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Mayara Floss, Thais Mauad, Su-Ming Khoo, Paulo Hilário Saldiva Nascimento

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The moderation of this preprint received the endorsement of:

Ylana Rodrigues (ORCID: <https://orcid.org/0000-0003-0776-7792>)

# **Transformative education for medical postgraduates: centring planetary health**

## **Mayara Floss**

Family doctor, PhD candidate University of São Paulo (USP), member of the Institute of Advanced Studies – USP. ORCID: <https://orcid.org/0000-0003-0926-1306>

## **Thais Mauad**

Pathologist, Associate professor University of São Paulo (USP), member of the Institute of Advanced Studies - USP. ORCID: <https://orcid.org/0000-0002-3354-1466>

## **Su-Ming Khoo**

Senior Lecturer (School of Political Science and Sociology), University of Galway: Galway, Galway. ORCID: <https://orcid.org/0000-0001-8346-3913>

## **Paulo Hilário Saldiva Nascimento**

Pathologist, University of São Paulo (USP); member of the Institute of Advanced Studies – USP. ORCID: <https://orcid.org/0000-0003-2005-8253>

## **ABSTRACT**

The purpose of this article is to report, reflect upon and learn from a postgraduate course in Planetary Health. The 195 hours postgraduate course occurred in 2022 and involved 44 students at the Department of Pathology at University of São Paulo in Brazil. The course activities for students were carried out remotely and included self-reflexive, dialogical and creative learning methods. The evaluation was composed of four aspects: participation; poetic memory of encounters; 'plant' or planning a planetary health action; and 'penning'. This study used a qualitative method of thematic analysis to verify three main learning activities: poetic memories, "Plant a planetary health action" and 'Penning'. From the 44 students enrolled, 26 fulfilled the optional formulary given consent to participate in this study. 'Planting' a planetary action was organized in different levels: community, work and research, interpersonal, personal. In the 'penning' analysis, students repeatedly referred to art and future as core to learn about planetary health. This could be induced by the way that the course was structured, but rises to a point of the arts' potential to create awareness and a transformative topic for medical education touching other dimensions of learning like emotions and hope.

### **Keywords:**

Planetary health, Climate change, Arts, Climate action, Medical Education

## INTRODUCTION

The escalating rate of climate change is a sign of rapid changes in the Earth's systems. A "code red" for the planet is also an emergency signal for health professionals, who are on the front line of a complex planetary health crisis (Romanello et al. 2021). The so-called "Anthropocene" or "Plantatinocene" era (Haraway 2015) suggests that humanity has a limited timeline to advocate for and ensure the safeguarding of our planet and equity (Whitmee et al. 2015). Collective action is essential to achieve the dramatic change which will be required to keep global warming within the Paris Agreement challenging ambition of limiting warming to 1.5 degrees Celsius (IPCC 2018). The interdependence and interrelatedness of health and ecosystem is recognised by many parts of society, and especially in many Indigenous and traditional cultures. The questions of how academics are coping and working with the Anthropocene phenomena and how are we preparing students for collapsing worlds from here and now to the future are fundamental to education and mitigation and adaption of the consequences of Climate Change (Carstens 2016).

Planetary Health (PH) is a field that studies (and acts) on the connection between the health of human civilization and the state of the natural systems on which it depends (Whitmee et al. 2015). Health professionals are at a particular advantage to raise awareness of and to educate their patients on the health benefits of planetary health (IPCC 2018). PH education could be one of the keys to answer the "code red" and prepare the healthcare systems and its workforce to deal with climate change and other environmental issues.

There is resistance to the inclusion of PH in medical curricula which reflects the lack of emphasis on environmental health, preventative health and primary health care (Walpole et al. 2017; Walpole et al. 2019). The education of health professionals is progressively incorporating contents of Planetary Health in its curricula, which argues that promotion of human health is intrinsically dependent on the sustainability of the entire Planet (MacKenzie-Shalders et al. 2023; Visser et al. 2024). Higher education (HE) is often the space to transgress (Hooks 2013) frontiers on traditional pedagogy, providing a scenario able to build responses to climate change and global challenges.

