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Alternative Methodology of Problem Cases - AMPC for soil education guided by emancipatory principles

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ABSTRACT: Soil Education aims to give individuals a transforming formative process for conscious actions related to the soil in their life experiences in and with the world. As such, the educational methodologies addressing soil-related contents should be in dialogue with the purpose of this educational process. On the perspective of education for social transformation, it is recommended that professors of Higher Education avoid from pedagogical actions with traditional approaches, and start using other strategies and methodologies centered on students and their context. With the challenge of addressing the implementation of emancipatory principles in educational procedures within the disciplinary structure of a traditional paradigm of education and achieving the aim of Soil Education, we put forward the *Alternative Methodology of Problem Cases* (AMPC), which was shaped up from two methodologies with constructivist principles, P*roblem-Based Learning* (PBL) and *Team-Based Learning* (TBL). This methodology is divided into three phases (preparation, application, and reflection), which are in turn divided into seven steps that complement each other (recovery of socio-historical knowing and knowledge; study of the themes; problem case resolution; team guidance; individual activity report; and individual and collective feedback). In addition, the steps contain individual and team assignments, which revolve around the resolution of problem cases related to the future profession. The AMPC is different from PBL and TBL as the former is grounded on emancipatory principles that facilitate the development of educational processes that value the socio-historical knowing and knowledge of individuals and enable the development of students' autonomy, creativity, critical thinking, and awareness for actions in real life. The challenges through which individuals can develop relational, complex, and critical thinking, apply them to professional life situations, confront and reframe their knowledge and knowing, as well as create solutions and plan future scenarios with the practice of solving problem cases about soils consist in the capacity of AMPC to be efficient to soil learning.

Keywords: methodological alternative, educational process, higher education, emancipatory paradigm.

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INTRODUCTION

Formative process on soils and the concomitant transformation of individuals for conscious soil-related actions in their life experiences in and with the world demands approaches in an educational[1] paradigm that create opportunities for that intent. In Brazil, as in other countries, the traditional paradigm still prevails in Higher Education, guiding professors theoretical concepts and pedagogical practices. In this context, soil education processes are mainly grounded on that paradigm, with the routine use of teaching approaches and methods such as lectures, laboratory practice, and field classes (Silva and Ribeiro, 2004; Hartemink et al., 2014; Batista et al., 2016; Krzic et al., 2018; Amador, 2019; Jelinski et al., 2019). The student's role is essentially to listen, memorize and reproduce information conveyed by the professor, which facilitates neither knowledge construction nor the political transformation of the individual for actions in real life (Demo, 2011).

In contrast to the traditional paradigm, emancipatory educational processes value the use of methodologies that promote protagonism and autonomy while centered on the student (Gadotti, 2017). In this process, the professor is a facilitator for knowledge construction, and the students are encouraged to solve challenges. The purpose of student-centered educational processes is the preparation of emancipated, reflective, critical, creative, and conscious individuals that are able to construct their knowledge for the transformation of reality (Freire, 1987; Demo, 2011). Those features make us think that the emancipatory paradigm can contribute to reaching the goal of Soil Education in the context of Higher Education.

Dissatisfaction with traditional methods of learning about the soil has motivated professors from several universities around the world to use student-centered methodologies, such as Problem-Based Learning (PBL) or its combination with Team-Based Learning (TBL) (Krzic et al., 2015). Problem-Based Learning and TBL are constructivist methodologies[2] through which students learn from problem-solving (Michaelsen and Sweet, 2008; Lopes et al., 2019). Both are introduced in the literature as efficient for learning about the soil. They enable students to collaborate and think critically and creatively to solve problems they will likely encounter in their future profession (Amador and Görres, 2004; Krzic et al., 2018; Amador, 2019; Krzic et al., 2020). The PBL and TBL are consolidated in Higher Education, especially in Medicine programs, and during the COVID-19 pandemic, they were suggested as methodological alternatives for Remote Teaching in some situations (Hernández et al., 2021; Rezende and Silva-Salse, 2021).

