

TRAINING-ACTION PROGRAM IN CREATIVE SCHOOLS: A PROPOSAL FOR SCIENCE AND BIOLOGY TEACHERS



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ABSTRACT

The result of a dissertation carried out in the context of a Professional Master's Degree, this research aimed to develop a proposal for transdisciplinary and eco-formative training for Science and Biology teachers working in a Basic Education school in Santa Catarina, being of the participant type, with a qualitative approach. The study included three (3) Science and Biology teachers and three (3) members of the International Network of Creative Schools (RIEC). Data were constructed through three questionnaires and the analysis was carried out based on content analysis. The training proposal encouraged teachers to explore the Creative Eco-Training Projects (PCE) as instruments to promote contextualized teaching aligned with the principles of transdisciplinarity and eco-training. The results showed that the proposal met the demands of teachers, contributing to strengthen integrated pedagogical practices and foster ecosystem and transcomplex relationships in the teaching of Science and Biology.

Keywords: Continuing Education. Transdisciplinarity and Ecoformation. Ecosystem Paradigm.

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INTRODUCTION

In a society permeated by globalization, rapid transformations generate daily implications, especially "[...] in the ways of living (living together), in the ways of doing and being, signaling the difficulty of predicting in the short, medium and long term what must be learned and the skills necessary to inhabit this constantly changing world" (Moraes, 2018, p. 19). Associated with such conditions, the contamination and degradation of ecosystems, the depletion of natural resources and the loss of biodiversity (Cachapuz *et al.*, 2005), the expansion of the water crisis (UNESCO, 2021), the increase in world hunger (FAO *et al.*, 2022), among other conditions, show "[...] the urgent need for a better positioning in the face of current problems, in particular, the urgency of a paradigmatic reform in the processes of construction and reorganization of knowledge [...]" (Moraes, 2018, p. 19), constituting what Morin (2011; 2018) indicates as a reform of thought.

However, the school still persists in practices that collaborate for it to be characterized as an institution "[...] reproductive, authoritarian and arrogant when working with knowledge in its most linear aspect, aimed at the teacher who speaks and the student who listens and copies and tries to give back to the test the best he can" (Moraes, 2018, p. 21), that is, a perspective that values the positivist paradigm, which stimulates linear teaching, locally decontextualized and globally disconnected. This model reflects what Freire (1987, p. 33) denounces as a banking education, in which "[...] The only margin of action that is offered to the students is to receive the deposits, keep them and file them. Margin to be collectors or binders of the things they archive".

This context can cause a distance between teachers and students in schools, especially because the curricular contents are decontextualized from their reality. Therefore, "[...] it is up to education professionals to reconsider theoretical, methodological and evaluative conceptions, understanding that these need to be convergent to the demands of the current reality and to a new student profile" (Zanol, 2021, p. 9). Moraes indicates the ecosystem paradigm as a means of breaking the positivist paradigm, because it seeks to rescue the human being and "[...] stimulates a systemic view that recognizes the interdependence of all phenomena and the interplay of individuals and societies in the cyclical processes of nature" (Moraes, 1996, p. 61).

One of the training initiatives that is directly related to this paradigm is the Training-Action Program in Creative Schools, which consists of an alternative training that prioritizes training intervention practices based on the triad of complexity-transdisciplinarity-eco-

training (Zwierewicz *et al.*, 2017). This program intends to prevent continuing education from being restricted to the mere offer of lectures that, when worked in isolation, as Nóvoa (2001) points out, contribute little to education professionals. The program is also close to what Nóvoa (2019, p. 3) defends as metamorphosis, which occurs when "[...] Teachers come together as a collective to think about the work, to build different pedagogical practices, to respond to the challenges posed by the end of the traditional school model.

In this sense, the result of a dissertation defended in a Professional Master's Degree at a university in the west of Santa Catarina, this research aimed to develop a proposal for transdisciplinary and eco-formative training for Science and Biology teachers working in a Basic Education school in Santa Catarina. It is characterized by being an alternative that seeks to break with linearity, fragmentation, decontextualization and distancing of contents and activities from planetary reality.

PROJECTIONS FOR A PARADIGMATIC TRANSFORMATION IN CONTINUING EDUCATION

Training in Biology, whether bachelor's or licentiate, requires that the basic contents comprise "[...] biological knowledge and knowledge in the areas of exact, earth and human sciences" (Brasil, 2001, p. 5). However, certain disciplines may predominantly present content that is related to the tradition of training researchers in the area, disregarding the fact that academics may also act as teachers (Oda; Delizoicov, 2011). This scenario has roots that date back to the 1960s and 1980s, in which the technicist tendency was prominent in teacher training courses in Sciences, reinforcing problems such as "[...] the neutral, universal and strictly scientific treatment of the curricular components; the theory/practice dichotomy; the fragmentation of general education disciplines and the distance between school and social realities" (Nascimento; Fernandes; Mendonça, 2010, p. 234).

