

Reflections on educational leadership for sustainability: a Brazilian case study

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Abstract

Large-scale socio-environmental education to foster a culture of sustainability and transform degrading situations is considered a matter of worldwide urgency. Considering this, we present and discuss results from a thesis that investigated the potentials and challenges of a participatory methodology, capillarity architecture, to educate sustainability leaders used on a socio-environmental training programme for public servants from a Brazilian Higher Education Institution. Capillarity architecture, launched by the Brazilian Federal Government in 2005, is a methodological strategy that encompasses participatory action research and collective networks of educators for training in an exponential format. The participants in the process undergo training while developing educational practices for their university peers. The overall study included 2500 individuals, who were assigned to one of 160 learning collectives in seven university campuses. The research method includes a participatory-research approach, a focus group, participant observation and discursive textual analysis of process documents. The results are discussed considering two points: (1) Impacts of capillarity architecture on the university experience and; (2) Challenges and tensions between the commitment to leadership formation on a large scale and the search for emancipation in EE. It can be concluded that even considering the permanent risk of impairing quality in exponential Environmental Education training, capillarity (in its critical principles) allows for: gains in autonomy, critical reflection, exchanging experiences and repertoires within the university, educating new leaders, in addition to the concomitant engagement of a larger audience. The results of this project also provide us with evidence that leadership formation in sustainability is influenced by the access or not of the participants and coordinators to material conditions (budget, infrastructure, personnel). The relevance of promoting concrete investments in environmental education and training towards sustainability is indicated, so that large-scale training can take place in territories that have significant social inequalities. Capillarity architecture questions the traditional format of organisational training. It provides for the exchange of experiences among its participants, elaboration and development of courses in the socio-environmental area in a collective way, based on problems and social relations of the local territory. These are fundamental aspects when we think about leadership formation on a large scale in broad policies, which involve different cultures and diverse socioeconomic conditions worldwide.

Keywords Emancipation · Capillarity · Sustainability · Critical environmental education · Leadership formation

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1 Introduction

There is a general consensus, even considering so many social inequalities and plurality of views, to recognise the need for socio-environmental education of as many people as possible to transform degrading situations in life and in the world [23, 31, 34, 43].

Nowadays, environmentalisation is required in all sectors of society, including universities. As public assets, they play a central role in the development of critical thinking and in incorporating the issue of sustainability in all their educational processes, in the initial training of students, undergraduate courses, research, extension and management [4, 5, 44].

Numerous relevant experiences related to environmental education developed in Brazilian universities can be identified [40, 41], highlighting the collective experiences of educating local socio-environmental sustainability agents [32], from the ACES Network, to promote university environmentalisation among 11 partner institutions, including some from Iberoamerica [41] and the University Network of Environmental Education Programs/RUPEA [14].

Various institutional initiatives in Environmental Education (EE) are recognized in Brazil [43], but warn of their specific and sporadic characteristics, limiting their impact on the community and changing university management, research, extension and teaching. Another study [9] also present an overview of environmentalisation in Brazilian universities, agreeing that initiatives are, in general, specific, and do not have a regulated and policy-oriented institutional articulation.

Thus, there is still no institutionalisation of the environmental issue in different organisations "considering the profound political transformations demanded by environmentalism". On the contrary, there is "fragility of the broader, cultural, societal and structural discussion on the topic" ([14], p. 264) and prevalence of disseminating norms and campaigns that hold individuals accountable and blame them and their choices concerning environmental degradation. This resistance by universities to move forward with the environmental agenda within "their own home" is also related, in the author's view, to material and technological progress, to human domination and utilitarianism over nature. Moreover, the environmental issue, which requires another relationship with nature and rethinking the production system, "goes against the tide" [14].

According to two other surveys [4, 5], few Brazilian Higher Education Institutions (HEIs) present environmental policies and sectors responsible for the environmental area. The authors conclude that projects related to environmentalisation of campus management are still more common than structural changes in courses; curriculum transformations or teachers' pedagogical practices. They also identify a multiplicity of factors and reasons that prevent or hinder the development of sustainability culture in HEIs. Among them are the following: individual and collective resistance to sustainable actions, lack of interdisciplinarity between courses, non-integrated data systems that make it difficult to obtain information concerning teaching, research and extension developed in university faculties. According to the authors, the very existence of pluralism and diversity of understanding about sustainability between the different segments also interferes with implementing sustainability in HEIs,

