RPPI
Revista Brasileira de Políticas Públicas e Internacionais

Decarbonise! An online game-simulation experience on decarbonisation climate policies

Descarbonizar! Uma experiência de jogo-simulação online sobre políticas climáticas de descarbonização

João Paulo Pereira dos Santos[1]
Letícia Almeida Montenegro[2]
Artur Prado Borges do Egito[3]
Elia Elisa Cia Alves[4]

DOI: [10.22478/ufpb.2525-5584.2022v7n2.61028]

Recebido em: 01/10/2021
Aprovado em: 17/08/2022

Abstract: How to introduce a practical dimension to the study of climate change in international relations teaching? This article is a statement of the application of a gamification strategy in a class of graduation in International Relations from UFPB in a distance learning context, to illustrate the understanding of public climate policies on decarbonisation. The platform of simulation Decarbonise! was developed in Europe and is available online, free of charge, and with pedagogical purposes. In this article, we contextualize the importance of the discussion on environmental issues in International Relations courses and we present the operation and results of the simulation experience. Based on the feedback of eighteen students, the simulations enabled the theoretical discussion of the topic more practically and actively. According to eleven self-perceptions form responses around the simulation experience, we observed a significant increase in understanding around pricing-based policies (Carbon Tax) and alternative energy trading schemes (Energy Budget Scheme), while self-perceived understanding of multiple green policy instruments (Green Economy Toolbox) has also increased, but to a lesser extent.

Keywords: Online games; Simulations; Active learning; Decarbonisation Policies; Climate Politics.

Resumo: Como introduzir uma dimensão prática da discussão climática para o ensino em relações internacionais? O presente artigo é o relato da aplicação de uma estratégia de gamificação com alunos de graduação do curso de Relações Internacionais da UFPB em

[1] Universidade Federal da Paraíba. E-mail: joao.pereira@academico.ufpb.br.
[2] Universidade Estadual da Paraíba. E-mail: leticiaalmeidaamontenegro@gmail.com.
[3] Universidade Federal da Paraíba. E-mail: arturegito@gmail.com.
[4] Universidade Federal da Paraíba. E-mail: elia.cia@academico.ufpb.br.

contexto remoto, com o objetivo de ilustrar a compreensão em torno do desenho de políticas públicas climáticas sobre descarbonização. A plataforma de jogo-simulação Decarbonise! foi desenvolvida na Europa e está disponível online, gratuitamente, para fins didáticos-pedagógicos. Nesse artigo, contextualizamos a importância da discussão da temática ambiental nos cursos de Relações Internacionais e apresentamos o funcionamento e os resultados da experiência da simulação. A partir do feedback de dezoito alunos, o jogo-simulação viabilizou a discussão do tema de modo mais prático e ativo. Com base em onze respostas a formulários de auto percepção sobre a experiência, observamos um acréscimo significativo na compreensão em torno de políticas baseadas em preços (Carbon Tax) e esquemas alternativos de comercialização de energia (Energy Budget Scheme), enquanto a auto percepção de compreensão de múltiplos instrumentos de política verde (Green Economy Toolbox) também aumentou, mas em menor proporção.

Palavras-chave: Jogos online; Simulações; Aprendizado ativo; Políticas de Descarbonização; Políticas Climáticas.

1. Introduction

Teaching practices at the higher level have undergone numerous changes, aiming to improve the teaching-learning process (Barr e Tagg, 1995). In this context, professors worldwide started active learning initiatives. Those initiatives consist in stimulating the improvement of critical thinking through different teaching-learning strategies that incorporate the students in the educational process. Some examples of this type of method are teaching cases, workshops, debates, simulations and the use of creative and challenging games (gamification) (Asal, 2005; Alves et al., 2019; Lantis et al., 2000).

Although still relatively incipient in Brazil, the expansion of the employment of these techniques in International Relations (IR) courses signals the efforts of educators to make learning in the discipline more participatory and interactive (Inoue & Valença, 2017). In this effort, the Mettrica Lab is an initiative that promotes an inter-institutional collaborative environment that brings together collaborating professors, graduate and undergraduate students from institutions located in various regions of Brazil. Through the development, testing and reproduction of active teaching-learning techniques and methodologies, the Mettrica Lab performs adjustments and improvements in teaching cases, dynamics and simulations, to then apply them in the classroom.

In this scenario, the article in question has as its object of analysis the application of the online game-simulation entitled *Decarbonise!* in the discipline of Global Environmental Politics of the Bachelor's Degree in International Relations at Universidade Federal da Paraíba (UFPB, Brazil) in May 2021. The environment is an

essential topic when discussing International Relations in the 21st century, and it is even a requirement in courses in the area, according to the National Curriculum Guidelines (DCN) (MEC, 2017).

The consequences of climate change have become the subject of countless debates and studies, which seek to find alternatives to reverse the damage caused by human action to the environment. The atmosphere, considered a global public good, has a limit on the emission of gasses, with carbon being one of the elements responsible for the greenhouse effect, which results in the warming of the earth (Viola, 2002). Thus, to achieve a reduction in the emission of these gasses, it is necessary to coordinate numerous interest groups, not always converging. The climate summits, the agreements signed by the States and the participation of society represent a joint attempt to resolve the dangers of this scenario, even though they involve countless challenges.

Our main goal is to describe an application of a game-simulation discussing decarbonization politics, including the results from students' self-perception on main concepts before and after the experience. We divided this work into five more sections, in addition to this introduction. Section 2 discusses the context of active learning teaching methodologies, specifically the gamification aspect, and section 3 presents brief conceptual theoretical elements related to public decarbonization policies. Section 4 explains the Decarbonise! game rules and its educational potential. In section 5, we report the game simulation experience and its practical implications in the students' perception of the studied topic, and section 6 summarizes the work with some final considerations.

2. Active teaching and gamification in International Relations

Active learning approaches allow for greater student involvement in complex topics in order to facilitate the development of critical thinking more effectively than traditional learning techniques, through different types of activities that stimulate reflection (Fink, 2013), such as simulations, cinema, art, teaching cases, interactive games, among others (Lantis et al, 2000; Inoue and Valença, 2017). Priority is given to the use of instruments that promote significant interaction in the classroom, with the aim of developing skills and not just transmitting information, encouraging the student to employ a critical analysis of the theoretical elements presented.

Although definitions vary, they generally share common priorities: a) students need to do more than just listen; b) the teacher seeks to develop skills and abilities, according to predetermined learning objectives (Lantis et al., 2000); c) students

participate in activities that interact with the content and are encouraged to analyze and criticize, positively or negatively, specific theoretical elements (Fink, 2013).

In essence, it seeks to remove the student from a passive position, to occupy an active role in his teaching-learning process, which is composed by: information (content), experiences and reflection. When combined, these moments allow the student to develop a broader and more holistic perspective on a given topic. Intuition and imagination are developed through the action of relating the concepts learned during the reading and the lecture, with the reality portrayed in a more practical way (Inoue and Valença, 2017).

In addition to the perspective of active teaching strategies, it is noteworthy that teaching through games is not new. According to Huizinga (1938), the game is part of the transmission of knowledge from the oldest societies that have a historical record. Kapp (2012) reinforces this idea by proposing that every teaching process configures a type of game. This is because, as learning is usually marked by a logic of challenge and offering solutions, the same structure can be simulated with the help of games. In this way, it reiterates that the strategy itself is quite compatible with the classroom environment, functioning as a learning enhancer if there is attention to planning the activity.