This article argues that planetary health is a potentially transformative topic for medical education. It describes and analyzes the course and reports on evaluations of the students' experiences and course outcomes that occurred in 2022 in PH involving 44 students in a 195 hours course at the Department of Pathology at University of São Paulo in Brazil. The article describes the course's aims and format and presents an evaluation of the students' experience and course outcomes.

## MATERIAL AND METHODS

### Context: Course structure

The postgraduate online course "Planetary Health" (MPT5807) was ministered in the Pathology Programme, from 07/04/2022 to 21/07/2022, at the Department of Pathology at University of São Paulo in Brazil. The intention was not only to train, but that could increase awareness of difficult planetary challenges, yet still offer hope and inspire action.

The links between climate change, the planet and human health were presented through 16 weeks from april to july 2022. The course was divided in 14 modules adapted from earlier pilots and experience in MOOCs on Planetary Health (Floss et al. 2021; Floss et al. 2023) and organized with a synchronous class from an invited specialist, and supporting reading materials. There was at least one obligatory reading and from 3-5 complementary and optional readings, students had access to a presentation that linked all materials and information about the week module. The first class had an introduction of the aims and course dynamic where the learning objectives were presented at each class and intended outcomes. Classes lasted 150 minutes weekly on Google Meet. Students had to have an internet connection and were asked to enable the microphone and video on their computers.

For each module (Panel 1) an expert on the topic was invited to give a class and have a discussion with the students, prior to the class the learners had access to the presentation with the links for texts and references. After the expert explanation there was a conversation about the topics. Five modules had a different structure with a seminar presented by the students and experts commenting on it and bringing insights.

**Panel 1. Modules of the course.**

- Introduction to Planetary and Anthropocene Health
- Heat waves and heat-related illnesses
- Climate Change, Air Pollution and Health
- Mental health and planetary health
- Syndemic, food and planetary health
- Infectious Diseases and Planetary Health
- Capitalism, Migrations and Planetary Health
- Natural disasters
- Indigenous Health and Planetary Health
- Bioethics
- Education and planetary health
- Garbage, Waste and Planetary Health
- Presentation of the planetary health actions
- Activism, adaptation, mitigation and regeneration

The assessment was carried out remotely and included self-reflexive, dialogical and creative learning methods, composed of four aspects: Participation; Poetic memory of encounters; 'Planting' a planetary health action; and 'Penning' (Figure 1).

Figure 1. Assessment structure diagram.



Because participation was deemed to be important a threshold of 70% class attendance was set, in order to meet accreditation requirements. The poetic memory of the meeting consisted of an activity at the beginning of each class, where a pair or trio who volunteered previously, welcomed the colleagues and invited speakers with a reflection of an artistic or creative work related to planetary health. The duration of it was 5-10 minutes. The students could choose any manifestation of art made by them or others like poetry, excerpts of literature books, music, painting made by them or others to present and relate to planetary health.

“Planting’ a planetary health action”, was a part of the final assessment where students presented a planetary health action that they have done or committed regarding their personal, community or work. It could be within existing repertoires of personal or professional work in any of the topics discussed, since saving energy to changing food habits, with the aim to show to each other that it is possible to change and suggest changes. ‘Penning’ was a creative reflexive self-assessment activity (Morris, Perry, and Wardle 2021) designed where students wrote a letter to anyone and copied to the professors. The letter could be up to 1000 words on any topic that mobilized or involved the student during the classes.

## **Study design**

This was a qualitative study analyzing the student's activities of the course specially: poetic memories, “Plant’ a planetary health action” and ‘Penning’. A qualitative design was chosen because it allows for exploration of subjective experience (Malterud 2001) and can be particularly interesting on topics where little is known or are still being constructed like planetary health. A thematic analysis was as it is useful to search for common or shared meanings (Kiger and Varpio 2020).

## **Ethical approval**

This study was approved by the Research Ethics Committees of the Grupo Hospitalar Conceição (CEP/GHC) (CAAE 25272619.7.0000.5530). Consent (n=26) was obtained from the participants .