In international studies [10], it is clear that after decades of EE in universities, actions are still restricted to volunteering, without concretely including the theme in the institutions' decision-making, challenging change in HEIs' organisational culture. Hence, showing the importance of training personnel. Another published recent research [30] addresses the influence of governance on the ways in which sustainability is perceived and practiced in a higher education context. Moreover, based on various studies they point out the lack of adequate personnel training to deal with issues related to sustainability, which ensures appropriation of related concepts, to include them, in fact, as part of their daily work. It was found that employees tend not to be very knowledgeable about basic sustainability concepts and are uncertain about their practical implementations. Furthermore, they indicate that there are still many challenges in terms of integration between sustainability and governance in these institutions. In addition, in another related study [31], the researchers note that there is a demand of university lecturers themselves to be educated in sustainability. They point out applying concepts to real world problems as being important in Sustainable Development Education (SDE), recognising the value of using engaged and specific learning in each local context. In addition, they require SDE in undergraduate and postgraduate courses as learning objectives.

Amid a certain trend of more prescriptive programs or based only on specific and voluntary actions of environmental education in universities, the object of study of this article is a project proposed to challenge the normative and depoliticised perspective of education and to assume an emancipatory trajectory with its participants. It is an ambitious and innovative project seeking democratisation of EE with the engagement/commitment of all public servants of an HEI, through a "capillarity architecture".

The term “capillarity architecture” is defined as a methodology for educating environmental educators on a permanent, continuous and network basis, aimed at the totality of inhabitants of a given territory [44], based on two viewpoints—PAP^{1,2} and simultaneous performance of networked collective learning [12, 13]. This concept has roots and influences in progressive references and in the popular Latin American organisation.³ This perspective “breaks with the idea of profession and training of specialists, bringing EE to the field of citizen praxis to be exercised by all people on a daily basis”, in the search “for another form of production and consumption, of organisation and relationship in human societies, different from the hegemonic capitalist order in modernity” ([44], p. 30).

According to these authors [44], in critical EE, capillarity architecture can fulfil two roles in HEIs.

that of educating the institution itself, so that it incorporates environmental issues in its daily life—environmentalisation of the Institution, found in its teaching, research, extension and management activities; and to contribute to educating society environmentally—an environmental project of the country and the educational actions committed to it (p. 25).

Thus, leadership formation does not make the leader the centre of attention but invites him/her to take part in the protagonist exercise of motivating/cooperating and helping the collective of participants in transforming degrading realities, while at the same time exercising humility and stripping themselves of vanity on a daily basis. Leaders also need to learn how to develop, conduct and socialise strategic, participatory, incremental and articulated plans, which allow shared construction of strategies, objectives and directions [44].

It was by sharing the critical perspective of environmental education, under the influence of the aforementioned public policy [36, 37] that the PAP project was developed at the university that participated in this study. Capillarity architecture is assumed as a methodological strategy aiming to democratise EE within the institution, for all its employees.

The project was developed considering the efforts from an environmental agency of the public institution involved and various partners who contributed with important results together with the participants, becoming a reference for several other universities that seek to expand environmental education in their community [5, 6, 35, 42]. It was a training process designed to be developed during working hours, having institutional approval and support [46, 47].

Based on data from a broader survey [45], this article addresses the contributions of the capillarity methodology to the socio-environmental formation and strengthening of sustainability culture in an HEI. This rich experience, however, did not take place without contradictions and resistance from the academic environment and there were challenges within the coordination group itself, which made us reflect on the development, in a dialectical perspective and to investigate the complexity of leadership formation regarding sustainability.

The results are discussed from two viewpoints: (1) Capillarity architecture and its impacts on the university experience and, (2) Challenges and tensions between the commitment to leadership formation on a large scale and the search for emancipation in EE. Finally, it is shown how this experience enables one to offer reflective parameters for leadership formation in different spaces, organisations and cultures. An assessment of the capillarity architecture in a concrete experience like this can provide a valuable contribution to thinking about the preparation of leaders for sustainability at a global level.

2 Research methods

This study contains data from qualitative research [45] using a participant research case study, in which the researcher developed the project at university. Participant-research, despite presenting a wide range of social practices, theoretical and methodological foundations, encompasses, in general, the objective of promoting “the production of knowledge

¹ The acronym in Portuguese is used in its original form in this article because of its resonance.

² The concept of PAP is characterised by Orlando Fals Borda as a methodology that involves participant-action-research, adult education, scientific research and social or political action, based on a critical perspective of analysis, diagnosis of reality and everyday practice searching for transformations [8, 17].