Although the employment of the playful element in teaching is ancient, the term gamification dates back to the digital age and reflects the role that virtual reality and games have acquired in human interactions, reinforcing their ability to create, transmit and share content (Deterding et al., 2011). In the classroom, there are several reports of the use of playful games and simulations to discuss theoretical elements (Alves et al. 2019), however, a novelty with the Pandemic was the intensification of this type of playful element in the digital environment.

Although there is no convergence on how to implement gamification in the learning process, there is the possibility of going beyond than only scoring activities, such as verifying aspects like creativity, ability to recognize errors and change directions, technical knowledge, logic and ability to deal with decisions and consequences (Kapp, 2012). In this context, game platforms have the differential of creating virtual environments that allow participants to get in touch with themes or role-play in scenarios/situations that encompass global politics (McGonigal, 2011).

According to Kapp (2012), the first academic works that report experiences of creating, using or incorporating games into classes are relatively recent and date from the first decade of the 21st century. Researchers have widely recognized and validated this

teaching strategy, although unconventional in most of the field of knowledge, mainly for its capacity for engagement, due to the logic of awards and inputs that demarcate the methodology (Hakulinen, Auvinen & Korhonen, 2013). Games also stands out for offering instant feedback to the student about their performance, in addition to ensuring the general perception of participants about the fulfillment of the steps and tasks required in groups or individually (Kapp, 2012). Finally, these activities may develop skills useful for real life (McGonigal, 2011).

Regarding the application of this strategy in the classroom, the first step is to select the activity that provides the means to achieve educational content goals, favoring initiatives that encourage collaboration and participation at the same time (McGonigal, 2011, Kapp, 2012, Rocha Seixas, Gomes & Melo Filho, 2016). Reeves & Read (2009) reinforce this idea, suggesting that work environments that introduced learning platforms through games had increased levels of creativity and collaboration from the moment of implementation.

Prince (2004) discusses some of the problems related to these strategies, as well as attempts to gather data on their effectiveness. The author highlights the establishment of multiple and general educational goals by teachers, which are difficult to assess, for example. On the other hand, the writer concludes that employing such strategies in a specific and intentional way, focused on overcoming basic difficulties of students, can increase engagement and learning. The review by Ishiyama (2013) concludes that this is not necessarily a reason not to accept simulations for teaching, but that more research is needed to contribute to this agenda. Onuki and Oliveira (2017) also have an important contribution to this agenda, gathering data from more than 10 years applying simulations in international negotiation courses.

Considering that, in the next section, we will introduce important contextual elements about decarbonization policies, before reporting the experience of the application of the Decarbonise! game-simulation.

3. Public policies for decarbonization: the paths of the Paris Agreement up to the 1.5°C ceiling by 2100

The 1990s marked international relations from an environmental perspective, especially with the signing of the Framework Convention on Climate Change (UNFCCC) in 1992. Since then, countries and non-state actors have sought to structure and consolidate strategies in order to promote the mitigation of greenhouse gases (GHG)

(Alves et al., 2021). In this sense, there was a growth in the relevance of public policies seeking to enable the energy transition, given that the generation and use of energy are the main global sources of GHG emissions (Leite et al., 2020).

With the progress of negotiations, the countries established, in 2015, the Paris Agreement, through which they defined targets to reduce GHG emissions, based on voluntary contributions from the countries. One is to keep global warming below 2 ºC, preferably at 1.5 ºC by the end of the century [2100] (UN, 2015). National governments have become involved in building their own commitments, considering specific social and economic landscapes, with Nationally Determined Contributions (NDC) (Figueres, 2020).

In order to promote the functioning of NDCs, Bataille et al (2016) quote the global consortium Deep Decarbonisation Pathways Project (DDPP). The initiative represents an alternative for decision makers on how to implement decarbonization policies at the domestic level, through short-term strategic plans in line with long-term goals. The DDPP proposal is to promote GHG mitigation through the implementation of a common transition method, through which different actors can debate and compare their decarbonization policies (Bataille et al., 2016). Regarding this framework, Green et al. (2020) reiterates central obstacles: the modesty of changes in behavior when it comes to business operation and the existence of different paths to achieving decarbonization. They argue that the most ambitious firms in the business sector prefer to implement hedging, which consists of mitigating GHG risks through diversification rather than decarbonization policies, a practice which researchers discredit (Green et al., 2020).

The establishment of a global decarbonization policy represents a process that requires systemic reorganization, as it affects and regulates different sectors of society (Bernstein & Hoffman, 2015). Examples of public policies applied in different countries indicate that carbon governance is not restricted to tool offering (or technical cooperation), once they are embedded into the phenomenon that Tozer (2020) calls *momentum*, which is effectively the strengthening of partnerships and political dynamics towards decarbonization. With a team of more than 40 experts, the author carried out a study on energy transition in Stockholm, London and San Francisco, seeking to verify whether public institutional political dynamics relate to the implementation of renewable energy policies [fossil-free]. The author proposes that decarbonization initiatives to be

effective must offer instrumental solutions and provide momentum through organization and political implementation.

Studies on renewable energy incentive policies, which comprise a sectorial niche of decarbonization, suggest a categorization into three groups of policies: technological, market and industrial regulation. The first group includes Research and Development (R&D) programs, as well as instruments aimed at promoting interaction and creating innovation links between the main actors in the sector. Market regulation policies aim to create and consolidate demand and supply of renewable energy. Such policies are based on several different setting mechanisms such as quotas (e.g. renewable portfolio standards, RPS); feed in tariffs (FITs), fiscal incentives for consumption (reduction in energy sales taxes), on excise duties, on value-added taxes (VAT), or on auctions that encourage the inclusion of renewable sources in the energy matrix. Finally, the category of industrial policies includes measures to protect local industry, with capital subsidies or subsidized interest rates, tax credits for production or investment, or to encourage the creation of foreign markets (Alves et al. 2019).

Another aspect in decarbonization policies is the short-term negative impacts on competitiveness and distributional results. Based on a systematic review of the results and trade-offs of ten types of decarbonization policies, Peñasco et al. (2021, p. 263) argue that "in some contexts, and under specific policy instrument designs, there are short to medium term trade-offs between decarbonization and other socioeconomic objectives". Some notable examples are direct government investments, subsidies for the deployment of renewable energy and carbon prices.

Furthermore, the literature also points out that even in the cases of the implementation of low carbon transition policies, the problem of climate injustice and vulnerability persists. Sovacool et al (2019) conducted a study on four types of decarbonization policies (nuclear energy in France, smart meters in the UK, electric vehicles in Norway and solar energy in Germany) applied in the European context. It was possible to observe the externalities generated by the adoption of these decarbonization policies on the pre-existing structural factors of injustice in the energy markets and in the economy/society in general. This example reveals how the trade-offs of decarbonization policies present themselves in different ways and in different contexts.

The aforementioned initiatives regarding the types of decarbonization policies are some of the most elaborated since the signing of the Kyoto protocol, in which it was

noticeable an increase in the number of actors involved, starting from an individual level to the state level. Bernstein & Hoffman (2018) question how such initiatives, combined with the various actions of actors, especially subnational ones, can contribute to decarbonization, without dispersing activities. For these authors, it is necessary to face decarbonization policies not as a goal, but as a journey.

Regarding the Brazilian case, the implementation of public policies aimed at environmental issues is, in general, a matter of interest to policy makers and, gradually, it became part of government strategies, especially after the Rio-92 Conference. During the UNFCCC COP15, held in 2009, Brazil announced voluntary targets to reduce between 36.1% and 38.9% of the total GHG emissions projected for 2020. This goal was endorsed by Law No. 12,187, which established the National Policy on Climate Change (PNMC) (Brazil, 2009), providing reduction instruments, especially for the three largest emitting sectors in the country: agriculture and deforestation and land change and the energy sector.