The student's protagonism and the implementation of pedagogical actions based on educational methodologies that catalyze students' critical and creative potential are some of the guidelines from Institutional Pedagogical Projects in Brazilian federal universities to the pedagogical projects of their respective programs (PDI UFBA, 2017; PDI UFG, 2018-2022; PDI UFPR, 2020). In this context, professors should turn away from traditional pedagogical actions and progressively reorganize their educational procedures while mainly incorporating student-centered methodologies since the protagonism of students is understood as a necessary condition for their learning, development, and conceptual understaning (PDI UFPR, 2020).

This paper aims to introduce the proposal of an *Alternative Methodology of Problem Cases* (AMPC) for Soil Education at universities while pointing out the emancipatory principles that it contemplates, its structure, and operational procedures, as well as a proposal for student learning assessment in the educational process.

[1] According to Behrens et al. (2006, p. 185) educational paradigms are "educational practices with well-defined, grounded ideas and assumptions that are taken as criteria of truth, validation and reference to be embraced by science at a given time, according to the current world view".

[2] Constructivism is a learning theory which the knowledge is constructed by the individual's interaction with his physical and social environment (Becker,1992).

Theoretical foundation of the Alternative Methodology of Problem Cases (AMPC)

The use of problems to assist the learning process is not new to education. The Alternative Methodology of Problem Cases (AMPC) was based on two methodologies, the modified Problem-Based Learning *(PBL)* introduced by Lopes et al. (2019) and the Team-Based Learning *(TBL)* presented by Michaelsen and Sweet (2008).

Modified Problem-Based Learning (PBL) as introduced by Lopes et al. (2019)

Use of real-life problems to assist learning is not new and precedes the PBL methodology, which has been widely disseminated in the literature since 1970. The PBL was systematized by the McMaster University Education Committee (Canada) in 1969 to replace the lecture approach in the Medicine program (Mattar and Aguiar, 2018). It is currently used in different Higher Education programs, especially in medicine programs, Elementary Education, and Continuing Education for Professor (Lopes et al., 2019). In this methodology, the professor is the guide of the educational process; learning is self-directed, student-centered, and takes place in individual steps and small groups. Introducing a problem to be solved by the students is a tool for learning development (Barrows, 1996), as it promotes the organization of knowing and is a catalyst for knowledge construction. Consequently, students learn while analyzing and solving significant problems (Dochy et al., 2003).

The PBL is not fixed, as there are several adaptations of this methodology in the literature, guided by five constructivist principles: knowledge construction, social interaction, epistemic motivation, real-life interaction, and metacognition (Ribeiro, 2005). That is why learning is understood as a constructive, self-directed, collaborative, and contextual process (Dolmans et al., 2005).

The adaptation introduced by Lopes et al. (2019) is divided into three moments and nine steps. In the first moment, the professor: 1) introduces the problem situation to the groups, and they are instructed to 2) recognize the problem scenario and identify the facts; 3) create hypotheses to solve the problem; and 4) identify the information needed to solve the problem, as well as the learning difficulties. The second moment is a self-directed study in which each student should individually 5) look up and collect information considered necessary for solving the problem; 6) define strategies to solve the problem. Finally, in the third moment, with new and different information, each group should: 7) apply the new insights to solve the problem; 8) discuss and assess the new insights; 9) reach one or more conclusions. At the end of the cycle, each group authors a final report with the solution if the problem is solved. A new cycle begins if the group does not come to a solution.

The PBL assessment has a procedural and formative character (Lopes et al., 2019), and professors use it to reframe their teaching strategies. The student is assessed via content objectives; the skills developed during the process, such as cooperation, communication, group work, and individual and group competence to respond, manage and solve problems (Lopes et al., 2019).

Team-Based Learning (TBL) as introduced by Michaelsen and Sweet (2008)

Team-Based Learning is analogous to PBL, but they are different methodologies. Larry K. Michaelsen developed TBL at the University of Oklahoma (USA) in the 1970s for the Business Administration program (Hrynchak and Batty, 2012) to work with large classes with the types of problems students would come across in their professional practice (Parmelee et al., 2012). It is a methodology centered on teamwork, in-depth reasoning, and critical thinking (Sakamoto et al., 2020). In it, students manage concepts, solve problems, and the majority of the class time is used for team assignments (Michaelsen and Sweet, 2008).