³ In 2006, a public policy to educate environmental educators was introduced in Brazil, including some technical guidelines and national articulation for the formation and performance of collective educators in capillarity, in a perspective of critical and popular training on a large scale. The technical reference document addresses contents and principles that refer “to schools of thought such as Hermeneutics, Critical Theory, Environmentalism and Popular Education” (p. 8). It also indicates the following as methodological strategies: psychosocial intervention, PAP, communicative action, learning collectives, culture circles, and the learning community, among others [36]. Hence, the spread of the term “capillarity architecture”, which is analysed in this study.

Table 1 Data collection techniques for research
Source: elaborated by the authors with data from Sudan [45]

Technique	Ways to register	Quantity
Meetings in the project's coordination group	Memories of meetings	Eighteen memories Seven transcripts of recordings
Focus groups	Recording transcription	Two
Participant observation	Notes from researcher from 2013 to 2015	Notes in word file
Document analysis	Data from articles/abstracts published by the coordinating group Reports authorized for access by the researcher, with disclosure restrictions	Romero et al. [42] Sudan et al. [46] Meira et al. [35] Bonzanini et al. [6] Project reports ^a

^aInternal Project report (2016); We do not mention it in detail in the references so as to preserve the anonymity of the institution participating in the research

of both the researched subjects and the researcher, searching for transformations of a given reality" ([7], p. 5) This type of research requires delving into the intersubjectivity of the collective dialectic, by prioritizing the historicity of the phenomena, praxes, contradictions and the subject's action on their realities [8, 15, 17].

The research data⁴ [45] were collected or produced in face-to-face meetings in the project's coordination group, in planning and evaluation meetings, in focus groups and their resulting documents (recording transcription or memories of meetings), as well as notes from participant observation by the researcher from 2013 to 2015 (Table 1).

A focus group is a collective interview technique [21] which was chosen with the purpose of enhancing dialogical and reflective moments for the participants and for the researcher in understanding the meanings attributed by the coordination group to the main issues of the PAP project, including capillarity architecture.

Based on the discursive textual analysis [38], we carried out the interpretation of the data based on Critical Theory concepts. Several excerpts from the documents of the corpus were presented, with manifest and other latent aspects on the theme of capillarity regarding public servant training. The validation of the comprehensions reached was sought in the relationship between theory and practice, in the "acceptance of a reality understood as dialectic, in a permanent movement of overcoming" [38].

Many authors [3, 8, 22, 24, 26, 48] assert that research is a political action in Critical Theory as research actions are closely related to the researcher's values, requiring a dialogical and transformative method, facilitating the transformation of reality. This type of research must also carry out a permanent self-criticism, reviewing its foundations, assumptions, praxis and concepts searching for emancipation in society [48]. Likewise, for Critical Theory "contradictions are constitutive parts not only of the subject who thinks reality, but also of the objects that compose it" ([11], p. 135).

3 Research results and discussion

3.1 Capillarity architecture and its impact on the university experience

Capillarity architecture gains life and functionality in an institution considering the formation and performance of learning collectives in four consecutive phases, from PAP1 to PAP4. The PAP1 collective coordinates the process and in the formation and direct supervision of seven PAP2 collectives, which comprise groups of experienced public servants in

⁴ All data collection actions, as well as the general project for this research, were approved by the UFSCar Ethics Committee, associated with its registration on *Plataforma Brasil*, of the National Research Ethics system/SISNEP.

seven social campuses. PAP2 collectives develop and coordinate 31 face-to-face courses in their work units for the PAP3 collectives, which in turn, are committed to developing educational actions involving other PAP4 employees [35, 42] (Internal Project Report, 2016).

The training took place as face-to-face and meetings and was aimed at the PAP 2, 3 and 4 collectives. Practices were monitored on the campuses. The general training program for the PAP2 collective had three dimensions; the first was a conceptual repertoire (with a set of contents on sustainability, education and environmental management, to be further developed); a situational repertoire (including orientation for carrying out participatory socioenvironmental diagnoses in the workplace, identifying specific problems and needs of each territory) and the promotion of a socioenvironmental educative action with other public servants on the campus (Internal Project Report, 2016).

The support materials were made available on a virtual academic platform, comprising scientific articles, books, forms and guides used in face-to-face classes. As support to the planning of educative actions and continued reflection on educational activities, tutorials were given to the PAP collectives. This took place from the PAP1 (or other invited teachers) to the PAP2 collectives and from the PAP2 to PAP3 collectives, concomitant with the planning and carrying out of educational activities. It is noteworthy that each PAP2 collective had the autonomy to develop a 20-h classroom course for the PAP3 collective (plus 20 h of monitored practices) based on the issues raised in the socio-environmental diagnoses made at their campus of origin. Likewise, the PAP3 collective was able to choose the themes that would be addressed with the PAP4 collective [35, 42].