Through the PNMC, efforts were focused on equating socioeconomic development with the protection of the climate system, reducing anthropogenic GHG emissions, preserving and conserving environmental resources (with a focus on local biomes), encouraging reforestation of areas that suffered degradation and development of the so-called Brazilian Market for Emission Reduction (MBRE) (Brasil, 2009). In line with these initiatives, oversight bodies such as the National Adaptation Plan (PNA) and the National Emission Registration System (SIRENE) were created (Santos, 2021). When analyzing Brazil's GHG emissions, Santos (2021) identified a significant reduction since the signing of the PNMC, noting, however, important divergences between government data and those from the Climate Observatory.[5]

4. Decarbonise! Rules and Operation

The challenge of limiting global warming to 1.5°C by 2100 would make it possible to achieve many aspects of sustainability, including reducing poverty and inequality. However, with targets nationally determined under the Paris Agreement, achieving such planning seems unlikely (Vick, 2021). Its fulfillment requires a transformative systemic change that leads to the combination of innovative policies, directing financial flows towards low-emission investments. Therefore, it is necessary to

[5] Non-Governmental Organization composed of members of civil society. Available at <https://www.oc.eco.br/> Accessed on September 28, 2021.

stimulate debate and promote discussion around the design of public policies that drive the zero carbon transition of economies.

In order to achieve that, the researchers Veronika Kiss and Klára Hajdu, who carry out studies in the areas of sustainability, domestic energy consumption and issues related to the environment created the game *Decarbonise!*. Both were part of sectors of the European Union on issues related to environmental preservation, seeking to promote new policies aimed at reducing the negative consequences of climate change (Decarbonise, 2021).

Decarbonise![6] is a digital decision-making game-simulation platform that can be downloaded for free from the website. The rules in Portuguese are available in Annex A. The goal is to achieve carbon neutrality in a country by 2050, without negatively influencing important socioeconomic variables such as unemployment and inequality. The game starts in 2020 and has three rounds. Each group needs to choose a climate policy kind for each of the decades (2020, 2030 and 2040).

The game serves the most varied audiences, including educators, policy makers, working in large companies or activists. The groups, which can be composed of different stakeholders, must represent some country (real or fictitious) and choose specific climate policy options in each round. You can choose between three types of policies — Energy Budget Scheme (EBS), the Carbon Tax, and the Green Economy Toolbox — that could potentially achieve decarbonization by 2050 and then make decisions about particular aspects of those policies later. Table 1 presents possible decisions.

Table 01: Group's decision options

Options	Definition and decision
Energy Budget Scheme (EBS)	It is a system of transfer of rights, defined based on the per capita consumption of energy. It is necessary to choose the initial entitlement distribution rule and its pricing.

[6] See <https://www.decarbonisegame.com/play> Accessed May 29, 2021.

Carbon Tax	It consists of a tax that a government imposes on the burning of fossil fuels. You need to decide (i) the amount of tax (price per tonne emitted, which can range from 1 EUR/tCO2e in Mexico, Ukraine or Poland, to 85 EUR/tCO2e in Switzerland and Liechtenstein and 114 EUR/tCO2e in Sweden) and (ii) the revenue distribution mechanism obtained from taxes.
Green Economy Toolbox	It is a list of policy instruments already implemented in several countries, such as renewable energy subsidies, sustainable construction rules, phasing out fossil subsidies, green state funds, among others. It is necessary to decide among various types of instruments, considering the country's budgets restrictions.

Source: Own elaboration (2021), based on the rules of the game.

EBS aims to reduce the consumption of non-renewable energy at national level. This policy is based on an energy rights scheme and establishes a limit on the use of energy with a high carbon content, in which individuals who use less than the allocated amount can sell their excess energy to an issuing agency. Consequently, individuals and businesses that consume more non-renewable energy must pay for the additional expense. Thus, the game requires groups to i. establish an initial percentage to limit the amount of non-renewable energy bonds and that ii. choose between three general energy rights distribution strategies and iii. fix pricing mechanisms to deal with individuals who consume more energy than was allocated.

The general strategies for the distribution of energy rights are per capita distribution based on: the national average of consumption (equal transfers); socioeconomic differences between families (the lowest the income, the greater the amount of rights received) or the level of energy consumption (the less costly it became the greater the rights granting). The six pricing mechanisms are: i) excessive consumption, progressively priced (throughout the year); ii) the previous mechanism plus

price increase, if the annual target exceeded; iii) excessive consumption paid at the end of the year; iv) based on the previous target (an extra tax at the end of the year, if the target is exceeded); v) linear pricing (regardless of the increase or decrease in consumption) and vi) linear pricing with taxation in case of national exceedance (with a final annual payment).

The Carbon Tax is a tax imposed by the government regarding the burning of fossil fuels, that is, the greater the burning of fossil fuels, the higher the price of the carbon tax. Initially, groups need to establish a fee in euros per ton of CO2e (carbon dioxide equivalent). Next, the game offers five scenarios for allocating these revenues that envision a reduction in income tax, financing the energy transition or redistribution to members of society, with some variants between these options[7].

The Green Economy Toolbox consists of a compilation of policy options that players can adopt to reduce their carbon footprint. These choices bring together options such as national awareness campaigns, policies to encourage research and use of renewable energies, among others. Although the game offers nine options of policy instruments that make up the green economy, there is a limit of instruments per round, considering the public budget (4X). In this sense, a fictitious value is assigned to each green economy policy instrument ranging from "-2X" to "3X".

The first instrument of the Green Economy Toolbox is the national public awareness campaign, as a way to encourage changes in people's lifestyles (1X); the second is a national campaign aiming to change business practices towards a carbon neutral economy (1X); the third envisions the corporate tax benefit for research and development for renewable energy and energy efficiency technologies (2X). The fourth is the incubation program for startups to promote innovative energy with technologies with the help of funding and training (1X); the fifth consists of greening state funds to invest in renewable energy companies instead of oil and other fossil energy (0.5X); the sixth is the national building renovation program to increase energy efficiency (3X). The seventh is a state support program for the use of renewable energies, such as solar, wind or geothermal (2X); the eighth is the phasing out of harmful state subsidies for non-

[7] Specifically, the options are: i) the revenue could be used to reduce the income tax, so that neither the state nor the household budget would suffer from the introduction of carbon tax collection; ii) the tax revenue would be partially spent on the energy transition, aiming at adapting less harmful energy policies; iii) the revenue could be fully spent on the energy transition; iv) the revenue could be distributed among society as carbon dividends and v) option iv), but considering the socioeconomic differences, that is, the poorest population would benefit more.

renewable energy (-2X) and, finally, the ninth is support for alternative fuels and gasolines (e.g. biodiesel, bioethanol, fuel cell technology, fuel from hydrogen) (1.5X).

After selecting the policies, at the end of each round, participants can observe the social, economic and environmental impacts on five reference indicators: i) CO2 emissions; ii) the use of land and natural resources; iii) proportion of the population affected by energy poverty; iv) household savings and v) unemployment rate. In each round, the policy scenario chosen by the groups will distinctly affect these five indicators and will serve as a basis for understanding the implications that each policy adopted has on the ultimate goal of decarbonization by 2050 (Decarbonise, 2021).

5. Decarbonise! Practical Experiences

The first experience of application was within Mettrica Lab's members two weeks before class, in order to test the platform. This was a fundamental step and it is recommended that any professor who wishes to implement this activity (or any other that involves a playful dimension, such as games or simulations), does it beforehand on an experimental basis. This step makes it possible to become familiar with the rules, with the game software and allows mapping potential failures.