Thus, the teacher was understood as a technician, whose ability was centered on delimiting teaching objectives and plans to gain control of student learning. Thus, a dichotomy was established between teacher training and school practice, unveiling the fragility that training courses can present in relation to the subsidies for the performance of teachers in Basic Education (Goedert; Delizoicov; Rosa, 2003). In this sense,

[...] Although in recent years significant knowledge has been produced about training and educational practices carried out in different contexts, the difficulties in implementing changes in the proposals for training science teachers are still

evident, mainly due to the fact that many training courses continue to have a strictly disciplinary and essentially cognitive character (Nascimento; Fernandes; Mendonça, 2010, p. 239).

It is understood, therefore, that continuing education demands to favor "[...] the personal, professional and institutional development of teachers, enhancing collaborative work to change practice" (Imbernón, 2009, p. 49). However, it is worth asking "[...] how to build teacher training programs [...]" that enable the recovery of "[...] a connection to schools and teachers weakened in recent decades, without ever ceasing to value the university, intellectual and investigative dimension?" (Nóvoa, 2017, p. 1109). One possibility of formative tendency consists of that which "[...] considers the school as the locus par excellence of education [...]", since in it "[...] teachers decide together the type of training they want, plan, execute and evaluate their work, constituting collaborative teams" (André; Martins, 2020, p. 194).

This perspective is in line with the ecosystem paradigm, defined by Moraes (2018), and with the transcomplex, indicated by González Velasco (2017), which stand out for "[...] existing relations between the various aspects of life [...] opposing any disjunctive mechanism" (Petraglia, 2013, p. 16) in the formative processes. To this end, it is necessary to establish training alternatives that, collectively, define spaces for pedagogical experimentation and also innovative practices, providing conditions for effective teacher professionalization (Nóvoa, 2019). Furthermore, in order to break with the focus on transmission, teacher training programs need to be thought of and defined in the sense of "[...] mobilize teachers to work collectively, triggering changes in the school and increasingly meeting the learning needs and training of students" (André; Martins, 2020, p. 194).

Training also requires stimulating in teachers the courage to work with the unforeseen, with the random and with uncertainties, so that they can create different solutions that strengthen the knowledge of living, as discussed by Morin (2015). Thus, the research focused on the contributions of complexity, transdisciplinarity and eco-training for the elaboration of a training program that considered, in its activities, local and global demands, based on the Training-Action Program in Creative Schools.

The program is linked to the International Network of Creative Schools (RIEC), coordinated by Saturnino de la Torre, professor emeritus at the University of Barcelona (UB), Spain, and Marlene Zwierewicz, from the Alto Vale do Rio do Peixe University

(UNIARP), Brazil. The RIEC is made up of different nuclei linked to Higher Education Institutions (HEIs) in Brazil and abroad, among which: UB Nucleus, UAM Nucleus (Autonomous University of Madrid), UFG Nucleus (Federal University of Goiás), RIEC Tocantins Nucleus (Federal University of Tocantins), RIEC UFAL Nucleus (Federal University of Alagoas), RIEC UEG Nucleus (State University of Alagoas), PUCPR Nucleus (Pontifical Catholic University of Paraná) and RIEC UNIARP Nucleus. Participants in these professional groups are committed to breaking with linear, fragmented, decontextualized and globally disconnected teaching (Zwierewicz *et al.*, 2017).

Guided by the triad complexity-transdisciplinarity-eco-training, which considers the reconnection of knowledge interrelated with the transcendence of disciplinary teaching and with the resignification of the relationships of the human being with himself, with the other and with the environment, the Training-Action Program in Creative Schools is structured in five stages (Figure 1).

Figure 1 - Stages of the Training-Action Program in Creative Schools



Source: adapted from Zwierewicz *et al.* (2017).

The connection stage, as pointed out by Zwierewicz *et al.* (2017), refers to the beginning of the program, aiming to have an impact on the participants, through strategies that can situate the practices, identify and value the creative initiatives carried out before the beginning of the training, as well as identify the challenges to be faced. In the meetings of the connection stage, the theoretical bases that guide the program are worked on and contextual and global demands and the possibilities of using the methodology of the Creative Eco-Training Projects (PCE) are discussed.

The projection stage, in turn, refers to planning, whose purpose is to reduce the distance between what is intended to be accomplished and what is actually accomplished,

constituting itself as the stage of the definition of the PCE, whose practice contributes to the expansion of creativity and stimulates the rupture of linear teaching and disconnected from local and global realities (Zwierewicz *et al.*, 2017).

In the strengthening stage, according to Zwierewicz *et al.* (2017), the intention is to deepen theoretical knowledge to link it to practical possibilities, encouraging the necessary transformations to reduce the distance between the real and the desired. It is therefore intended for the participation of teachers in study meetings and workshops to improve theoretical knowledge and propose practices compatible with them and with the school context (Zwierewicz *et al.*, 2017). In this process, professionals from the most diverse areas and institutions collaborate, with the purpose of helping them with issues suggested by the participants of the program.