## **Participants**

The course had 44 postgraduate students enrolled, six observers and 38 regular students. Three of the observers withdrew before the course ended and one enrolled student did not participate. Forty students completed the course of which 26 students agreed to participate in this study. As the participation where optional some decided to not answer the consent form or engage in the research.

## **Data collection**

Upon completing the course, learners were asked to answer an evaluation questionnaire of fifteen questions online with demographic data (graduation, post-graduation area, specialization, gender, year of birth, place of work), satisfaction about the course, grading of it, teaching and learning methods evaluation, workload, instructions of the course and free text feedback space for critiques and suggestions. For those students that agreed to participate in the study, all the content of the course activities were collected: poetic memories, “Planting’ a planetary health action” and ‘Penning’ a letter.

## **Data analysis**

A descriptive analysis was carried through the online evaluation questionnaire (n=26) using Excel software. The analysis of the students' poetic memories was grouped in four main themes: three genres (literature, music and visual arts) and examples of change.

Separate thematic analyses were conducted on the 'Planting' and 'Penning' assignments. All the analysis and coding process had two rounds and used the MAXQDA 22 software.

The findings of “‘Planting’ a planetary health action” were organized into four different levels or areas of actions: community, work and research, interpersonal (relationships) and individual or personal actions. A diagram was designed to facilitate the communication of the findings.

For the ‘Penning’ activity the first themes were deductively determined (narrowing down) for the first stage of coding based on the Planetary Health Framework (Guzmán et al. 2021) which include: Interconnection with Nature; The anthropocene and health Systems thinking and complexity; Equity and Justice; Movement building. The contexts of the Planetary Health Framework were also included as themes for this analysis are: Local socioeconomic, cultural environmental conditions; Global and local agenda priorities and Anthropogenic changes at planetary scale. Two more inductive themes (generalizing on the basis of the data) were created at a second stage of coding to complement the analysis: future and arts.

## RESULTS

### Participants’ profile

The postgraduations participants that participated on this research mostly were more women (76,92%; n=20), from 30-<50 (84,62%; n=22) years old and mainly from graduation Medicine background (80,77%; n=21) however other graduations not directly related to health participated like Social Sciences (n=1) and Pedagogy (n=1); residency and postgraduation training where more from Rheumatology (17,86%; n=5) and Family Medicine (17,86%; n=5) and most of participants resides in the state São Paulo (76,92%; n=20).

Table 1: Distribution of participants characteristics in the study (n=26).

Variable	Category	N	%
Gender	Cis Man	6	23,08
	Cis Woman	20	76,92
Age (years)	≤29	1	3,85
	30 –< 50	22	84,62
	≥ 50	3	11,54
Graduation course	Medicine	21	80,77
	Biomedicine	1	3,85
	Social Sciences	1	3,85
	Veterinary	1	3,85
	Pharmacy	1	3,85
	Pedagogy	1	3,85
Postgraduation (specialization)* *Some have more than one specialization	Cardiology	1	3,57
	Clinical analysis	1	3,57
	Cosmopolitics	1	3,57
	Endocrinology	1	3,57
	Family Medicine	5	17,86
	Health Management and Economics	1	3,57
	Hematology	1	3,57
	Nefrology	2	7,14
	Neurology	1	3,57
	Neurosurgery	2	7,14
	Occupational Medicine	1	3,57
	Orthopedics	1	3,57
	Pathology	2	7,14
	Pediatrics	2	7,14
	Psychopedagogy, Gerontology and Elderly Health	1	3,57
	Rheumatology	5	17,86
	State of residency	São Paulo	20
Pará		1	3,85

Mato Grosso do Sul	1	3,85
Rio Grande do Sul	1	3,85
Rio de Janeiro	1	3,85
Bahia	1	3,85
Amazonas	1	3,85

### Participants feedback on course satisfaction

Table 2: Participants Feedback on course satisfaction n=26)

Questions	Answers
From 0-10 what grade do you give for the course?	Average grade was 9,8
Course satisfaction (very satisfied, satisfied, indifferent, dissatisfied or very dissatisfied)	25 answered very satisfied and one as satisfied
Teaching and learning methods (excellent, good, fair, poor, very bad)	25 as excellent and 1 as good
Course workload (sufficient, insufficient and excessive)	24 as sufficient and 2 as insufficient

In the free text feedback space, critiques or comments referred to it as a “great experience” or “the most different subject that I have ever done”. Postgraduate students recommended offering it again to post-graduation and also to undergrad students, one participant mentioned that after the course they want to enroll in a PhD on Planetary Health. It also suggested more classes on environmental legislation and international agreements. Finally, there was a suggestion to create a study group on the theme.

