshops of a single session of three face-to-face hours at each school.

### Objectives

The initiative's learning objectives were, first of all, to ensure that attendees recognize the problem of climate change and perceive it as a relevant problem in their current realities and also recognize

those measures that strengthen their adaptive capacity. Secondly, get attendees to reflect on the climate information they use and also, acquire some tools to access and select appropriate information to implement adaptive measures.

The activities included an online game and a previous survey, the development of the workshop itself in which the students reflected and shared knowledge and local experiences, finally an online game and a final survey. The expected learning objectives were met, the evaluations carried out by the young people demonstrated that the concepts presented were understood. In the workshop instances, reflection was produced and tools for adaptation to climate change that the students knew (by experience or by training) were exposed.

In total, 440 students participated, all of them between 15 and 19 years old. There was genuine interest in climate change, which is recognized and considered relevant by the students. The interest in the topic is clearly evident in two questions that were used in the evaluation of workshops. 83% of the groups stated that what they learned had been useful and 94% said that it would be important to have more information.

### Learned lessons

From the methodological point of view, the experience was able to confirm the relevance of the active participation of the target audience, not only as recipients of information but as co-builders of the dynamics, something that should allow a flexible educational proposal. Also, it was noted that family and/or personal closeness to agricultural production facilitated reflection on climate change and variability.

From didactics, useful tools were identified such as the combined use of computer tools (slides, applications and online platforms of climate information) with group dynamics. Also the importance of maintaining flexibility of the educational proposal adapted to the students and the territory characteristics.

The activity was effective as a tool for adaptation to climate change in students and, secondarily, it impacts families, mainly in the case of students from agricultural schools with families on agricultural production. Likewise, the school is impacted by hosting the workshop, giving relevance to the topic. As weaknesses of the proposal, we could mention the costs and great effort from the lead team that had to develop an itinerant activity.

These weaknesses have as their counterpart, the strong adapting of the educational intervention to the characteristics of the target audience (adolescent students) and related to this, its high effectiveness.

### Course "Climate Change: Fundamentals for its approach"

Thirdly, the case of the Course "*Climate Change: Fundamentals for its approach*" is presented. This was a multimodal online distance training (tutored and self-administered) aimed at technical graduates, professionals and teachers.

It was developed at the request of the national focal point of the EUROCLIMA + Program which is the Climate Change Unit of the Environment Ministry. This program is aimed to support environmental sustainability and climate resilient development in Latin America<sup>23</sup>. Also, the financing agency was the International and Ibero-American Foundation for Public Administration and Policies (FIIAPP), which is the implementer of the "Political Governance" component of EUROCLIMA +.

To date, the course had two editions, 2020 and 2022, it reached a total of 200 participants throughout the country.

### Objectives

The objectives were to provide scientific foundations on climate change, to bring participants closer to the impacts of climate

change from a comprehensive multidimensional and interdisciplinary perspective, and also introducing the main tools available for intervention in public and private management. Additionally, to provoke reflection on climate change on the target audience.

It was designed within the framework of the PLANEA approach and included an environmental education module based on the contents of this participatory plan. During its design, the team in charge received feedback through the presentation of progress from the members of the "Education, Communication and Awareness Working Group" belonging to the SNRCC.

This group is made up of representatives of the Ministry of the Environment, the Ministry of Education and Culture, the National Administration of Public Education, the Ministry of Foreign Affairs and UDELAR, among other institutions. The representatives (all belonging to the areas of education and communication) made valuable contributions and conveyed visions from their fields.

After the final design of the course was supported by said group, it was structured into 5 Modules with the following contents:

- Module 1: Climate change within the framework of environmental issues and sustainable development
- Module 2: Climate change as an expression of the climate system and anthropogenic action
- Module 3: Impacts of global climate change in Uruguay
- Module 4: Climate Actions and Institutional Framework
- Module 5: Education and citizenship for climate change

Each module had a weekly frequency and a sixth module of consultation and preparation of final monography was added, for the tutored modality. For the self-administered modality, an explanatory Didactic Guide of activities and necessary time dedication was added.

For each module, the following were defined: a thematic text (Guide), an introductory video, bibliography, practical exercise, evaluation, chat (synchronous) and forum (asynchronous). The latter allowed the permanent exchange between students and teachers, as well as debate and reflection. The final presentation of 50 monographic works on climate change was also achieved.

It is relevant to mention that this course was launched in February 2020, just before the COVID Pandemic, this allowed it to be taught completely since it was remote and also that a second edition could be launched later.

### Learned lessons

The opinion of the participants (assessed through surveys) was highly positive. 32% of those surveyed had never taken a distance learning course before, and 100% thought the course design was appropriate. When asked if the course met their initial expectations and if they considered it appropriate and motivating, the responses obtained an average of 4.6 on a scale of 1 to 5.

As result, the proposed learning objectives were achieved. The level of student commitment during the course was high, actively participating in forums and meetings. Furthermore, the final monographic works achieved a good level of reflection on the problem of climate change and its application to specific cases proposed by the participants themselves. It was concluded that, through the methodology used, distance education for climate change can maintain participation, the shared construction of knowledge and be a valid modality to reach diverse audiences and residents in distant places.