The TBL sequence described by Michaelsen and Sweet (2008) consists of allocating students into teams and organizing content into units. In each unit, there are six steps: 1) individual study of the material assigned by the professor for the unit; 2) individual test of the main concepts studied; 3) as a team, students take the same test as in Step 2 to reach a consensus on the answers. In the end, the professor provides immediate feedback; 4) each team has the opportunity to write appeals and arguments about the answers they got wrong, and the professor evaluates; 5) the professor should clear doubts that come up during the team test and in the appeals and arguments; 6) significant problem resolution as a team, discussion as a team and among the teams to recognize and defend the solutions found.

Student's assessment is performed throughout the process and includes peer assessment. In TBL, the assessment is essential for analyzing individual and team performance and each student's contribution to teamwork success (Krug et al., 2016).

Critical analysis of PBL and TBL

The potential of PBL and TBL for student learning and cognitive development is significant. According to some authors, those methodologies improve the student's verbal and written communication; promote the apprehension of concepts and content; improve teamwork cooperation; boost critical thinking; and ensure motivation and greater student engagement in the educational process (Amador and Görres, 2004; Nieder et al., 2005; Alkhasawneh et al., 2008; Abdelkhalek et al., 2010; Ofstad and Brunner, 2013; Wilder, 2015). On the other hand, the negative aspects are related to the initial uncertainty of the professor and student; they are very time-consuming and may not be suitable for some curricula and programs (Thompson et al., 2007; Souza and Dourado, 2015). However, several papers in the literature use PBL and TBL in Higher Education, especially at the undergraduate level.

Although PBL and TBL have a constructivist foundation, some essential characteristics of their methodologies dialogue with the emancipatory paradigm of education, such as: solving significant problems can spark curiosity for research; the creativity to conceive projects, and critical thinking to change reality; and learning is a constructive, collaborative and contextual process. However, some characteristics do not support the emancipatory paradigm since the learning process focuses on developing the students' skills based on training with the professor as a guide. They can create competition in terms of "who knows best" among the students; learning is restricted to what the student needs to know to solve a problem, and the so-called procedural and formative assessment focuses only on content objectives and the performance of skills and competencies.

For that reason, we believe that the outline of an adapted methodology that takes emancipatory principles into account in an educational process is more suitable to meet the demands of the current society and the purpose of Soil Education.

Alternative Methodology of Problem Cases (AMPC)

The PBL (Lopes et al., 2019) and TBL (Michaelsen and Sweet, 2008) methodologies served as a structural basis to outline the Alternative Methodology of Problem Cases (AMPC), laid out in figure 1. The theoretical foundation for the AMPC also considered emancipatory principles (Table 1) in the scheme of its phases and steps, and they are the differentiators against the PBL and TBL methodologies.

The AMPC incorporates aspects of some steps from PBL (Lopes et al., 2019) and TBL (Michaelsen and Sweet, 2008) (Figure 2). It is divided into three phases (preparation, application, and reflection), which are in turn divided into seven steps that complement one another (recovery of socio-historical knowing and knowledge about the theme; study of the themes; problem case resolution; team guidance; sharing the solution to