The interaction stage, in turn, seeks to stimulate the local socialization of the actions carried out during the training, constituting a means of connection between theory and practice. It is, therefore, essential to enhance the creativity of the team through the exchange of ideas shared by professionals from the educational institutions that participate in the proposal (Zwierewicz *et al.*, 2017).

The pollination stage, on the other hand, has the role of stimulating the wider dissemination of the elaborated/developed PCEs, valuing the participants and their initiatives, as well as resignifying their practices based on what was shared and developed throughout the training. In the same way, it serves to disseminate possibilities, favoring a recursive process evidenced in new actions that use those already disseminated as a reference for their projection and development, as highlighted by Zwierewicz *et al.* (2017).

It is also noteworthy that the PCE methodology, created by Torre and Zwierewicz (2009), constitutes a methodological reference for Creative Schools in the Brazilian context committed to consolidating education from life and for life, developing pedagogical practices from real problems, prioritizing the development of sustainable personal, social and environmental awareness, as well as stimulating the formation of resilient people, capable of transforming the adverse situations they may encounter in the local community and on the global stage (Zwierewicz, 2011).

In addition to being based on the triad of complexity-transdisciplinarity-eco-training, as well as on the methodology of the PCE, the proposal considered problems at a global level and the resignification of the person-environment relationship, addressing the Sustainable Development Goals (SDGs), especially SDG 4 Quality education and SDG 16

Peace, justice and effective institutions. The implication of these and other SDGs in the PCE does not mean, however, the defense of the idea that planetary emergencies can be solved through just a one-off action in an institution, but that transformations occur through interactions, as Loureiro (2019) argues, especially those that reverberate beyond the walls of the school. Therefore, it was sought to adopt the SDGs within a perspective that values not only the attitude of the individual, but of society in general from the perspective of a livable environment for current and future generations.

METHODOLOGY

Due to the search for understanding, valuing and welcoming the formative demands of the participating teachers for the elaboration of the training program, participant research was prioritized, which presupposes the "[...] the researcher's entry into the field, also considering his offers and possible knowledge that are mixed, dissolve in the joint doing" (Furlan; Campos, 2014, p. 892). In this research, the participants were informants and interlocutors of their demands, as well as collaborators and evaluators of the training proposal.

Regarding the approach, the qualitative approach was used, which corresponds to those studies "[...] who are guided by the interpretative paradigm, which conceives reality as a construction that takes place through the interaction between people and the world", emphasizing that "[...] researchers try to get as close as possible to the participants being studied" (Gil, 2019, p. 31), prioritizing the deep interpretation of the data.

Approved by Opinion No. 6,223,273 by the Research Ethics Committee, the study had the participation of two groups. The first was composed of 3 (three) Science and Biology teachers working at the Antonio Gonzaga School of Basic Education, Santa Catarina. As a selection criterion, teachers working in the areas of Science and/or Biology (Natural Sciences and their technologies) interested in participating were included. This organization occurred in this way because the type of sampling of the survey is by convenience, in which "[...] the elements are selected because they are more available to participate in the study" (Gil, 2019, p. 106).

The second group, in turn, was made up of 3 (three) coordinators of the RIEC Centers, who analyzed the proximity of the proposal to the SDGs. The criteria for the inclusion of these researchers consisted of: having a link with one of the RIEC Centers,

developing research associated with complex thinking, transdisciplinarity and eco-training, and developing research, teaching or extension activities in Basic Education.

To constitute data, the three instruments recorded in sequence were used, which were developed and validated specifically for this research: a) 1 (one) questionnaire to know the teachers' training demands and suggestions for the elaboration of the training program compatible with them; b) 1 (one) questionnaire to evaluate the approximation of the proposal with the local training demands; and c) 1 (one) questionnaire whose purpose was to evaluate the approximation of the proposal with the premises of transdisciplinarity and eco-training and, as a result, with SDGs that characterize these concepts.

For data analysis, the theoretical assumptions of content analysis were adopted, which consist of a set of techniques that use systemic methods of describing indicators, enabling the interpretation of data (Bardin, 2016). In addition, the data processing relied on the use of the MAXQDA software, which enables the qualitative interpretation of texts, images and other resources, enabling data analysis through codes and notes. Thus, word clouds can be obtained, for example, characterizing proximities and distances in the positions of the research participants.

RESULTS

The data that characterized the Science/Biology teachers of EEB Antonio Gonzaga and their formative demands were obtained through a questionnaire elaborated and validated. The results characterize the teacher's profile and dimension their context of action, as well as specificities about planning, needs related to pedagogical practice and demands related to other important issues for the elaboration of the formative proposal.

Of the 3 (three) participating professors, 100% identified themselves as male. Regarding training, 66.7% (2 professors) have a specialization and 33.3% (1) a master's degree, and 100% graduated from a public institution, in the face-to-face teaching modality.

Regarding the participants' time of experience, 66.7% (2) have been teaching for more than 15 years and 33.3% (1) between 10 and 15 years. Regarding the number of schools in which they work, 66.7% (2) in one school, with a workload of 40 class hours, and 33.3% (1) in two schools. Furthermore, when asked about participation in any continuing education activity in the last two years, 100% (3) of the teachers stated that they had.