### Poetic Memories

The poetic memories (n=29) proposed to work with the dimension of “connecting with nature” of the Planetary Health Framework through art expressions (Table 3). They were presented in the beginning and/or the end of the class through 5-10 minutes. Some students decided to create their poetic memories while others decided to present diverse artistic manifestations. Where analyzed and classified 29 poetic. The poetic memories were classified as examples of change (sub-classified in: Circular Economy, News, Podcast and Talks), literature (sub-classified in: Excerpts/Books, Poetry and Short Story), music (subclassified in: Latin American songs and Brazilian Popular Music) and visual arts (sub-classified in: Cinema, Cartoons and Painting).

Table 3: Classification of poetic memories and examples presented by students. When available links were added to the examples. Some students presented more than one poetic memory.

Themes	Codes	Examples - Summary
<b>Examples of change</b>	Circular Economy	Circular economy examples " <a href="#">Poetika</a> " and " <a href="#">Verdes Marias</a> ".
	News	<a href="#">Children distributing flowers in São Paulo.</a>
	Podcast	A children telling story program " <a href="#">Contos da Capivara</a> " for change about residues, water, recycling and revolutionary habits.
	Talks	<a href="#">TED talk</a> of the historian Rutger Bregman, sharing his defense of a ,provocative idea: the guaranteed minimum income.
<b>Literature</b>	Excerpts and Books	Excerpt from the book “Quarta do despejo” by Carolina Maria de Jesus written in 1959-1959. It presents environmental racism and other inequities: poverty, garbage, city and favelas. It mentions snail disease (schistosomiasis) and lack of access to healthcare. English proverb "There are those who pass through a forest and only see wood for the fire". <a href="#">Text by Eduardo Galeano</a> about the right to the delirium, the right to dream.
		Chapter by Graciliano Ramos from the book "Vidas Secas" (1938). The student read the scene where due to hunger, famine and other difficulties the dog owner had to kill his pet because he could not feed it and deal with its hunger.

		Excerpt by Guimarães Rosa from the book "Sagarana" (1946) where the author describes the mosquito and malaria: "The female mosquito does not sting by day; She is sleeping with her stinger full of menace".
		Excerpt by Dee Brown from the book "Bury My Heart at Wounded Knee" (1970) about the price paid by the environment and indigenous people for 'civilizing' processes.
Poetry		<a href="#">Poem</a> by Matilde Rosa Araújo from the book "As fadas verdes" (2015) about trees that were cut and the poet asks "who can wipe away the weary earth's tears?"
		<a href="#">Poem</a> by João de Jesus Paes Loureiro "Receita Marginal" about youth and "future", but a torn future "better not to bloom".
		<a href="#">Poem</a> from Unknown about flowers and beauty.
Short Story		Student poem that criticizes capitalism and talks about protecting Earth
		A student fictional text about the future and a time capsule of the future. It mentions the Greta Thunberg phrase from her speech indicting world leaders at the UN Climate conference in 2019: "how dare you?" and reflects that it is the announcement of a tragedy.
<b>Music</b>	Latin American songs	<a href="#">Song</a> by Violeta Parra interpreted by Mercedes Sosa "Me gustan los estudiantes" about students and hope. It talks about: the voice of the voiceless.
	Brazilian Popular Music	<a href="#">Song</a> by Ney Matogrosso "Rosa de Hiroshima" about the atomic bombs
		<a href="#">Song</a> by Raul Seixas interpreted by Ney Matogrosso "Metamorfose ambulante" about being an ambulant metamorphosis and about changing old opinions.
		<a href="#">Song</a> by Antonio Carlos Jobim and Chico Buarque "Sabiá" about a bird and reflecting on coming back home.
		<a href="#">Song</a> by Fagner "Somos todos índios" about everybody being indigenous.
<b>Visual Arts</b>	Cinema	Documentary <a href="#">Cowspiracy</a> (2014) produced and directed by Kip Andersen and Keegan Kuhn that explores the impact of animal agriculture on the environment—examining such environmental concerns as climate change, water use, deforestation, and ocean dead zones.
		Animation <a href="#">The story of Solutions</a> about "changing the game". It shows how we can move our economy in a more sustainable and just direction, starting with orienting ourselves toward a new goal. About scheduled obsolescence.
		Mad Max (2015) movie scene about a post-apocalyptic world and people desperate with hunger and thirst.
		Video created by the student of his feet walking in the forest about cosmopolitan, estetic, ecology and (des)humanization.
	Cartoon	<a href="#">Cartoon</a> by Pedro Molina with a man and a child, the man says that the "weather is crazy" and the child answers "the weather.." referring to factories and cut trees.
		Cartoon by Sb Shovan of a child planting a tree in front of a factory. The child is using a mask with an oxygen tube on its back.
	Painting	<a href="#">Painting</a> by August Levin von Wille of Barmen, seen from the Ehrenberg (1870) showing a and its factories and smoke.
		<a href="#">Painting</a> by Candido Portinari "Retirantes" (1944) that portraits hungry and famine.