The PAP Project had institutional funding and support in various different aspects, which were fundamental for the costs incurred by intercampus meetings and external speakers; acquiring basic equipment (computers, cameras, tablets, etc.) on some campuses; hiring professionals, granting scholarships and offering internships for the support team; the articulation of partners and managers; institutional certification and promoting intervention projects during working hours ([35]; Internal Project Report, 2016).

Among the results of the project at the HEI, the coordination group highlighted the promotion of 31 face-to-face courses (40 h) on socioenvironment, promoted by the 92 PAP2. Moreover, 533 PAP3 participated in these courses. The PAP3 collective's Education and Environmental Management actions totalled 127 interventions, in which 1853 PAP4 participated in the seven campuses. The total number of participants was around 2500 people in the period from 2013 to October 2015 (Internal Project Report, 2016). A website was created and a book about the project was also published by the PAP collectives. The following qualitative results that emerged from this study can be indicated: recognition by the university community of the importance of continuing this training; strengthening the autonomy of the PAP2 collective, both in planning and in the collective development of an educative action. It also notes that some public servants, in contact with other campuses and areas, have broadened their views on the university's organisational structure and its internal dynamics. Among the contents learned by PAP 2, 3 and 4 collectives are those related to environmental management, Education, society, culture, Psychology and social action. Many civil servants' engaged participation in meetings and experiential experiences of the process can also be highlighted [42].

Other publications [5, 6, 35] and the following excerpts from the focus groups confirm these results, showing signs of strengthening groups and links between civil servants, developing a capacity for constant assessment of their training process itself, as well as a broadening of their perception of the complexity and diversity of organisation and power relationships of the campuses involved.

Fisáis: As one of the PAP commented, "Since I have been here, for 30 years, I have never seen people meeting in the laboratory", therefore, there is nothing more integrating than the simple fact of people from each area on the campuses [sic] sitting in a circle talking, and which is even one of the pillars of Environmental Education. Good meetings enhance the empowerment of subjects [...] (Focus group transcription, May 4, 2015).

As the specific study [29] notes, the PAP 1, 2, 3, and 4 engaged actions in each local context, are very important in Education for sustainability because they enable specific learning considering the challenges and problems of the place.

The PAP1 collective assessed that capillarity: "makes it possible to reach people who might not be able to access much information"; it expanded the "perception of the surroundings and thereby created new links between public servants, departments, units and campuses; it was "a strategy that offered various contributions" (Memory of meeting, 13 August 2015).

In a publication by the PAP1 group [6] affirm that even the specialists in sustainability and environmental education of the project's coordinating group—the PAP1—were able to significantly grow in the project's development process, expanding their experiences, their self-assessment capabilities and their own way of dealing with diversity at the university.

Based on the documents and publications of the project, three collaborations of capillarity architecture stood out in terms of reflecting on training sustainability leaders, namely: (i) they provided a large number of educational interventions for sustainability, concomitantly and sequential (from PAP1 to 4), during the short period of 2 years; (ii) they provided actions rooted throughout the institution, in its seven campuses and different sectors, for employees from different areas of expertise and knowledge; (iii) a conduct of leadership was required from all its participants, who had to design, mediate and develop courses for their co-workers, considering leadership and responsibility.

3.2 Challenges and tensions in the capillarity praxis in the HEI

The main challenges for training environmental educators in capillarity architecture at the HEI were:

3.2.1 Networking within a hierarchical institution

Capillarity architecture presupposes a horizontal relationship between learning collectives, and that is why from the first meeting of the project, its viability within a hierarchical organisation, such as a Brazilian university, has been questioned.

I didn't know PAP and I think it is ambitious. It is a very democratic project, for a not very democratic institution. We have to prepare and be aware of this so as not to underestimate resistance (Inhame, transcription of the meeting on 28 March, 2013).

In view of this, the organisers sought an institutional articulation, considering the "importance of the proposing organ of the joint project with the institution's managers, support for training their employees and allowing them leave to participate in the process" (Memory of meeting, 28 March, 2013).

Some excerpts show PAP1 collective's daily dealings with the hierarchy in the institution. They illustrate the time and commitment of the group to carry out each task, passing through different sectors, waiting for authorization.

Moringa: [...] bureaucratically, hierarchically I don't know if we can ask the director first to inform people and then send it to the boss, I think it has to be the other way around, his boss has to inform people and then the director.

Pana: Isn't the director in charge? [or] Isn't it the boss who gives orders and defines things?