As weaknesses, although it requires initial investment, even it has the advantage of being a resource that can later be used multiple times (for the self-administered version), however, the tutored version requires the dedication of tutors and financial resources. On the other hand, although it was an educational resource aimed at a specific audience (professional adults), it was noted that within this audience there are various groups with specific needs that would need to be addressed, for example,

**Table 1.** Source: prepared by the author.

Main features	Audiovisual	Workshops	Online course
Type	Educational resource	Educational activity	Educational resource and educational activity
Origin	Detection of need by previous investigations.	Detection of social actors and need for government localization action	Need for government localization action
Participation in design	Researchers, experts panel and educators.	Researchers in consultation with national government unit.	Researchers in consultation with a group of various national government representatives.
Participation in execution	N/A	Students and schools	Students.
Public	All public (12 and more)	Young students, 12–19 years old	Adult technicians, professionals and teachers.
Territory	Developed and filmed in an area affected by climate change and variability.	Implemented in or close to rural areas affected by climate change or variability.	Incorporated in the contents (with emphasis in the case of Uruguay) by the students from their personal experience.
Pedagogical approach	Scientific communication (contents from IPCC and national experts). Constructivism in education and meaningful learning.	Scientific communication (contents from IPCC and national experts). Constructivism in education and meaningful learning. Popular Education.	Scientific communication (contents from IPCC and national experts). Constructivism in education and meaningful learning. Popular Education, IAAP.
Didactic approach	Educational communication, visual communication tools (images, animations, speeches, story).	Virtual tools, climatic platforms, participatory face-to-face dynamics and virtual games.	Virtual distance education tools: Moodle platform, forums, synchronous meetings, monographs.
Contribution to the ODS location:	Open and available educational resource. Impact on the contextualization and localization of climate change.	Itinerant activity in locations in various parts of the country. Primary impact on future agricultural technical professional students and secondary impact on study centres and families.	Contextualized educational resource available. Impact on local decision-makers or planners (technicians, professionals) and trainers (teachers).

teachers seek guide to develop educational interventions, while the technical advisors focus on finding applications in planning and management areas.

A summary table of the referred initiatives, highlighting the main features to consider, is presented below (see Table 1).

As original contributions, the evaluated experiences, had in common that, the one hand, the importance of knowing how to carefully consider the characteristics of the target population before designing educational actions, this influences whether they are adapted and relevant. Particularly, is relevant to agree on theoretical and epistemological guidelines among the organizing group, concepts such as climate change itself must be previously discussed, as well as the selection of pedagogical and didactic approaches.

The simultaneous use of various tools (audio-visuals, platforms, texts, etc.), always selected for their application in the local context, is also a successful common point in the three experiences.

Also, the experiences show the importance of continuous evaluation; in all cases the opinions of the participants were gathered while they were being carried out and this enriched the practice, allowing the improvement of the proposals.

## DISCUSSIONS

The experiences showed the validity of the constructivist approach to education, with emphasis on participatory construction both in the design of proposals and in their application. Likewise, they are examples that the “anchoring” of new knowledge in daily contexts and pre-existing knowledge and territory based situations is a valid and effective approach to achieve reflection and the transposition of theoretical contents. The participants, both in workshops as well as in the writing of monographs, were highly motivated by the application of acquired knowledge, in everyday cases and situations.

On the other hand, the approach proposed by Meira is validated, to identify knowledge gaps as well as “barriers” or preconceptions, something that was the focus of all the proposals, with good results. The design of educational resources on climate change can be enriched with this information both for its design and for its execution.

In turn, the experiences also had in common that they show the validity of the approaches of Popular Education and Latin American environmental education, with students who are active participants in the educational process as stated in the PLANEA.

The validity of this type of approaches for the location of sustainable development objectives through educational actions is also noted. In general, it coincides with the perspective of the key role of educational initiatives for localization through critical reflection, especially among youth these initiatives directly impacted young people and others key actors (professionals and teachers) with high participation and meeting the objectives set.

In turn, the experiences confirm what Tosun proposed about the benefits of constructive exchange between academics and professionals to offer an intellectually stimulating and scientifically analysis of climate change. Valuable contributions were generated for the success of the experiences, coming from the territorial organizations and in the exchange with experts. It is noteworthy that this generates essential multidisciplinary spaces for education on climate change.

Finally, it is necessary to highlight that, in the case of education, there is no linear causal relationship between education and behavioural changes, but it is possible to measure some impacts of educational actions. At this point, experiences have shown that education for climate change, under referenced theoretical approaches, are necessary and well received by various audiences. They are welcomed mainly by young people in secondary education and also by trainers from all educational subsystems. The study of these cases affirms the need to promote the development of and educational resources and activities, with a global vision but based on a local context, close

to the daily life of the key stake holders, mainly young people, professionals and teachers.

### Reporting summary

Further information on research design is available in the Nature Research Reporting Summary linked to this article.

### DATA AVAILABILITY

All the relevant data are available from the author.

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### COMPETING INTERESTS

The author declares no competing interests.

### ADDITIONAL INFORMATION

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