In order to collect data to adapt the training proposal to the context of the participants, the teachers were asked about how they perceived the educational context of insertion, especially with regard to organization, physical space and collaborative work. The answers indicated two conditions: absence of a science laboratory and fragile collaborative work. In relation to the students, the professors indicate that they are mostly uninterested.

With regard to the planning of the teaching work, the participants were asked about the time invested in planning, the ways of planning and the main possibilities found in the planning of teaching. Particularities of each teacher in relation to planning were noted, as D1 points out that the planning changes during the classes, D2 does not follow predefined steps and D3 follows the annual planning of the Santa Catarina base curriculum. Thus, the relevance of training that also contributes to the enhancement and resignification of teachers' educational practices was observed.

The teachers were also questioned about the teaching methodology, especially in relation to the choices they made and what they understand about the project methodology. The reports revealed that the participants understand the methodology as a strategy and a method that guides the way of teaching, and as for the methodology that each one employs in the development of their planning, they indicate that

According to the cognitive capacity of the majority of the class, not forgetting the National Common Curricular Base - BNCC, Base Curriculum of the Santa Catarina Territory - CBTC (Teacher 1).

First, I try to separate the most important part of the content, indispensable to all common sense, and in the background the part of the content that will only be used well by more dedicated and attentive students (Teacher 2).

In general, I use more the traditional methodology and case study (Teacher 3).

It is observed that teachers follow the more linear strand of educational paradigms. It is understood that it can be challenging to use methodologies linked to the ecosystem paradigm, however it is relevant to advance in the teaching and learning processes and, therefore, the relevance of providing access to methodologies such as the PCE. Thus, the formative proposition had to respect the possibilities and availability of the teachers, inviting them to know and, possibly, implement the PCE, but, under no circumstances, present itself as the only methodological option to break the positivist paradigm, nor as a script to be followed without enabling adjustments according to local and global demands.

When the participants were asked about the evaluation process, it was identified that its use focuses on verifying student development and learning. The answers also showed a commitment to self-evaluation, through the evaluation results.

In general terms, perceptions, difficulties, weaknesses and suggestions for the development of the proposal of continuing education were revealed. It was observed that transdisciplinarity and eco-training can contribute to Science and Biology teachers, who have significant academic training, experiences, needs and potentialities related to the understanding of planetary changes, contemporary student demands and the need for a paradigmatic change, valuing the collaborative emphasis and pertinent practices.

Although it was revealed that the participants are not in the habit of working with projects, still demonstrating difficulties in collaborative work and opting for disciplinary and individual planning, they recognize the relevance of the reconnection of knowledge, indicating an opening for reflection on the teaching practice itself in the teaching of Science and Biology. Thus, it was found that thinking about dynamic, diversified and creative practical activities can contribute to a more attractive and instigating teaching process for students.

The central conditions of the training proposal were alternatives linked to the themes suggested by the participants (Figure 2), including: transdisciplinary and eco-training strategies and practices, promoted through the PCE methodology, providing opportunities for collaborative work; evaluative activities focused on student multidimensionality; and complex practices involving student and faculty health, sustainability, and active methodologies.

Figure 2 - Themes suggested by teachers for training proposals



Source: Prepared with the support of the MaxQDA Software.

The program proposed with the purpose of meeting the demands observed in the research is flexible, seeking to be linked to the needs and potentialities of the participants, unveiling the dialogical, hologrammatic, and recursive character of the training and the very stages that constitute it. To this end, the meetings were articulated and designed based on self-heteroeco-formation, on what transcends the disciplines and on what is woven together, following the stages of the Training-Action Program in Creative Schools (Chart 1).