Umbu: Yes, but ... did you send the first letter? [No]. So, the first letter goes to the director, it is the director of the proposing body who will talk to the boss [...] (Transcription of the meeting, 30 September, 2013).

The hierarchy associated with bureaucracy in the HEI management requires various articulation strategies and takes up a large chunk of the group's time that should be dedicated to teaching and related to the PAP collectives in the process. For example, the waiting time to hire a professional to work on the project (for 3 months, without employment) ranged from 3 to 9 months.

Quinoa: ... Sometimes you even have the resources, but you can't hire anyone, so this is a problem with rules, bureaucracy rules. (Transcription of the focus group, May 5, 2015).

The issue of hierarchy and bureaucracy as the core of the institution's functioning is complex and is related to its history and political-economic relations in Brazilian society. Brazilian universities underwent a university reform during the military dictatorship (1964–1985), adopting vigorous science and technology policies and establishing immense bureaucracy "restricting the freedom of both teachers and students" [39, p.15], having influenced "scientific and technological production" [39, p.16] and the functioning of institutions since then.

It is worth noting that the search for democratizing EE by the capillarity "arrows" was, contradictorily, faced with the hierarchy and bureaucracy existing in the HEI, not represented in its design.

Dialectically, the capillarity architecture hierarchy was problematised by the PAP1 collective.

Baru: But [...] that PAP4 with PAP4 thinking about the exchange not only base-periphery-centre, but periphery-periphery; if it is from the inside out, it is hierarchical.

Pupunha: You can say. Why be afraid of the word hierarchy? [...] It is nice that they [have] representations that show, at the same time, the complexity coming and going, but also that they do not hide the fact that there is a hierarchy, yes. PAP1 PAP1 is not going to give certification, PAP1 PAP1 is going to give certification (PAP1 PAP1 and PAP2 PAP2), right? So, like, there is a hierarchy. We are not going to deny the existence of a hierarchy, but we are making a process that tries to really encourage self-management, autonomy, the deconstruction of hierarchy that has no meaning. But, we will not deny that there is a project that is being planned by people for other people to get involved, it's not being planned at the end; it is not being demanded at the end, right? It is being planned, what is written here (transcription of the meeting of the coordination group, 22 August, 2013).

Unlike a hierarchical relationship of power, here Pupunha emphasises the importance of a "hierarchical" relationship of responsibility for the process, of competence and authority in the field of EE that the coordination group needs to have, to promote adequate planning and ensure theory and practice in the subjects under study. Freire [16] discusses the tension between freedom and authority in educational practice, highlighting the most difficult position to be based on democratic ethical principles (equality and solidarity), founded on authority by professional competence and not by authoritarianism.

To sum up, PAP1 collective's differentiated responsibility in capillarity architecture seems to us to be a fundamental indication of quality assurance in training processes, in which the necessary competence in the area of EE is not exempt, even in a non-formal context.

The discussions raised by international studies [29–31] also emphasize the importance of ensuring quality in sustainability training in higher education, so that such concepts are in fact implemented in practical actions in the work environment. Likewise, as their studies point out, this project also sees the need for greater integration between sustainability and governance so as to streamline the implementation of sustainable actions in the institution, without having to face so many hierarchical barriers and bureaucratic procedures.

3.2.2 Political-institutional issues and material structure in EE

Regarding political and institutional issues, the group had to deal with the changes of the university's administration that took place during the second year of the project, in the middle of the PAP2 collective's training. The times, deadlines and changes in the institution had been a matter of concern for the group since the beginning, as Capim Limão points out: "It is important to have a schedule, of the activities, a schedule of disbursement of funds, right? Because then you are making it all difficult in the next administration" (Transcription of the coordination group meeting, 22 August, 2013).

Capillarity training implied continuity over time, more in-depth and articulated training, which requires commitment from the institution, regardless of the change of manager.⁵ In addition, a financial crisis was announced at the institution, which would interfere greatly in the following months of the project and cause a major change in its schedule. All public universities in the state of São Paulo were affected by the change/decrease in transfers from the collection in the State's ICMS tax⁶ in the period. This context led to further budget cuts in the PAP project. Approximately 30% of the forecast was approved. Therefore, the budget for communication, production of teaching materials and other items had to be relocated and the number of professionals hired was reduced⁷ (Internal Project Report, 2016).

The project's dependence on the possibility of temporary hiring presents and confirms the demand for more professionals in the area of EE. It also illustrates the precariousness in the work of the environmental educator, who lives (in general) off temporary contracts in Brazil [27].