## 'Planting' a planetary health action

Most participants have proposed in the action plan more than one action. In total 26 action plans were analyzed and 143 segments were coded and grouped by themes. We organized them in a diagram with different action levels: community, work and research, interpersonal, personal. The actions were grouped in themes at the framework and key directions of the action plans (Figure 2).

We also found that for those participants that are parenting tend to involve actions with their children. Partners' opposition to changes like reducing meat consumption and composting were presented in the action plan as barriers for interpersonal actions.

Figure 2. Action plan diagram.

**Community actions** ▶ traditional quilombola\* and indigenous, schools, neighborhood

- Waste management: start sorting and recycling.
- Vegetable garden and seeding: planting vegetable and medicinal gardens; planting trees.
- Sanitation and water management: home renovations of people in need and bathroom constructions, organization of meetings to discuss sanitation and water management.
- Education: learning with indigenous and quilombola communities, lectures and meetings to discuss climate change and planetary health.

**Work and research actions** ▶ hospitals, clinics, primary care, laboratory (analysis and research)

- Waste management: especially reducing the use of paper and plastic, example of more use electronic medical record and avoid printing; stop capsulated coffee and avoid use of plastic glasses; reducing environmental hazardous substances on research; waste sorting and recycling; proper disposal of batteries; reuse or recycling of materials like electrodes; plastic to wood tongue depressor change.
- Water management: reuse of dialysis water;
- Sustainability: Active Transportation, prescription of nature connection.
- Energy management: looking for sustainable resources; changing to more sustainable lamps; turning off lights.

**Interpersonal actions** ▶ family, partners, children, friends, pets

- Waste management: reducing the use of paper and plastic, avoid plastic use; waste sorting and recycling, composting; change of disposable to washable urine dog mats;
- Vegetable garden and seeding: planting vegetable gardens and trees.
- Circular economy: reduce consumption of delivery food; thrift stores and clothes donation.
- Water management: change of home toilet drain.
- Energy management: changing home lamps to a more sustainable option, turning off lights.
- Food: reduce or stop meat consumption; adopt one day without meat.

**Personal actions** ▶ knowledge, skills, behaviour

- Waste management: especially reducing the use of paper and plastic, reducing consumption of plastic.
- Water management: reducing time of baths.
- Energy management: turning off lights.
- Food: reduce or stop meat consumption; start the use of vegan products.

\*\*"Quilombola" are rural black communities formed since slavery with resistance and a deep relationship with its territories (Maria Da Silva and Souza 2022).