Panel 1 – Training proposal

Stage	Description	Proposed activities
Connection	<p>Beginning of the program, whose purpose is to impact participants through strategies that can situate the practices, identify and value the innovations carried out before the start of the training, as well as the challenges to be faced. In order to welcome the participating teachers, the opening meeting may be held in a green/open space of the school or in another place suggested by the participants.</p> <p>Expected number of meeting(s): one face-to-face meeting.</p> <p>Training demands: introduction to the concepts of complexity, transdisciplinarity and eco-training, highlighting their importance for collaborative work; creation of a WhatsApp group for participants, providing opportunities for the exchange of information and the sharing of experiences and experiences during the training program; use of active methodologies that stimulate collaborative work.</p>	<p>Face-to-face meeting I</p> <p>Activity 1 - "Don't let the balloon fall": in this dynamic, participants will be invited to make a circle, joining their hands, preventing the balloon from falling to the ground. In this activity, the concepts of complexity, transdisciplinarity and eco-training will be introduced.</p> <p>Activity 2 - "Rotation by stations": participants will organize themselves into groups and will have questions proposed in different learning stations, arranged in the courtyard, to reflect on: i) what are the possibilities of scientific practices that can be carried out without a laboratory? and ii) what practices may involve other disciplines, parents/guardians and community professionals? Then, a debate will be held with all participants about their answers in a conversation circle.</p> <p>Activity 3 - "Group massage": consists of organizing yourself in a circle and performing massage on the other. The objective is to promote care and otherness with the other (hetero-ecoformation), as well as to recognize the importance of health in the work environment and the role of the team in this aspect.</p>
Projection	<p>This stage consists of moments of planning with the participants, discussing possibilities for the elaboration of the PCE, with the objective of contributing to the rupture of linear and watertight teaching in the Teaching of Science and Biology by connecting it to local and planetary demands. This meeting can be mediated by Google Meet.</p> <p>Expected number of meeting(s): one virtual meeting.</p> <p>Training demands: introduction to complex thinking; introduction to the</p>	<p>Virtual meeting I</p> <p>Activity 1 - "What is complex thinking? Time to understand the principles of complexity"</p> <p>Activity 2 - "What is the PCE methodology? At this point, the mediator must exemplify and contextualize the PCE and their applicability in the Teaching of Science and Biology."</p> <p>Activity 3 - "Planning Creative Eco-Formative Projects - PCE": in this activity, participants will begin the delimitation and planning of the PCE for the Teaching of Science and Biology, valuing themes such as: sustainability, environment and environmental conservation (themes that are associated with the 4th and 16th SDGs); mental health and encouragement of healthy and pesticide-free eating (3rd SDG), among other topics that can be linked to the SDGs.</p>

	PCE methodology, highlighting the possibilities of procedural, continuous and multidimensional evaluation of students.	
Strengthening	<p>This stage consists of the participation of teachers in reflective meetings on theoretical and practical knowledge, enabling alternatives and transdisciplinary and eco-formative practices for the Teaching of Science and Biology.</p> <p>Expected number of meeting(s): three face-to-face meetings and two virtual ones.</p> <p>Training demands: Transdisciplinary and eco-formative principles for the Teaching of Science and Biology; Ecosystem practices that provide opportunities for "thinking" in the Teaching of Science and Biology; Use of resources such as: Google Meet, WhatsApp groups, digital whiteboard, cell phones and <i>laptop</i>; Reflections on teacher health.</p>	<p>Face-to-face meeting II</p> <p>Activity 1 - "Conversation circle": sitting on the floor, the teachers will be invited to have in the center object(s), brought by them, that represent them as students and object(s) that represent them as education professionals. Dialogue will therefore value self-hetero-ecoformation.</p> <p>Activity 2 - "Transdisciplinarity, Eco-training and Creative Schools": exploration of these concepts.</p> <p>Virtual meeting II</p> <p>The central theme of the meeting may involve a subject that arises at the meeting or "Teacher health and quality of life".</p> <p>Face-to-face meeting III</p> <p>Activity 1: "Changing Paradigms in Education": dialogue on paradigmatic changes.</p> <p>Activity 2: "Quality of my colleague". In a circle and with their backs to each other, each participant must glue a sheet of paper with masking tape, on the back of the colleague. On the sheet, each participant must write 3 to 5 qualities of the colleague. After everyone has written, the participants can talk about the dynamics.</p> <p>Activity 3: Coffee and dialogue about the teachers' planning about the PCE.</p> <p>Virtual Meeting III</p> <p>Planning of the PCE, with the purpose of reflecting in a group on ways to link resources such as Google Meet, WhatsApp, digital whiteboard, cell phones and <i>laptops</i> as potentiating tools for the process of implementing the PCE in the Teaching of Science and Biology. This moment can be made more dynamic through rotation by learning stations, a methodology already mentioned above.</p> <p>Face-to-face meeting IV</p> <p>Activity 1: "We need to focus on the professional training of teachers": discussions and reflections.</p> <p>Activity 2: "Resuming the PCE": collaboratively reflect on the mobilizing conditions observed and proceed with the delimitation of the plans.</p>
Interaction	This stage is characterized by the socialization of the actions developed from the training. The meeting may be organized by the participating professors. In this meeting, activities can also be defined to meet demands that have arisen since the previous stage.	<p>Face-to-face meeting V</p> <p>Activity 1: Planned by the participating teachers, for socialization with the guests they have invited.</p> <p>Activity 2: Presentation of the PCE in a round table, in green/open spaces of the school or other places suggested by the participants. The purpose of the activity is focused on: presenting what was planned; collect suggestions; and inspire innovations.</p>

	<p>Expected number of meeting(s): one face-to-face meeting.</p> <p>Training demands: Outlines of creative projects; Actions for "sentithinking" (connection between reason and emotion).</p>	<p>Activity 3: Adaptations of the PCEs collectively, according to the suggestions and ideas that emerged in the previous activity.</p>
Pollination	<p>This stage seeks to value the school institution, education professionals, students, that is, the entire school community, characterized by the moment of broadening horizons, so that the PCE(s) developed continue to provide enriching teaching and learning processes even after its completion.</p> <p>Expected number of meeting(s): one face-to-face meeting.</p>	<p>Encounter VI</p> <p>Activity 1: Plan and disseminate the PCE developed with the participants.</p> <p>Activity 2: "Retrospective video": after planning the publicization of the PCE, organize a video with images and testimonies related to the formative experience.</p> <p>Activity 3: Delivery of certificates of participation in recycled paper, with 40 hours of training.</p>

Source: Prepared by the authors.