From this experience, it was possible to identify the need to implement adaptations to the game's-simulation recommendations, given the limitations of time and space, in the context of remote education imposed by the Covid-19 pandemic. We decided not to adopt the proposal of role-play, in which students would represent different stakeholders linked to the climate issue of the country represented. In addition, we adjusted the rules, which were available to the students, who should attend the activity having read the material and with any doubts resolved in order to optimize the time on the day of the activity.

The game-simulation was applied with International Relations students of the Global Environmental Policy (GEP) discipline taught between March and July 2021. This teaching technique was inserted in the course to allow the fulfillment of one of the learning objectives of the program, namely: *to enable the student to elaborate analysis and conjectures on topics in environmental policy*. During the preparation of the Course Plan, a possible gap was observed, it was that students of the Bachelor's Degree in International Relations could not dominate knowledge related to public policies associated with climate change. In this sense, after dividing the course into three modules, that is: i. concepts, theories and methods of GEP; ii. GEP actors and institutions; iii.

themes in GEP. An entire class was designed to address the theme, in the transition from the second to the third part of the course.

This lesson would consist of two activities: a lecture with a public sector representative who would explain concepts related to climate policies and the game *Decarbonize!* At first, the professor had thought of using the game as an evaluation of the class, but, throughout the discipline, this was changed, since it was observed that the students' lack of similarity with the theme of public policies in general, had become a hindrance and a risk in terms of evaluation. The theoretical material and information related to the simulation were made available to the students three weeks in advance so that they could prepare.

The class in question, taught after the third stage of the course, took place after a lecture with a former government representative of the city of Recife/PE, responsible for creating the carbon emissions inventory of the state. The responsible professor and the teaching assistant participated in the simulation, plus eighteen students present in the online class, previously divided into three groups, each representing a fictitious country. There was an initial moment to resolve doubts and the activity lasted 2 hours.

In order that each group could negotiate their decisions, we created three parallel rooms, one for each group. The groups had 10 minutes to discuss each round. At the end of each round and the presentation of the results of the decisions, the teacher conducted the following debriefing questions:

1. What were the best decisions made? Why?

2. What were the worst decisions made? Why?

3. Which aspect of the chosen policy caused the greatest difficulty in your group's decision? Why?

4. What would you do differently in the next round of play?

These moments of discussion were essential for students' reflection and learning on the policies path, for the next application. In the midst of the game, the students started asking for more time for group discussion and debriefing, in order to enable greater deepening discussion of the object.

We highlight each groups' decisions. The groups were Brazil, Vittarlândia and Norway, respectively. We follow the order proposed in the rules of the game, that is, the analysis of decisions in 2020, 2030 and 2040 to understand the results of each group on the indicators for decarbonization until the year 2050.

Round 1: 2020

The first round of decisions consisted in the definition of a climate policy, by each group, in 2020. After the moment of private discussion of the groups, two groups decided for the carbon tax policy, with different tax levels, and one of them opted for the policy of EBS. Table 2 summarizes these decisions.

Table 02: Decisions in 2020

	Climate Decarbonization Policies (2020)					
	EBS			Carbon Tax		Green Economy Toolbox
	Consumption limit	Distribution of rights	Pricing Mechanisms	Carbon tax price fee	Purpose of tax revenue	Options
Brazil	-	-	-	30 EUR	2.5	-
Vitarlândia	-	-	-	250 EUR	2.2	-
Norway	85%	2.2	3.1	-	-	-

Source: Own elaboration (2021). See more of the EBS and Carbon Tax items on Appendix I.

Despite the similarity in policy choice, the group “Brazil” adopted a relatively modest carbon tax ($30 euros), while the group “Vittarlândia” opted for a significant tax ($250 euros). In addition, both policies differ, given that the "Brazil" chose a distribution of revenue considering social differences (2.5), while the "Vittarlândia" preferred to adopt a distribution that considers both the energy transition and the reduction of income tax (2.2). The "Norway" group, on the other hand, decided to establish a limit of 85% for the production of fossil energy, which adopted the strategy of distribution of bonds considering social differences (2.2), based on the progressive pricing instrument throughout the year (3.1).

In the first round, when we announced the groups' decision, there was a certain insecurity and little grounding in the justifications. It is noteworthy that the decisions sought to consider, from the beginning, social aspects in the distribution instruments.

After the results generated by the software in the first round, students visualized the impacts of their decisions, referring to the idea of instantaneous feedback from the literature that addresses games in education. The high carbon tax adopted by "Vittarlândia" had a significant impact on the reduction of GHG, but generated a considerable negative increase in energy poverty rates and household savings (as shown in Graphs 1, 3 and 4). At that moment, it was already possible to identify that the students began to understand how their decisions affected the socioeconomic variables. The possibility of repeated rounds to change the decision, as pointed out by the literature on games in education, proved important as a learning tool for the groups, according to observations until the end of the activity.

Round 2: 2030

After observing the results, we started a new round and groups had to decide on possible changes in policies in 2030. At that moment, the game software announced an external shock: the occurrence of a global economic recession, affecting unemployment rates and shrinking productive sectors. In addition, it also presented the International Advisory Council on Carbon Neutrality (CCINC), an *ad hoc* international organization, which would start to propose recommendations at each new round of the game, including the possibility of stimulating international cooperation in the dimension of decarbonization. In this round, the CCINC suggested the adoption of a global treaty on land use, in view of the worsening of all groups in this indicator. Each group had to consider the impact of their decisions in this crisis, as well as decide whether to sign this treaty. Table 3 summarizes the decisions taken in 2030.

Table 03: Decisions in 2030

2030	Climate Decarbonization Policies						Signatur to the treaty on land use change
	EBS			Carbon Tax		Green Economy Toolbox	
	Comsumption limit	Distribution of rights	Pricing Mechanisms	Carbon tax price fee	Purpose of tax revenue	Options	

Brazil	-	-	-	-	-	1, 4, 5 e 9	Yes
Vittarlândia	20%	2.2	3.4	-	-	-	Yes
Norway	-	-	-	110 EUR	2.2	-	Yes

Source: own elaboration (2021).

At this stage, "Vittarlândia" changed the type of policy, but adopted the same profile of more ambitious actions. This group chose to establish a limit of only 20% of fossil energy use and a distribution of bonds in the EBS market, considering social differences (2.2), from the progressive pricing instrument at the end of the year with an extra amount in case of national overrun (3.4). In turn, the "Norway" group changed to the Carbon Tax policy and adopted a rate of 110 euros, seeking a distribution that considered both the energy transition and the reduction of income tax (2.2). The "Brazil" group decided on the Green Economy Toolbox and chose a series of options, including the (1) national public awareness campaign, (4) startup incubation program to promote innovative energy technologies, (5) greening of state funds and (9) support for alternative fuels and gasolines.

In this new round of discussion, after the definition of policies, we verified a concern among students with social indicators, mainly by the "Vittarlândia" group. The students mentioned the context imposed by the economic recession as a major reason for redefining the trajectory of each group's policies. In addition, all groups opted to sign the treaty on land use change, which resulted in an immediate stabilization of the indicator, according to the projections made by the software, as shown in Graph 2.

Round 3: 2040

In the last round, the context of economic recession remained and the CCINC made a general recommendation regarding supporting most vulnerable groups and the poorest families, in order to guarantee their basic needs without harming the environment, while also warning about the urgent action to avert the global catastrophe. We reinforced it was the last decision-making round and the facilitator again highlighted the imminence of the global decarbonization framework of the economy until 2050.