## 'Penning'

In total 27 letters were analyzed and 180 segments were coded, 26 students wrote one letter, and one student wrote two. The recipient of the letter was also coded and organized by frequency (Table 4), in total 30 recipients were identified as some letters were addressed to more than one recipient. The 'Penning' recipients themes involved generations, nature, family and friends, time capsules, public agencies, politicians, course professors and colleagues.

Table 4. Letter recipients analysis with themes and examples. In total 30 recipients were identified.

Recipient themes	Example
Course professors and colleagues (5)	Professors (4) Colleagues (1)
Generations - future and past (4)	Survivors (1) Future (2) Past - someone in the 1920 (1)
Politicians (4)	Senators and deputies (1) Municipal Councils (1) President (2)
Family and Friends (3)	Good-daughter (1) Grandfather that died recently (1) Friends (1)
Public Agencies (3)	Basic Sanitation Company of the State of São Paulo (1) Environmental Company of the State of São Paulo (1) President of the Amazon Council (1)
Nature (2)	Tree (1) Earth Planet (1)
Time capsule (2)	To the student in the future (2)

<b>Others (7)</b>	Prayer (1) To the End of the World (or the fall of the sky) (1) To all the human beings who still don't care (1) School teachers (1) Rap composer and singer Emicida (Leandro) (1) Ombudsman of the biggest Brazilian Journal - Folha de são Paulo (1) Brazilian Youth (1)
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The letter content was analyzed and segments were coded and organized as deductive and inductive themes (Table 5). Deductive themes were identified with reference to the Planetary Health Framework from Gusmán (2021). We decided in a second coding analysis to add to the themes two new domains: future which was constantly referred to as an important dimension and arts also as a construction of awareness and emotions.

The practical experience of planetary health education demands us to understand the interdependent and interconnected nature of each domain, in this sense the division of the domains is artificial and only for study purposes to summarize our findings.

Table 5. Summary of findings of ‘Penning’ activity analysis with deductive themes from Planetary Health Framework (GUZMÁN et al., 2021) and inductive new themes.

	<b>Themes</b>	<b>Definition</b>	<b>Summary of findings</b>
<b>Deductive themes from Planetary Health Framework (GUZMÁN et al., 2021)</b>	<b>Interconnection with Nature</b>	Interconnection within nature is an approach in which the cognitive (the sense of connection), the affective (the caring component), and the behavioral (the commitment to act) are integrated when designing transformative educational strategies. Co-benefits of education of indigenous and western education. Also the knowledge of spiritual traditions, especially those of Indigenous peoples that teach of the deep interconnectedness within nature.	Indigenous and other traditional learnings Happiness of learning Decelerate society (more attention, connection, harmony) Work as a way to connect with nature Humanity as part of nature and not apart of it Commitment with Earth Perspective change leading to attitude changes
	<b>The anthropocene and health</b>	Understanding of how specific anthropogenic impacts on Earth's natural systems are connected to health outcomes. Understanding the links between the anthropocene and health requires a social and ecological approach to health promotion and disease prevention and control, ranging from individual to population-level determinants of human, animal, and ecosystem health. This domain also focuses on understanding the underlying and mediating factors that enhance or lessen health outcomes, which relate to learning in the fourth domain, equity and justice.	Distress or ecoanxiety "too much to do and too few time" Climate change is not alarmism Worry about the future, a bad planet for new generations. Understanding that climate change is an actual problem (not a future one) Imagination of healthcare on the future with like heat stress, infectious diseases and air pollution consequences Media communication Individual changes as a way to connecting with nature and reducing footprint
	<b>Systems thinking and complexity</b>	To characterize the linkages between environmental changes and human health at different geospatial and temporal scales as part of complex systems. Doing so requires systems-based understandings that incorporate characteristics of complex adaptive systems. Within this domain, learners work towards self-awareness to acknowledge their own biases and epistemological groundings.	Media communication as a key driver to develop systems thinking Connection between economical, social, political and beliefs systems Post-pandemic world The need to overcome the medical thinking of isolated factors