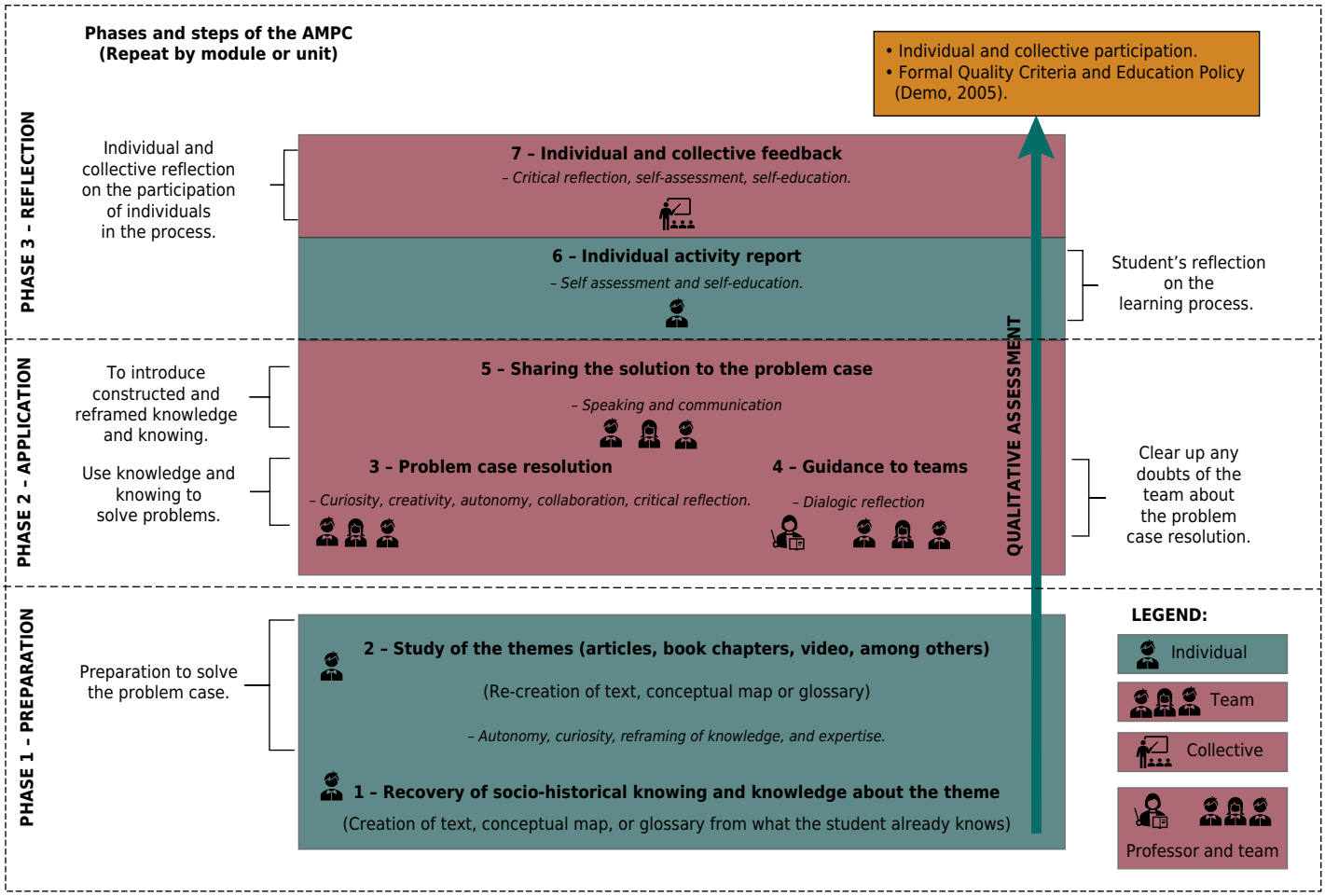

Figure 1. Structure of the Alternative Methodology of Problem Cases (AMPC).

the problem case; individual activity report; and individual and collective feedback), which are outlined in figure 1.

Before being used in the classroom, the professor should explain its structure and workings to the students and how he/she will lead the process. For its application, the content given in the syllabus needs to be divided into modules, and each module should contain thematic units to implement the method according to the following sequence:

Phase 1 – Individual preparation to solve the problem case.

It is the students' preparation to solve the problem case via two individual steps.

Step 1. Recovery students' of socio-historical knowing and knowledge of the themes (individual):

In the first step, the students should be instructed to individually write a text, a conceptual map, or a glossary and list the main concepts they find necessary to study the themes in the unit (Figure 1). They should not refer to any materials but rather perform the assignment based on their current knowledge.