Again, there were changes in the choice of policies by the groups: "Vittarlândia" decided to switch to the Green Economy Toolbox and "Norway" returned to the EBS

choice. “Brazil”, on the other hand, decided to stick with its choice of the Green Economy Toolbox policy. Table 4 shows the final choice of these policies:

Table 04: Decision in 2040

2040	Climate Decarbonization Policies					
	EBS			Carbon Tax		Green Economy Toolbox
	Consumption limit	Distribution of rights	Pricing Mechanisms	Carbon tax price fee	Purpose of tax revenue	Options
Brazil	-	-	-	-	-	4, 6, 7 e 8
Vittarlândia	-	-	-	-	-	2, 5, 7 e 8
Norway	25%	2.2	3.2	-	-	-

Source: Own elaboration (2021).

This time, however, Brazil adopted different options, such as the (6) national program for the renovation of buildings, to increase energy efficiency; (7) national program for the use of renewable energy and (8) phasing out of national subsidies for non-renewable energy resources. “Vittarlândia” also adopted this policy and, in addition to options 7 and 8 mentioned above, they also chose the (2) national campaign aiming at changes in the practices of companies aiming at a carbon neutral economy and (5) the greening of state funds. "Norway" returned to the EBS policy, but signaling for a lower limit of 25% for the production of fossil energy, in which it also adopted the strategy of distribution of titles considering social differences (2.2), now based on the progressive pricing instrument throughout the year and an extra amount to be paid in case of national overruns (3.2).

In this final round, the groups were aware and confident of the policies adopted and had greater knowledge of some positive and negative impacts on the indicators. Given the limited time, we held a final discussion of the results. Regarding the activity, students reported its usefulness for discussing climate policies in practice, which was

complemented by the lecture with the public manager, previously performed. However, they also highlighted time limitation impaired the quality of their decisions, as well as the limits of doing it online. They also declared it would be better to participate in person of the dynamic, instead of its realization online, due to the pandemic of Covid-19.

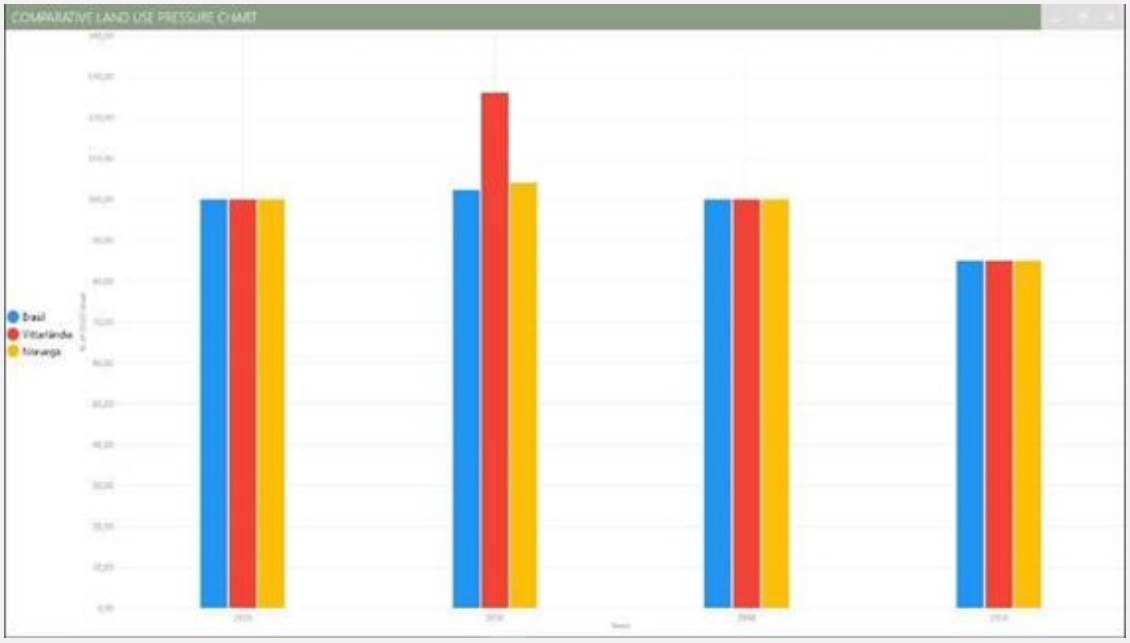
The game software reports the general performance of the groups by each indicator. Figure 1 illustrates the level of per capita emissions of all countries in 2020: 6.97 tons/capita of GHG emissions in 2020. Regarding the results in 2050, only "Vittarlândia" and "Norway" were successful in individual reduction of emissions. This suggests that "Brazil's" decisions were less effective in this central aspect of climate policy, precisely because they only replicated policies and measures widely adopted by other political units, which reinforces the need to implement tougher measures with the goal of achieving decarbonization.

Figure 01: Comparison of the indicator "greenhouse gas emissions" every decade, by group (country)

Source: Decarbonise! Platform (2021).

Regarding the indicator on land use, all groups initially started from a rate of 100% in 2020. Due to the high carbon taxation action of the "Vittarlândia" group in the first round, there was an increase in land use in this country, while the changes were modest in the other groups. Figure 2 illustrates that the signature by all groups of the global treaty proposed by the CCINC contributed to stabilizing the rates of this indicator below 90% in 2050.

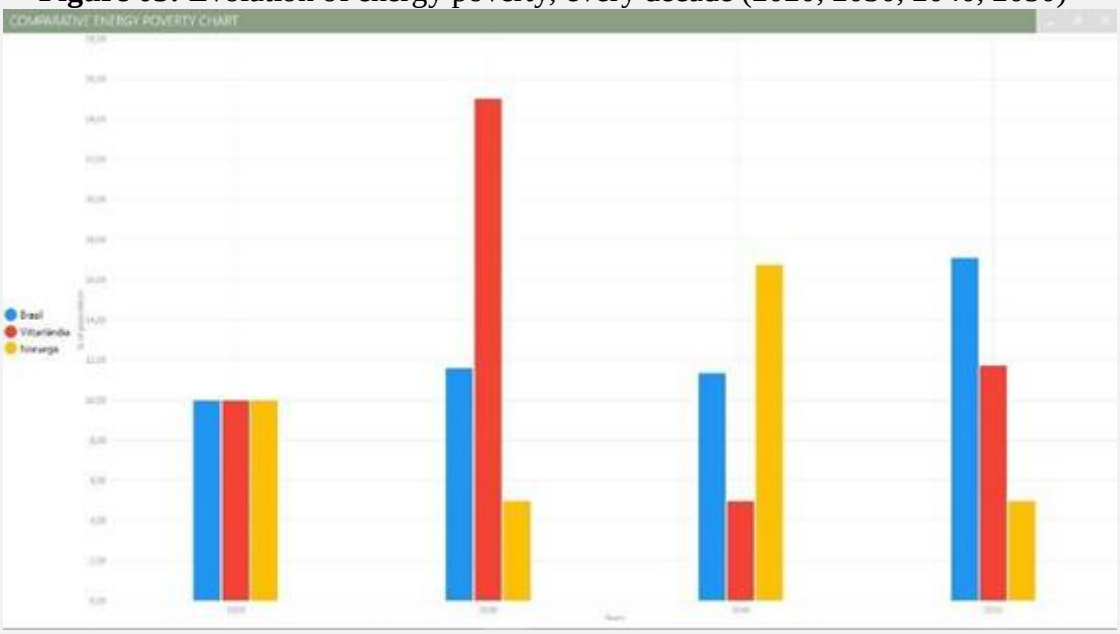
Figure 02: Comparison of percentages by group of the indicator "changes in land use" for each deca



Source: Decarbonise! Platform (2021).