<b>Equity and Justice</b>	Realizing equity and justice requires eliminating systemic disparities so that no population carries disproportionate burdens of environmental and health impacts while others are able to thrive. Education processes must acknowledge the structural inequities and how historical and political injustices, including settler-colonialism, white supremacy, racism, patriarchy, and capitalism or neoliberalism, have contributed to the disenfranchisement of populations and a degraded environment. Future planetary health practitioners of the field must be able to rebuild the institutions (eg, laws, health care, and education) that promote and reproduce inequities and shape planetary living conditions.	Responsibility (individual, communitarian, national, economical) Awareness and consciousness Rational use of medications, prescription of nature, change on determinants Transdisciplinarity of gaps to dealing with our time challenges Indigenous knowledge and acknowledge
<b>Movement building</b>	Action through relationships, thoughtful strategy, effective communication, and transformational partnerships. So learners and future professionals can build effective movements to support systems change and the great transition to a just future. Mentorship, solidarity, and the development of concrete skill sets help to reduce apathy, increase engagement, and create much-needed momentum for change.	Economical alternatives Local changes Media communication Address negationism Capacity to change Post-pandemic momentum Recognition of those that are teaching and activist of planetary health
<b>Local socioeconomic, cultural environmental conditions</b>	Level of actions and examples. Also vectors of possible fields of change and actions.	Generation compromise (elderly and youngs) Personal and small changes as a start Schools and children education Micropolitics National Brazilian Government Entities crossed by climate change and turning laws into action Tourism Local actions at level of cities, factories, and community responsibilities Individual changes "getting out of the comfort zone"
<b>Global and local agenda priorities</b>	The agenda is a plan of action for people and the plane, including its priorities pointed by the participants.	Amazon and biodiversity Urgency of economical changes Economical alternatives to capitalism, impossibility to sustain economic growth as it is. Economical boundaries as planetary boundaries
<b>Inductive new Future themes</b>	Future includes thoughts on hope and urgency as a learning tool. Also as a path for awareness.	Compromise with future Work as a way to conserve nature Generation responsibility (ambiguity between the burden for new generations and also hope) Hope on democracy and political decisions.
<b>Arts</b>	Art as a tool of learning and for connecting the domains. A possible connector between the learner and the topic.	Arts perspective and affection Possibility of arts as a way to connect with nature and with humans

## DISCUSSION

### Poetics, 'Planting', participation and 'Penning': the idea of Planetary(ies) health(s)

More information or scientific research in the field of planetary health and climate change did not involved or connected people to understand the urgency of this “wicked problem” (Hulme 2009). The translation of evidence into practice is not spontaneous but requires effort, in this sense the field of implementation science has gained more space since 2006 to fill the gaps between scientific research and interventions (Bauer et al. 2015; Wilson and Kislov 2022). In this context, health professionals can facilitate the translation of this evidence and if well trained can help to adapt to the urgent needs of climate change. The majority of students enrolled on the course were health professionals.

The transformative education introduces the need to reorient the education systems to (UNESCO 2021, 1): “equip learners with the knowledge, values, and abilities to act for the betterment of all people and the planet, as responsible citizens of a global community”. The need to create literacy for understanding (Stengers 2023) planetary health is urgent. Ecopedagogy, according to Kahn (2008), is a way to educate about the liberation for animals, nature and oppressed people. There was a worry by the course professors to not provoke climate anxiety that the structure of the course incorporates action plans to help the students to deal with possible emotional responses (Brosch 2021) to the information.

In this course context, it is important to recall where the term “planetary health” comes from. Planetary Health was first used by the Rockefeller Foundation and it should be approached critically, so it does not itself become a colonizing concept. This “decolonizing perspective” is necessary to acknowledge the historical, economic, cultural, and ideological impact of colonialism and to seek to deconstruct unjust colonial ideologies and social arrangements including racism and Eurocentrism (Floss et al. 2021). Care must be taken not to create an “intellectual monoculture” and repeat patterns of colonization (Shiva 2003), reflecting on the expansion of an idea of one planetary health to planetary(ies) health(s). Latour (2018) makes us reflect on the terrestrial nature of humanity, of belonging to the Earth. This memory also speaks to the etymology of the word “humans” which contains humus, or Earth (Latour 2018). A reminder of our humanity and “uniformity” is absurd and detaches ourselves from earth, as the Brazilian indigenous leadership Krenak (2019, 12) said: “The idea of us, humans, detaching ourselves from the earth, living in a civilizational abstraction, is absurd. It suppresses diversity, denies the plurality of forms of life, existence and habits. Offer the same menu, the same costumes and, if possible, the same language to everyone.”