Moreover, in the context of this crisis, the Voluntary Exit Incentive Program (PIDV in Portuguese) resulted in 2760 technical and administrative employees (more than 15% of the staff)⁸ self-selecting themselves for termination. This occurred simultaneously with course registrations being made available for PAP3. There was general discouragement among the civil servants as the work environment scenario was reconfigured and as colleagues were leaving, many of their routines would change significantly in their sectors.

In the day-to-day development of the project, the problems related to the socio-political and economic conditions of Brazilian education appear, thus identifying various material issues, such as: the precariousness of temporary hiring; the

⁵ It should be noted that, in this case, the new manager of the proposing environmental agency continued the project.

⁶ Tax on the circulation of goods and provision of services.

⁷ In total, six extension scholarships (10 h of performance per week), six interns (20 h of performance per week) and five educators were hired (20 h of performance per week) for the project.

⁸ Electronic message from the university administration on 25/08/2020.

Table 2 PAP training workload and activities

PAR workload	PAR1	PAP2	PAP3	PAP4
Face-to-face activities	120 h planning and evaluation meetings	64 h Integrated training meetings from all campuses	20 h Participation in the course given by PAP2	2–8 h Participation in educational activities provided by PAP3
Practices monitored at the workplace	Not estimated	66 h Planning and training meetings at the campus of origin Applying the educational action to the PAP3 collective	Educational action planning (12 h) and application with PAP4 (8 h)	–
Total	Around 180 h	130 h	40 h	From 2 to 8 h

Source: Sudan 2017

civil servant strike in São Paulo State and the voluntary dismissal plan that occurred in the period. This scenario generated a climate of insecurity for the coordination group regarding the conditions for continuity of the project so as to address this issue constantly in the group's planning meetings.

The institution's budget crisis is linked to state, national and global political issues and consequences of the capitalist system are revealed in the institutional daily life. Hence, the importance of unveiling the appearances of reality and considering these elements as having an impact on any training process in order not to evaluate the "successes and failures" only as the responsibility and (in)competence of those involved [1, 33].

The specific context of this project and its material conditions modified during the development of its actions give us clues about the relevance of considering the unequal conditions in which training projects for sustainability occur at a global level and that differentiated investments, according to these needs, need to be provided to break basic obstacles for leaders to access socioenvironmental training and to be able to act with ease in their territories [18–20].

3.2.3 Differentiated workload

According to Table 2, the distribution of the workload in this project decreased in the capillarity wheel—in the centre-periphery direction of its design. It was higher among the PAP1 collective and lower in the PAP4 collective. The decrease in workload also reflects the reduction of content worked in the activities. The PAP1 collective emphasises this aspect when they assess that "capillarity brings the challenge of guaranteeing the training of people who go into the final stages" (in this case, the PAP4 collective) (Memory of meeting, 13 August, 2015).

According to the PAP1 collective, the educational actions of the PAP3 collective together with the PAP4 were "more laborious and demanded more from the PAP1 and PAP2 collectives and the support teams involved"; PAP3 "had problems executing and transmitting [knowledge] to PAP4 due to the limited amount of techniques and knowledge gained"; they thought it was "difficult to find available time to prepare interventions"; struggling to "mobilise people to participate". "We can identify several very interesting, relevant, innovative interventions" ... It is also possible to observe some poor, innovative, precarious interventions ... The majority of which can be classified between these two extremes" (Memory of meeting, 13 August, 2015).

Even with a reduced workload, however, we highlight two characteristics in the PAP4 collective's training, provided by the capillarity methodology. The first is that some people from the PAP4 collective were able to develop theoretical and practical analyses in their courses and workshops (technical visits to environmental management initiatives; practical workshops for composting organic waste, reusing water from air conditioners; pesticide packaging recycling, etc.), mainly in activities that included debates between invited experts (on "sustainable mobility", including lectures by architect engineers from the campus and researchers in the area and "scarcity of water and actions for the quality of life", and talks given by lecturers from the Nursing Faculty, among others). The second positive characteristic of capillarity is

Table 3 Comparison between the initial goals of training HEI employees and the result achieved at the end of the project

Goals	Initial planning	Final results
Number of university campuses (from the same institution) involved	7	7 (100% concerning the initial goal)
Project coordinator group size—PAP1 (lecturers, higher education technicians and support staff)	40	15 (37.5%)
Number of PAP2	128	92 (~ 72%)
Number of PAP3	4,495	533 (~ 12%)
Number of PAP4	12,970	1853 (~ 14%)
Total number of public servants involved in the project	16,509	2500 (~ 15%)

Data organised based on the Internal Project report (2016)

that it provides a progressive approach to new people in the area, including those who are learning about sustainability for the first time [45].