The energy poverty indicator starts at a level of 10% for all groups, and it varied a lot throughout the rounds. Figure 3 indicates a large negative effect on this indicator, from the large carbon tax made by the "Vittarlândia" group in the initial round, while the redistribution action considering the social differences of the "Norway" group had a positive impact on the reduction of energy poverty. At the end of all rounds, "Norway" had greater success in reducing energy poverty.

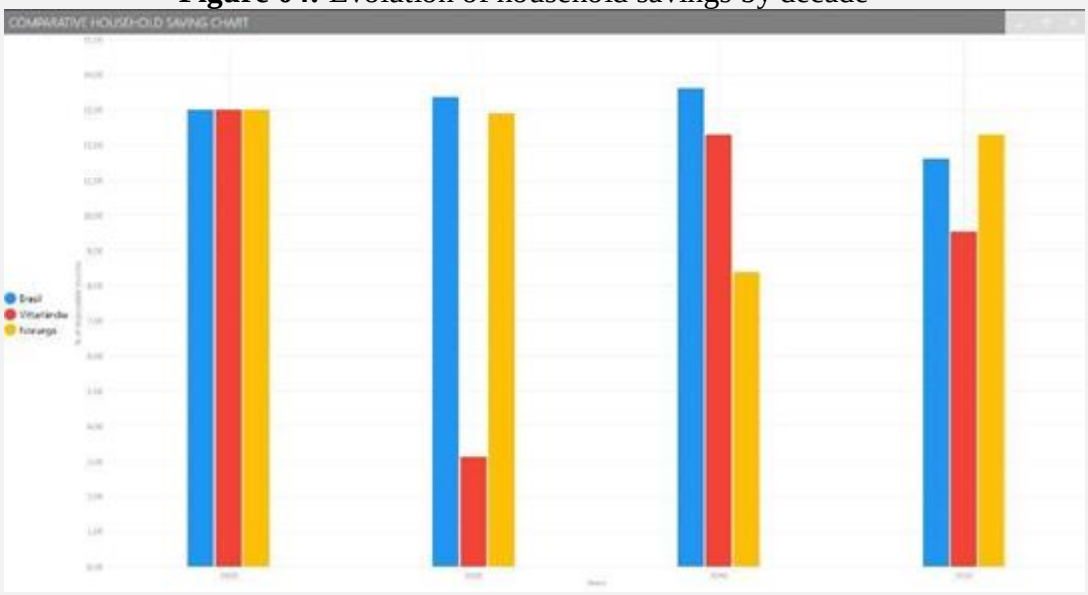
Figure 03: Evolution of energy poverty, every decade (2020, 2030, 2040, 2050)



Source: Decarbonise! Platform (2021).

Similarly, Figure 4 shows the initial negative impact of the high carbon tax decision made by "Vittarlândia", in which initial household savings dropped from 13% to 3%. However, overall, all groups performed well on the indicator. The "Brazil" and "Norway" groups managed to increase the percentage of household savings after all decisions on climate policies.

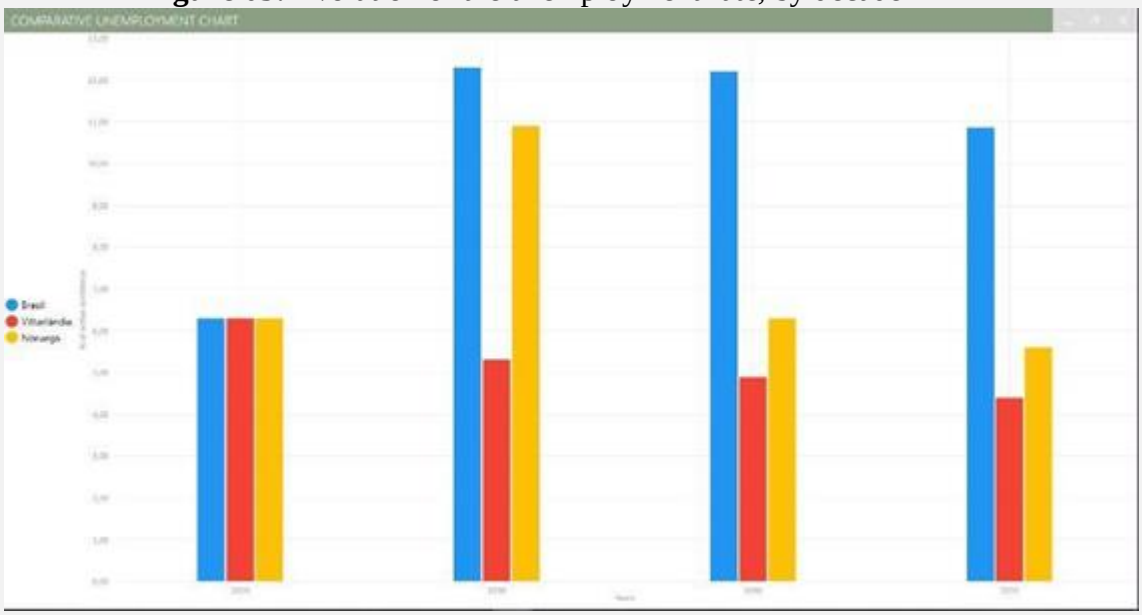
Figure 04: Evolution of household savings by decade



Source: Decarbonise! Platform (2021).

Finally, the indicator on the unemployment rate shows how the "Vittarlândia" group was successful in progressively reducing the issue based on its decisions. On the other hand, the decisions of "Brazil" resulted in an increase in this rate over the 2020 and 2030.

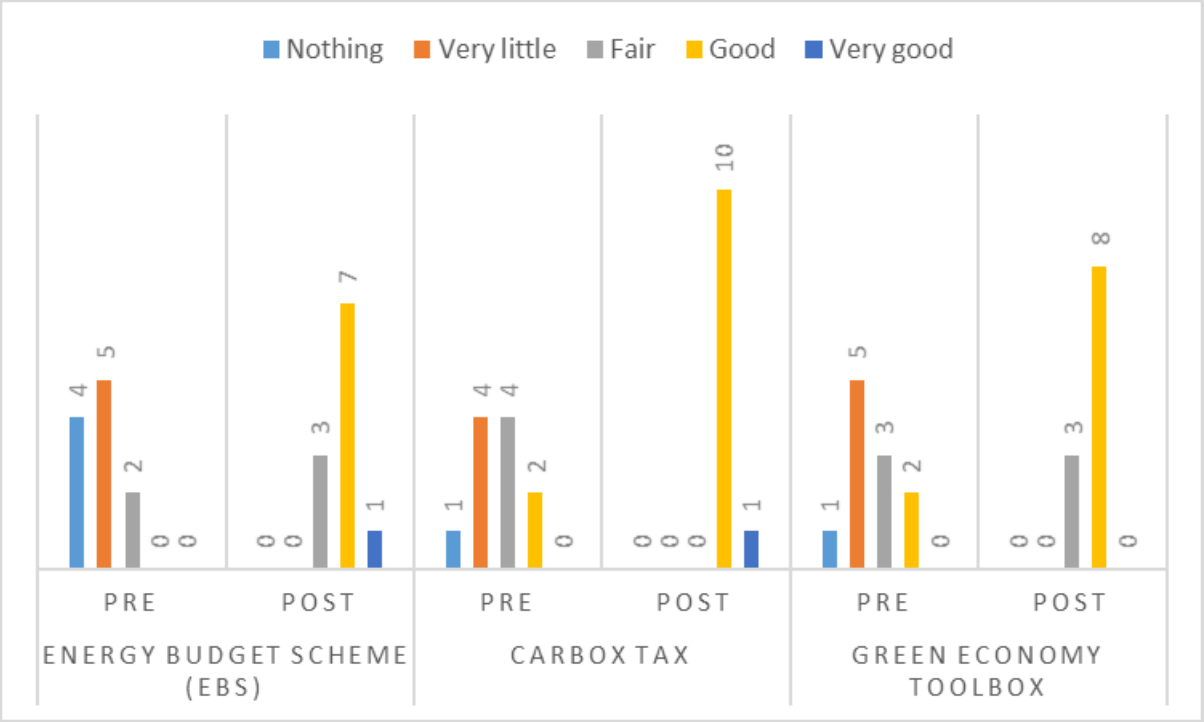
Figure 05: Evolution of the unemployment rate, by decade



Source: Decarbonise! Platform (2021).