The proposal was defined, therefore, by complex, transdisciplinary and eco-formative reflections and strategies, presenting as a fundamental condition the valorization of pedagogical practices based on creativity, collaborative work, resilience and innovation, committing to local and global contexts. Furthermore, the proposal was anchored in the previous experiences of the Training-Action Program in Creative Schools, as well as in the demands of the Science and Biology teachers of EEB Antonio Gonzaga, from Porto União, Santa Catarina, and in the SDGs (3rd, 4th and 16th). With a total of 40 hours, the meetings consisted of training activities based on hologrammatic, recursive and dialogical principles, prioritizing solidarity and cooperation among teachers.

The evaluation of the training proposal indicated that it was satisfactory in terms of meeting the teachers' demands, especially in relation to the context of the teachers' work, the stimulus of collaborative planning, the methodological aspects and the evaluative multidimensionality. The proposition of strategies and activities for teachers with the potential to work with the individualities and similarities of students was revealed to be salutary.

Regarding the commitment of the training proposal to the principles of transdisciplinarity and eco-training, through the SDGs, satisfactory performance was also revealed. This is because the RIEC coordinators indicated that the proposal is aligned with the Creative Schools Movement and the 2030 Agenda for Sustainable Development. This is expressed in the following statements:

The proposed program offers conditions for a transformative education based on values, human potentials and life skills, since there are other fundamental conditions for schools such as the interaction between people and nature in a conscious way and committed to life, which reiterates the relevance of dialogue and the humanization of man (Coordinator 2).

The conditions for a transformative education are built from the constitutional guarantee of education as a right; from public funding for schools and for teacher training (initial and continuous); valuing the teacher and student learning; from humanistic, democratic educational purposes that contribute to creating a "just school", which teaches "science with consciousness"; that is capable of situating and contextualizing teaching and learning in the school reality considering multiple dimensions and aspects (structural, social, economic, political, cultural and institutional; epistemological aspects, pedagogical trends and didactic approaches; specific aspects of the knowing subjects - motives, interests, emotions, life history). The document points out concepts and methodology for the collective and authorial construction of the teaching project, which has value (Coordinator 3).

Keeping in mind all the limitations of future applicability of the proposal elaborated, especially due to the issue of the time of the professionals themselves, teachers of Science and Biology and related areas, its theoretical-methodological, transcomplex and eco-formative value is highlighted.

DISCUSSION

The participating teachers had indicated several challenges, such as the issue of students' lack of interest in Science and Biology classes. In this sense, the importance of teachers creating

[...] pleasant situations, facilitating self-learning. We must begin to take into account that the explanations of a teacher not only inform, but, with their performance and paralanguage, transmit stimuli and can contribute to the secretion of neurotransmitters that provoke enthusiasm, euphoria, satisfaction, the desire to learn or, on the contrary, boredom, disconnection and lack of interest. Thus, multisensory stimulation plays a decisive role in integrated learning. A learning that is not limited to knowledge, but involves skills, attitudes, values, habits and relationships (Moraes, 2018, p. 95).

That is why continuing education programs are fundamental, committed to the dissemination of differentiated practices in Science and Biology, which provide opportunities for transdisciplinary and creative teaching and eco-training practices. In view of this, it is perceived that the PCE methodology can mobilize teachers, because it has a strong potential for teaching "[...] anchored in life, encouraging teachers and students to go 'beyond the reproduction' of knowledge and 'beyond the critical analysis of reality'" (Zwierewicz, 2013, p. 166), and focused on a teaching and learning process with

autonomy, transformation, collaboration and search for integral development (Torre; Zwierewicz, 2009).

From this perspective, the active methodologies suggested by the participating teachers, if worked from complex practices, can provide possibilities for solving problems arising from reality. In addition, what involves the environment and sustainability is fundamental, especially because "[...] the school and its pedagogical practice can enable awareness of attitudes and reflections on sustainability" (Pukall, 2019, p. 84).

In relation to teacher health, another theme suggested by them for the elaboration of the proposal, its relevance stands out, because "[...] it is essential to improve working conditions and avoid risk factors that negatively influence the quality of life of teachers" (Rocha *et al.*, 2017, p. 260). Although the program does not have the potential to transform the complete scenario, it was intended to stimulate teacher self-care, interconnecting it to the themes previously suggested by the participants.

Considering the flexibility of the program and the articulation of the meetings designed based on self-heteroeco-training, the PCE again stand out as possibilities for action, especially "[...] by the ability to work in teaching from life, turning to it with solutions projected in the classroom itself, with the help of situations and resources that go beyond the exclusive use of scientific knowledge" (Torre; Zwierewicz, 2009, p. 155).