Faced with these issues then, the challenge still remains in this methodology of: expanding the training of those who had a lower workload—PAP3 and PAP4. This aspect that can be overcome (in part) in the continuity of education in forthcoming years, with the change of capillary level from some PAP4 to PAP3, in a procedural mobility of the PARs in a centripetal sense.

And more than the workload involved in each PAP group, it is up to the organisers to commit to the depth of the meetings held. From the point of view of Critical Theory, capillarity training will be emancipatory as long as it incorporates a permanent individual and collective self-critical movement of its participants. This reflective action involves “dialogical fecundity, hermeneutics of horizontality; accept dissent and lead to its problematisation”, “with decisions increased and supported by clarification” ([49], p. 162).

3.2.4 Large-scale training

In order to reach 16,509 public servants, it would be necessary to engage 128 PAP2, 4495 PAP3 and 12,970 PAP4 collectives, in addition to the PAP1 group formed by 40 people (teachers, higher education technicians and support staff). The coordination group did not give up on this goal (Table 3), although it always worked by adjusting the schedule and tasks in view of the material conditions they had at the time.

Among the results of the project at the HEI, the coordination group highlights the promotion of 31 face-to face courses (40 h) on socioenvironment, promoted by the 92 PAP2. Moreover, 533 PAP3 participated in these courses. The PAP3 collective’s Education and Environmental Management actions totalled 127 interventions, in which 1853 PAP4 participated in the seven campuses. The total number of participants was around 2500 people in the period from 2013 to October 2015 (Internal Project Report, 2016).⁹

Some notes and memories of meetings reveal an issue about the size of the public, in addition to pointing out the “need to reduce the workload of PAP2 and extend the duration of the project from 2 to 4 years” (Subgroup meeting memory process design/theoretical analysis, May 2013).

Aguapé: Guys, I just have one question: should we continue with this goal of 16 thousand? Because we feel a sense of failure ... because it was really cool, there were 600 people, 700 to register,¹⁰ that’s a lot, but at the same time we were a bit frustrated because we didn’t reach the three thousand [PAP3] expected, so, I don’t know, if we should decrease our goal, so that we can achieve it.

Capillarity architecture raises several challenges and tensions if the coordination team is not proportionally large to its demands for tutoring, institutional articulations, administration, secretariat and pedagogical actions.

The comparison between the goals initially planned and the results achieved reveals a great mismatch in relation to the number of PAP3 and 4, followed by PAP1 (coordinating group). The PAP2 group participating in the project was the closest to what was planned. In order to understand these differences, it seems essential to consider the several limiting

⁹ Internal Project report (2016); We do not mention it in detail in the references so as to preserve the anonymity of the institution participating in the research.

¹⁰ From PAP 3.

factors of the project, discussed in the previous categories, such as the lack of certain material conditions and insufficient size of the project's coordinating team; institutional bureaucracy and political issues (which required more time to proceed with each step of the project). In addition, the difference in components in the PAP1 group can be explained by the fact that the work in this project is characterised as "university extension", still little valued and without status in the curriculum of Brazilian teachers (who also already have many other demands for teaching and research). As a result, many who were invited to the coordinating team declined to join [45]. Concerning PAP2, it seems that the fact that the greater dedication and time spent by PAP1 to the process occurred in the first phase of capillarity work (in institutional articulation, dissemination, mobilisation and training of PAP2) has interfered in this result. It was necessary to obtain enough subscribers and develop actions in the training process, with a greater workload. In general, PAP2 was given greater independence in the dissemination and development of the following phases (to mobilise the participation of PAP3 and after PAP4), whereby the PAP1 group was dedicated to tutoring the groups. The diversity in the preparation, leadership and work autonomy of each PAP2, 3 and 4 group may have influenced the number of participants in the whole project. In any case, this difference between the initial goal and the achieved one expresses an initial ambition that is disproportionate to the possibilities of the participating groups (who were quite engaged), requiring future plans to be revised.

The results obtained in other survey [31] suggest that sustainability policies, certification, organisational structure, budget, reports, the sustainability team, staff training, as well as resources to support their implementation are key components in the consolidation of sustainability in HEIs. Having teams responsible for this topic at the university, with qualified professionals in the area, is a key point for promoting sustainability. The lack of this support can become a barrier, just as the lack of support from superiors also compromises the commitment of the rest of the administration.

At the same time, capillarity architecture can move towards an understanding and mass use of methodology in sustainability training, as Cambuci emphasises: it is "exponential training... you train ten, then each of these ten trains ten" (transcript from the focus group, 8 April, 2015).