At the end of the game-simulation, we surveyed students on their learning self-perception, assessing their previous knowledge on the game topics before and after the experience. We interrogated "What is your prior knowledge of climate decarbonization policies, in your perspective?" to infer whether the students understood the rules of the game and the climate policies they needed to decide. Students answered this question before and after the simulation, in order to assess progress in learning. Figure 6 systematizes the results.

Figure 06: Pre- and post game-simulation students' self-perception about the level of knowledge on climate decarbonization policies

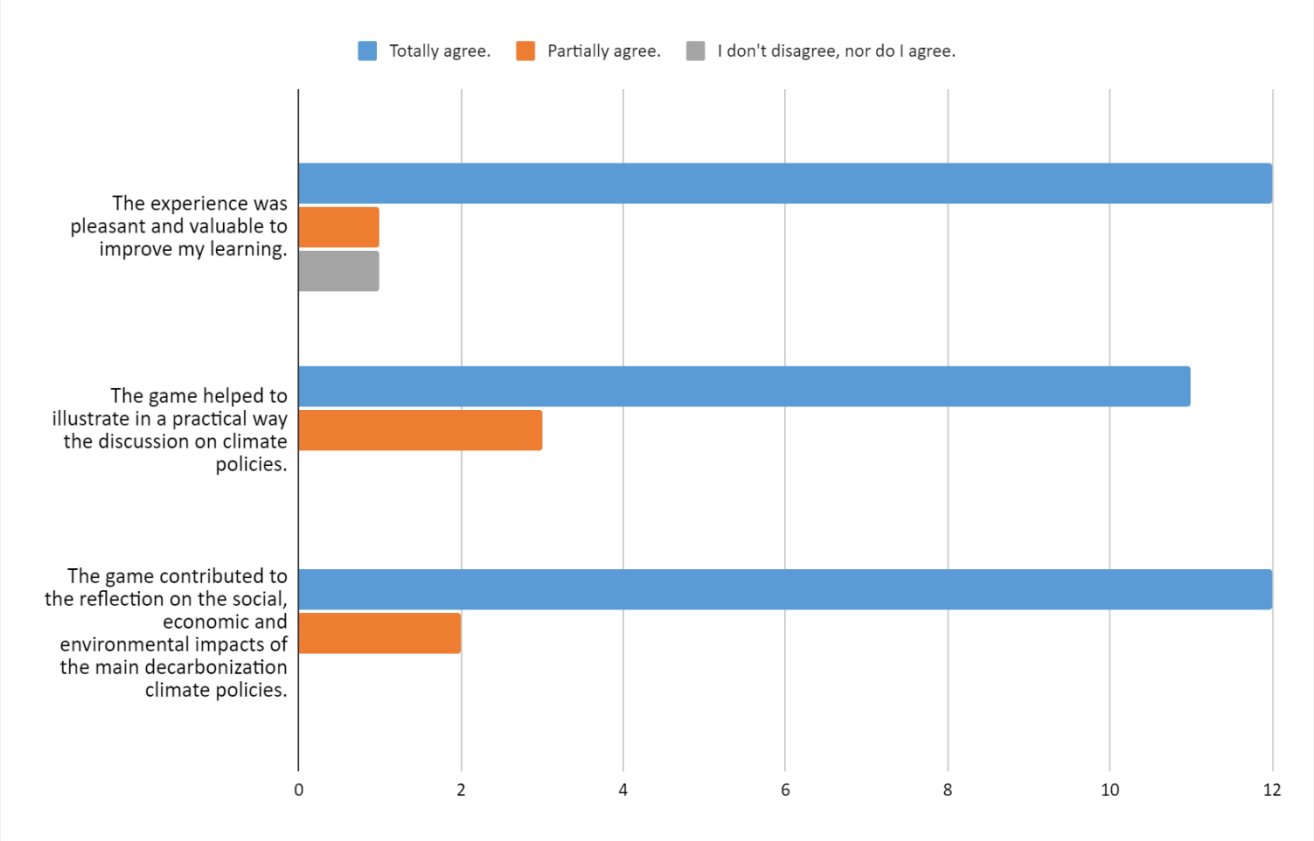


Source: Own elaboration (2021).

Only eleven out of the eighteen students who participated in the game-simulation answered the forms, before and after the simulation, and thus, the comparative analysis of the results was limited to this reduced number of answers. The responses suggest a significant increase in students' understanding of the Energy Budget Scheme and Carbon Tax policies after the experience. In turn, the perception of understanding of the Green Economy Toolbox policy instruments was relatively lower and no one chose the “very good” option.

From the perspective of pedagogical gains, based on students' oral reports and feedback[8], the game-simulation was effective in promoting student engagement in the discussion of climate policies. Feedback was collected in two ways, first, in a form that the students filled out anonymously, as well as in a diary, which the students had to deliver at the end of the course, reporting the knowledge learned during the course. The answers about the game experience are reported in figure 7.

Figure 07: Post-activity student statement about their experience



Source: Own elaboration (2021).

Among the six groups formed, one of the reports caught our attention:

As for the preparation for the dynamics, it must be said that it was affected by the confusing way in which it was explained. The lack of direct and concise guidelines made

[8] As well pointed out by one of the reviewers of this work, it was not the objective of the activity, nor of its report, to test the effectiveness of the dynamics in the teaching-learning process. The present experience reported here fits within the scope of the proposals and results of the present Dossier that it composes, bringing a portrait of the evolution of students' self-perception in relation to the apprehension of theoretical contents (Figure 6, before and after). We did not make a formal assessment around the perception of the dynamics itself, which is a weak point in the application as a whole. However, informally, students reported that the dynamics were very good in the sense of promoting interest in the discipline and in the course as a whole, in a context of great social, economic, health and institutional insecurity, with great potential for negative impacts on teaching (Alves and Ferreira, 2022).

the group confused at many times during planning. As for the day of the dynamics, the group of six students got together in a room at meets alone to be able to reason about the activity. The execution was very interesting, the game itself was very good for understanding the possible environmental policies. The dynamics were very engaging and in fact they fulfilled their pedagogical role.

We observed that, despite the preparation, explanation and availability of the material, in practice, the students only really understood what the game was about on the day of the activity. As in the reports of other colleagues, we perceived that the students said that the activity was 'engaging', further evidence that the students were engaged in the activity since one of the biggest challenges of the remote context was the promotion of engagement. We acknowledged that the proposal of a concrete discussion of a problem of international politics, promoted greater interest and participation.

Another pedagogical gain consisted in learning about the complexity of the climate change problem, involving socioeconomic and environmental dimensions, as well as the different results that different designs of public policies can generate. It was also noted the importance of repetition and the possibility of changes in decisions throughout the rounds as an aspect that reinforced results already identified in the literature on games for teaching. Although the platform does not foresee the interaction between the countries, the repetition of the round over the decades allowed the analysis of the effects of the decisions of the previous period, strengthening the learning process.