It is urgent to re-imagine our relationship with the earth or “earthpneutics” (Milonopoulos 2023). This post-graduation course in a Latin American context, is an exercise of the deviation from the North-South to South-North route. At the course the students had the opportunity to have a class proffered by an indigenous scientist this could have sensitized the students for the need of learning with them and appeared on 'Penning' and community actions. The course four P's ('Planting'/planning, participation, poetic memories and 'Penning') organization avoided the “banking” education which presupposes the act of depositing knowledge for students to just receive, memorize and repeat, archiving knowledge (Freire 2017).

The necessity of a paradigm change for education involves changes in the way we think, write and speak (Hooks 2013). In the 'Penning' activity, students repeatedly referred to art as core to learn about planetary health. This could be induced by the way that the course was structured with the poetic memories, but rises as a point to create awareness and touch other dimensions of learning like emotions. Art appeared as a way to connect childhood with memories of nature connection, it also created connections between admired singers, poets, painters, etc. Even the need to communicate with artists about the learning. Art possibly also adds a dimension correlated with nature connection that is emotions and even love. In this sense, not only education, but also the arts and humanity can play an important role in implementing science and breaking down the social and cultural worldviews or fissures that

filter information about climate change and separate the public from the reality of change (Corbett and Clark 2017). Emotional engagement through art can “tweak” people’s engagement and risk perception and be part of implementing this evidence personally and students practice (Corbett and Clark 2017).

The political context where the course was developed during the far-right populist ex-president Bolsonaro in Brazil where students and professors were facing an erosion of environmental governance (Sedrez 2022) and also other backlashes such as misinformation during Covid-19 pandemic. The adverse context could have collaborated with the need to communicate with political instances in the students' letters. It also referred to the need for information, communication and even that they are afraid of negationism.

Participants have outlined action plans at different levels, but predominantly on interpersonal actions. Family, parenting and a generation connection (past and future) showed as a possible drive for action. Waste and water management appeared consistently in all levels on the action plan framework, possibly it is a way to start discussions about planetary health. For interpersonal and personal actions to reduce or stop meat consumption and energy management and commitment like “turn off lights” were behavior commitments. The plans were a way to induce behavior change but the students were not re-evaluated to check if those changes were sustained.

Maybe Planetary Health is 'transformative' in being able to learn from communities at the front line - learning makes health communication bi-directional, which is helpful since indigenous and minority cultures have maintained a strong understanding of the interrelatedness and interdependence of health and the ecosystem, treating these as whole. Art's perspective could unlock both sides of the door on education and planetary health, reciprocally empower other languages to communicate, including traditional and indigenous communities as the course done in one of its modules, and to reconnect humans to Earth.

The proposal of a transformative and even transgressive education in medicine on Planetary Health added two new domains (Hooks 2013) in the 'Penning' analysis: art and future. Certainly, the provocation of art as it was one of the pillars of the course led to the addition of it as a tool of learning and connecting the domains. Future could also be a new domain for planetary health education as it includes thoughts on hope and urgency as a learning tool. The need of this hope as the future is ancestral and connects us back with nature, Earth and post-colonial thinking.

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The authors report no conflict of interest

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Mayara Floss: Conceptualization, Methodology, Data collecting and analysis, Writing Original Draft preparation, Writing - Review & Editing, Visualization; Su-Ming Khoo: Original Draft preparation, Writing - Review & Editing. Thais Mauad: Writing - Review & Editing, Resources. Paulo Hilário Saldiva Nascimento: Writing - Review & Editing, Supervision, Resources.

### **Research data availability statement**

The entire dataset supporting the results of this study was published in the article itself.

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