The critical Theory [3] warns us about the risk of the emancipation proposal moving towards that of the numerical conquest of the general public, in the eagerness to promote a far-reaching project. Thus, the current use of the term "a multiplier system approach in teacher training" should be cautious, due to the possible qualitative loss of the process and the impoverishment of experience when the focus of the work becomes "multiplication of leaders". Hence the need for this methodology to be carefully mediated with self-critical reflections, with procedural planning and assessments, commitment to participatory socio-environmental diagnosis in the territories of action, articulation of practices with theoretical analysis. Ensuring exercises of critical self-reflection [25, 28, 33], within the educating collectives is an antithesis of instrumental training propagated throughout society.

Reference researches in the diffusion of this methodology in Brazil ([13], p. 347) point out that, regardless of their numerical perspective, capillarity must guarantee the "opening of networked collectives as an ethical condition, implying the opening to new content and new members, with its consequent sustainability in the territory and expansion autonomy". It must also commit to "the establishment of public communicative spaces that allow for the disalienation and imaginary institution of sustainable societies".

The emancipatory potential of capillarity architecture is when planners and subjects (not objects) of planning are articulated, in an ethical-democratic process that transforms "any member of the collective into a planner and, therefore, into a co-governor who represents him/herself in the collectives" ([49], p. 162). Furthermore, social emancipation presupposes an immanent self-reflective social criticism and the socialization of objective conditions favourable to human development. Therefore, education for emancipation is, above all, a political education, an education for contradiction and resistance [2]. This is our permanent challenge when we propose to train leaders, on a large scale, for sustainability.

4 Considerations for educational leadership for sustainable development

The present experience of training environmental educators within the scope of the Brazilian HEI in this study enables us to point out some reflective parameters for the formation of leaders in different spaces, organisations and cultures.

Capillarity architecture has the potential for a greater rooting of EE in the different HEI segments, as it mobilises many dialogical circles in the respective PAP1, 2, 3 and 4 collectives. It provides different levels of participation and theoretical-practical analyses, even with the workload decreasing from PAP1 to PAP4. It provides more university employees with an initial contact with the theme of sustainability. In addition, such actions end up increasing environmentalisation of

university management and enable implementation of exemplary sustainable procedures and practices both for its own community (students and teachers) and for the whole of society.

Encouraging meetings and dialogue also risks reflection and critical action at university. This seems to be a nodal, dialectical point in this methodology. What, on the one hand, can move at all times in the multiplication/repetition of superficial actions, leading to qualitative losses on the initial proposal for socioenvironmental training, also allows for the development of autonomies and openness to new aspects within an organisation.

Some limitations of the capillarity architecture methodology, experienced in this case study, give clues to implementing new experiences in the training leaders for sustainability, such as: (i) the increasing reduction of the training load from PAP1 to PAP4; (ii) a very demanding performance to a reduced coordinating group, with insufficient material conditions; (iii) difficulty in reaching the entire public of a given territory/ institution in one part of the project. Such challenges can be overcome with continued processes in which PAP4 can become PAP3 in subsequent editions; ensuring material conditions and investments to support the actions; hiring professionals who work fully in the project, with the consequent expansion of the team; having appropriate valuation of the participation of lecturers, students and technicians with an impact on the professional curriculum; improvement of the institutional articulation to avoid mismatches of administrative procedures in the process and with adaptation of the desired goal to the concrete possibilities of its realization.

The results of this project also provide us with evidence that leadership formation in sustainability implies dependence on inequalities in material conditions (budget, infrastructure, personnel). Therefore, the relevance of directing concrete investments in environmental education and training towards sustainability is indicated, so that large-scale training takes place in territories that have significant social inequalities.

Nevertheless, capillarity architecture questions the traditional format of organisational training. It provides the exchange of experiences among its participants, elaboration and development of courses in the socio-environmental area in a collective way, based on problems and social relations of the local territory. These are fundamental aspects when we think about leadership formation on a large scale, in broad policies, which involve different cultures and diverse socioeconomic conditions worldwide.

As emancipation, in contrast to an idealised dream, is a dialectical process with concrete possibilities to be realised, it encourages one to know that, despite numerous obstacles, it is risky to happen in these intricacies and causes concrete transformations towards socio-environmental sustainability.

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Data availability Data supporting the conclusions of this study are available in Federal University of São Carlos-SP/Brazil, but restrictions apply to the availability of these data, which were used under license for the current study and therefore are not publicly available. Data are, however, available from the authors upon reasonable request and with the permission of the participating research subjects.

Declarations

Competing interests The authors declare no competing interests.

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