6. Final considerations

Teaching strategies through active learning have expanded significantly in the field of International Relations, resulting in the creation of teaching and research laboratories that aim to improve the application of learning methodologies. In order to contribute to this study, the work started with the realization of a *gamification* strategy in an International Relations class at UFPB, through the game *Decarbonise!*

Through a self-assessment instrument filled out by 11 students before and after the game-simulation, we found a consistent increase in public climate policies learning. The results reinforce the benefits of learning through gamification; all respondents declared that they acquired new knowledge on the subject after playing the game. Students reported several positive statements of the activity, in the final survey of the discipline.

Regarding the limitations of the application of the activity, we identified the limited time for debate (10 minutes) and the need for a minimum prior knowledge in the area of public management and public climate policies. We suggest the professor to dedicate one or two entire classes to the activity, foreseeing a theoretical stage with an indication of specific literature on the subject (such as those referenced in the theoretical part of this work).

During the rounds, the difficulty in political choice was notorious. Despite being educational, the game has a certain degree of complexity, requiring time both to internalize the rules (by students and teachers) and to carry out the rounds. This difficulty connects to the lack of perception about public policies, a field of study that is still in its new in IR.

In short, Decarbonise! demonstrated a potential teaching-learning tool for the discussion of environmental governance and which can be adopted in several disciplines transversely, in order to discuss the construction of public policy, for example, providing an environment of stimulating reflection on innovation in institutional designs. The game can be applied in face-to-face classes or in remote learning. Finally, the dynamics also proved to be effective in promoting engagement in remote learning, by making the class more dynamic and open to student participation in order to reflect on new public policy designs.

References

Alves, E. E. C., Silva, A. P. M., & Barbosa, G. G. (2019). A Framework for Active Learning in International Relations: The Case of the Challenge Game. Journal of Political Science Education, 17(1), 123-138.

Alves, E. E. C., & Ferreira, M. A. S. (2022). Teaching in Critical Junctures: Challenges to international relations bachelor's programs in Brazil during the COVID-19 Pandemic. In Pandemic Pedagogy (pp. 19-38). Palgrave Macmillan, Cham.

Asal, V. (2005). Playing games with international relations. International Studies Perspectives, 6(3), 359-373.

Barr, R. B., & Tagg, J. (1995). From teaching to learning—A new paradigm for undergraduate education. Change: The magazine of higher learning, 27(6), 12-26.

Bataille, C., Waisman, H., Colombier, M., Segafredo, L., Williams, J., & Jotzo, F. (2016). The need for national deep decarbonization pathways for effective climate policy. Climate Policy, 16 (sup1), S7-S26.

Bernstein, S., & Hoffmann, M. (2015). The politics of decarbonization: a framework and method. Available at SSRN 2619322.

Bernstein, S., & Hoffmann, M. (2018). The politics of decarbonization and the catalytic impact of subnational climate experiments. Policy Sciences, 51(2), 189-211.

Brasil (2009). Lei nº 12.187, de 29 de dezembro de 2009. Política Nacional sobre Mudança do Clima - PNMC.

Decarbonise (2021) Game Instructions and Background Document for Facilitators. Disponível em <https://www.decarbonisegame.com/downloads> . Acesso em: 27 mai. 2021.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

Figueres, C. (2020). Paris taught me how to do what is necessary to combat climate change. Nature, 577, 470-471.

Fink, L. D. (2013). Creating significant learning experiences: An integrated approach to designing college courses. John Wiley & Sons.

Green, J., Hadden, J., Hale, T., & Mahdavi, P. (2021). Transition, hedge, or resist? Understanding political and economic behavior toward decarbonization in the oil and gas industry. Review of International Political Economy, 1-28.

Hakulinen, L., Auvinen, T., & Korhonen, A. (2013, March). Empirical study on the effect of achievement badges in TRAKLA2 online learning environment. In 2013 Learning and teaching in computing and engineering (pp. 47-54). IEEE.

Huizinga, J. (1938). Homo ludens: proeve fleener bepaling van het spel-element der cultuur. Haarlem: Tjeenk Willink.

Inoue, C. Y. A., & Valença, M. M. (2017). Contribuições do aprendizado ativo ao estudo das Relações Internacionais nas universidades brasileiras. Meridiano 47, 18.

Ishiyama, J. (2013). Frequently used active learning techniques and their impact: A critical review of existing journal literature in the United States. European Political Science, 12(1), 116-126.

Kapp, K. M. (2012). The gamification of learning and instruction: game-based methods and strategies for training and education. John Wiley & Sons.

Lantis, J. S., Kuzma, L. M., & Boehrer, J. (Eds.). (2000). The new international studies classroom: Active teaching, active learning. Lynne Rienner Publishers.

Lee, M., & Shirkey, Z. C. (2017). Going beyond the existing consensus: the use of games in International Relations education. PS: Political Science & Politics, 50(2), 571-575.

Leite, A. C. C., Alves, E. E. C., & Picchi, L. (2020). A cooperação multilateral climática e a promoção da agenda da transição energética no Brasil. Desenvolvimento e Meio Ambiente, 54.

McGonigal, J. (2011). Reality is broken: Why games make us better and how they can change the world. Penguin.

Ministério da Educação. Diretrizes Curriculares Nacionais para o curso de graduação em Relações Internacionais, bacharelado. MEC, CONSELHO NACIONAL DE EDUCAÇÃO CÂMARA DE EDUCAÇÃO SUPERIOR, 2017. Disponível em: http://portal.mec.gov.br/docman/outubro-2017-pdf/73651-rces004-17-pdf/file.

Peñasco, C., Anadón, L. D. & Verdolini, E. (2021). Systematic review of the outcomes and trade-offs of ten types of decarbonization policy instruments. Nature Climate Change, 11, 257-265.

ONU. (2015). Transformando Nosso Mundo: A Agenda 2030 para o Desenvolvimento Sustentável. Nações Unidas, Brasil. Acesso em 30/09/2021. Disponível em https://brasil.un.org/pt-br/91863-agenda-2030-para-o-desenvolvimento-sustentavel

Onuki, J., & Oliveira, A. J. de. (2017). O uso do role-play no ensino de negociações internacionais. Revista De Graduação USP, 2(1), 45-51.

Prince, M. (2004). Does active learning work? A review of the research. Journal of engineering education, 93(3), 223-231.

Reeves, B., & Read, J. L. (2009). Total engagement: How games and virtual worlds are changing the way people work and businesses compete. Harvard Business Press.

Santos, A. de C. dos (2021). Política Nacional sobre mudança do clima no Brasil: uma avaliação de instrumentos e de efetividade. Espaço Público (Revista de Políticas Públicas da UFPE), 6.

Seixas, L., Gomes, A. S., & de Melo Filho, I. J. (2016). Effectiveness of gamification in the engagement of students. Computers in Human Behavior, 58, 48-63.

Sovacool, B. K. et al. (2019). Decarbonization and its discontents: a critical energy justice perspective on four low-carbon transitions. Climatic change, 155, 581-619.

Tozer, L. (2020). Catalyzing political momentum for the effective implementation of decarbonization for urban buildings. Energy Policy, 136.

Vick, M. (2021). Como os países se afastam das metas do Acordo de Paris. Nexo Políticas Públicas. Disponível em: https://pp.nexojornal.com.br/topico/2021/01/15/Como-os-pa%C3%ADses-se-afastam-das-metas-do-Acordo-de-Paris

Viola, E. (2002). O regime internacional de mudança climática e o Brasil. Revista Brasileira de Ciências Sociais, 17, 25-46.