Nevertheless, there were also challenges specific to the school context, making it clear that the PCE do not solve all the problems that permeate the educational environment, and this is not their purpose, but they can favor educating for life and from life. Morin (2011, p. 54) indicates precisely that the education of the future needs to consider human complexity, because the human being is singular and multiple at the same time, favoring knowledge "[...] of the condition common to all humans and of the very rich and necessary diversity of individuals, peoples, cultures, on our rootedness as citizens of the Earth".

It is noteworthy that the intention of presenting the PCE to the teachers was related to "inviting" and not to "prescribing" scripts. In this sense, although there are obstacles, such as the time to carry out the projects, they are part of the process that Morin (2011, p. 76) defines as the ecology of action, as it is necessary "[...] to take into account [...] the random, the chance, the initiative, the decision, the unexpected, the unforeseen, the awareness of drifts and transformations". In this context, the PCE do not serve as barriers,

but as generators of sparks of creativity and innovation, valuing strategies that coexist and complement what is already being done by teachers.

In addition, the program's commitment to the resignification of education was revealed, as it is committed to life and, therefore, is complex, because "The developments proper to our planetary era confront us more and more and more ineluctably with the challenges of complexity" (Morin, 2011, p. 36). The training proposal also considered the principle of dialogicity, which is not about "[...] simple overcoming of contradictions through a synthesis, but as a necessary and complementary presence of antagonistic processes or instances" (Morin, 2015, p. 114).

CONCLUSION

Unbridled consumption, socio-environmental and economic implications, hunger, deforestation, flooding and droughts, such extremes are explainable and capillarized, mainly, by thoughtless human action. Therefore, it is necessary to implement ethics and environmental responsibility, not only individually, but collectively. In this scenario, therefore, it is not effective to teach students only to memorize biological concepts, calculations applied to science or scientific theories, it is necessary to stimulate pertinent knowledge, moving towards a complex, transdisciplinary and eco-formative education.

However, it is not a matter of emptying contents, but of enabling teaching and learning processes that interrelate biological concepts, calculations and theories applicable to the concrete reality of students. This stimulates an education that is truly connected to the student context, permeated by multidimensionality, the global and the complex, which can favor the understanding of scientific applications and implications. A school like this, which collaboratively works with the demands of reality, is indispensable.

In this construction, it is understood the relevance of providing subsidies to teachers for their journey towards the ecosystem paradigm, favoring teaching and learning processes based on creativity, pertinent knowledge and local and global reality. These conditions mentioned above, as well as the understanding of the predominance of the positivist paradigm in education and continuing education and the need to overcome it, represent the intention of this research, which aimed to develop a proposal for transdisciplinary and eco-formative training for Science and Biology teachers working in a Basic Education school in Santa Catarina.

Despite the limitations of the research, as the training proposal was not effectively applied in the EEB Antonio Gonzaga, the theoretical value it presents stands out, providing subsidies for future application. It is expected, from this perspective, that the research has contributed to the theoretical and methodological field about socially committed continuing education, such as the Training-Action Program in Creative Schools.

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REFERENCES

1. André, M., & Martins, F. P. (2020). Reflexões sobre a formação de professores: um diálogo com Marli André. *Devir Educação*, 4(1), 188–198. <https://doi.org/10.30905/ded.v4i1.241>
2. Bardin, L. (2016). *Análise de conteúdo* (L. A. Reto & A. Pinheiro, Trans.). Lisboa: Edições 70.
3. Brasil. (2001). Parecer CNE/CES 1.301/2001. Diretrizes Curriculares para a formação de professores de Ciências Biológicas. Ministério da Educação, Conselho Nacional de Educação. Available at: <http://portal.mec.gov.br/cne/arquivos/pdf/CES1301.pdf>. Accessed on: November 25, 2024.
4. Cachapuz, A., et al. (Eds.). (2005). *A necessária renovação do ensino de ciências*. São Paulo: Cortez.
5. FAO, et al. (2022). *El estado de la seguridad alimentaria y la nutrición en el mundo 2022: adaptación de las políticas alimentarias y agrícolas para hacer las dietas saludables más asequibles*. Roma: FAO.
6. Freire, P. (1987). *Pedagogia do oprimido*. Rio de Janeiro: Paz e Terra.
7. Furlan, P. G., & Campos, G. W. S. (2014). Pesquisa-apoio: pesquisa participante e o método Paideia de apoio institucional. *Interface-Comunicação, Saúde, Educação*, 18, 885–894.
8. Gil, A. C. (2019). *Métodos e técnicas de pesquisa social* (7th ed.). São Paulo: Atlas.
9. Goedert, L., Delizoicov, N. C., & Rosa, V. L. (2003). A formação de professores de Biologia e a prática docente: o ensino de evolução. In *Encontro Nacional de Pesquisa em Educação em Ciências*, 4 (pp. 1–15). Bauru: ABRAPEC.
10. González Velasco, J. M. (2017). *Religaje educativo: espacio-tiempo*. La Paz: Prisa.
11. Imbernón, F. (2009). *Formação permanente do professorado: novas tendências*. São Paulo: Cortez.
12. Loureiro, C. F. B. (2019). Questões ontológicas e metodológicas da educação ambiental crítica no capitalismo contemporâneo. *Revista Eletrônica do Mestrado em Educação Ambiental*, 36(1), 79–95.
13. Moraes, M. C. (1996). O paradigma educacional emergente: implicações na formação do professor e nas práticas pedagógicas. *Revista em Aberto*, 70.
14. Moraes, M. C. (2018). *Sentipensar: fundamentos e estratégias para reencantar a educação* (2nd ed.). Rio de Janeiro: Wak.
15. Morin, E. (2018). *A cabeça bem-feita: repensar a reforma, reformar o pensamento* (E. Jacobina, Trans.). (24th ed.). Rio de Janeiro: Bertrand Brasil.
16. Morin, E. (2015). *Ensinar a viver: manifesto para mudar a educação* (E. de Assis Carvalho & M. Perassi Bosco, Trans.). Porto Alegre: Sulina.
17. Morin, E. (2011). *Os sete saberes necessários à educação do futuro* (C. E. F. da Silva & J. Sawaya, Trans.). (2nd ed.). São Paulo: Cortez; UNESCO.
18. Nascimento, F., Fernandes, H. L., & Mendonça, V. M. (2010). O ensino de ciências no Brasil: história, formação de professores e desafios atuais. *Revista Histedbr On-line*, 10(39), 225–249.

19. Nóvoa, A. (2017). Firmar a posição como professor, afirmar a profissão docente. *Cadernos de Pesquisa*, 47(166), 1106–1133. <https://doi.org/10.1590/198053144843>
20. Nóvoa, A. (2019). Os professores e a sua formação num tempo de metamorfose da escola. *Educação & Realidade*, 44, 1–15. Available at: <https://www.scielo.br/j/edreal/a/DfM3JL685vPJryp4BSqyPZt/?format=pdf&lang=pt>. Accessed on: November 25, 2024.
21. Nóvoa, A. (2001). Professor se forma na escola. *Nova Escola*, (41). Available at: <https://pt.scribd.com/document/350449964/PROFESSOR-Se-Forma-Na-Escola-Antonio-Novoa>.
22. Oda, W., & Delizoicov, D. (2011). Docência no Ensino Superior: as disciplinas Parasitologia e Microbiologia na formação de professores de Biologia. *Revista Brasileira de Pesquisa em Educação em Ciências*, 11(3), 101–122.
23. Petraglia, I. (2013). *Pensamento complexo e educação*. São Paulo: Livraria da Física.
24. Pukall, J. P. (2019). Projeto Criativo Ecoformador: nosso planeta, nossa casa. In M. Zwiewicz, V. L. Simão, & V. L. S. Silva (Eds.), *Ecoformação de professores com polinização de Escolas Criativas* (pp. 84–89). Caçador: UNIARP.
25. Rocha, R. E. R., et al. (2017). Sintomas osteomusculares e estresse não alteram a qualidade de vida de professores da educação básica. *Fisioterapia e Pesquisa*, 24, 259–266.
26. Torre, S., & Zwiewicz, M. (2009). Projetos Criativos Ecoformadores. In M. Zwiewicz & S. Torre (Eds.), *Uma escola para o século XXI: Escolas criativas e resiliência na educação* (pp. 153–176). Florianópolis: Insular.
27. UNESCO. (2021). Relatório mundial das Nações Unidas sobre desenvolvimento dos recursos hídricos 2021: O valor da água: dados e fatos. Paris: UNESCO. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000375751>. Accessed on: November 25, 2024.
28. Zanol, A. G. (2021). Programa de Formação-ação em Escolas Criativas: das demandas de docentes do ensino fundamental à Agenda 2030 para o Desenvolvimento Sustentável (Master's dissertation). Universidade Alto Vale do Rio do Peixe, Caçador.
29. Zwiewicz, M. (2011). Formação docente transdisciplinar na metodologia dos Projetos Criativos Ecoformadores – PCE. In S. Torre, M. Zwiewicz, & E. C. Furlanetto (Eds.), *Formação docente e pesquisa transdisciplinar: Criar e inovar com outra consciência* (pp. 141–158). Blumenau: Nova Letra.
30. Zwiewicz, M. (2013). Projetos Criativos Ecoformadores – PCE: Uma via metodológica desde e para o paradigma da complexidade. In S. Torre, M. A. Pujol, & V. L. S. Silva (Eds.), *Inovando na sala de aula: Instituições transformadoras* (pp. 151–175). Blumenau: Nova Letra.
31. Zwiewicz, M., et al. (2017). Pedagogia ecossistêmica, transdisciplinaridade e ecoformação na gestão da Educação Básica: uma iniciativa da Secretaria de Educação de Paulo Lopes. In *Seminário da Rede Internacional de Escolas Criativas – Educação transdisciplinar: emergem Escolas Criativas e transformadoras*, 3 (pp. 1846–1856). Palmas: Universidade Federal do Tocantins.