This step does not exist in TBL (Michaelsen and Sweet, 2008; Bollela et al., 2014; Krug et al., 2016), as its first step is to study the material provided by the professor, which shows the disinterest in the students' socio-historical experiences, a principle of the emancipatory paradigm. It is similar to Step 2 of Moment I in PBL since after students review the problem scenario as a team, they should identify their previous knowledge on the topic (Figure 2) (Souza and Dourado, 2015; Lopes et al., 2019). However, it is worth mentioning that the aim of Step 2 in PBL is not to value the socio-historical knowing

Table 1. Emancipatory principles that characterize the elements of an educational procedure, proposed based on Cunha (1998) and Mizukami (1983)

Emancipatory principles to be met by the educational process	Element of the educational process
1. Concern with popular culture, students' socio-historical knowing, and their local context, without disregarding the global context. 2. It proposes its own programmatic content. 3. Implemented by students based on research (experiments made by students). 4. It proposes existential situations concerning content research that students will reframe.	Methodology
5. It encourages reflective analysis by proposing the conceptual construction and reframing information, data, arguments, and ideas. 6. It encourages and values curiosity, problematization, questioning, doubt, and uncertainty. 7. Doubt and error are integral parts of the learning process and can propel thinking. 8. Knowledge is interdisciplinary and relational, attributing meanings of its own to contents, depending on social and academic objectives.	Course content
9. It focuses on knowledge from the historical location of its production and perceives it as provisional and relative. 10. Individual constitutes themselves and becomes an individual as far as he reflects on knowledge and commits himself to it, becoming aware of his historicity. 11. There are no standard models for answers, but as many answers as there are problematizations, and it is possible to find different answers for the same problematization. 12. Construction of knowledge is linked to the process of political awareness. 13. Process of political awareness is always unfinished, continuous, and progressive.	Knowledge in itself
14. Interactionist approach, with an emphasis on the individual as a maker and creator of knowledge. 15. Concrete individual: placed in a historical context, they are a being of praxis (action and reflection on — in and with — the world, to transform it). 16. The individual is an open system in successive reframings, never completely reached.	Agents of the learning process
17. Horizontal and non-imposed professor-student relationship. 18. Professor-student relationship values socio-intellectual skills as much as content. This perspective requires students and professors to address the problems of social practice, taking into account the perspectives of the future and the challenges of thinking, with commitment, about the demands of the new, the not-given. 19. Professor has the role of demystifying and questioning the dominant culture with the student, valuing their language and culture, and creating conditions for each one to analyze the contents and produce culture. 20. Student has an active role, responsible for constructing the learning processes.	Professor-student relationship
21. Teaching-learning relationship overcomes the oppressive relationship; through a problematizing education based on dialogicity, surpassing the subject-object dichotomy. 22. It encourages the students' own experiences to structure themselves and act through meaningful learning. 23. It prioritizes the individuals' activities, considering them as placed in a local/global context. 24. It understands research as a teaching instrument and extension as a starting point and arrival point for the apprehension of reality.	Teaching-learning relationship
25. Collaborative and integrated vision through the educational process. 26. Culture in systematic and relational acquisition in meaningful human experience (which makes sense to the individual). 27. The participation of persons as agents in society, culture, and history, is done to the extent of their awareness, which implies demythologization, that is, demystifying reality.	A vision of society-culture to be elicited during the process

Continue

Continuation

28. Education has a broad character, one not restricted to the University space. 29. University as a place where personal growth of the process agents is possible. 30. University as an institution that exists in a given society's historical context. 31. A participatory, decentralized, democratic University where decisions are shared and open to new knowledge, possibilities, and relationships with the community. 32. The University enables students to be autonomous and offers conditions for them to develop themselves in their becoming process.	A vision of the University that the process makes it possible to think about
33. It must be preceded by a reflection on the individual and an analysis of the individual's way of life. 34. It takes place as a process in a context that must be considered. 35. Process of socialization and democratization of relationships. 36. Stimulating a new understanding of reality. 37. It comes from the paradigm of interpretive, qualitative, subjective research with explicit values based on reality. 38. Holistic and contextualized.	A vision of education that the process makes it possible to think about
39. World is in interaction with the individual. 40. The world is subject to transformation by the individual, transforms the individual, and is again contextualized procedurally and continuously.	A worldview that the process makes it possible to think about
41. Procedural and continuous qualitative assessment and/or self-assessment, in which processes are more relevant than products. 42. Assessment is the ongoing educational practice of the members in the learning processes.	Assessment process

and knowledge developed throughout the students' lives, as in the AMPC, but only to determine what they find helpful to solve the problem.

In this step, the AMPC contemplates the following emancipatory educational principles: *"1. Concern with popular culture, students' socio-historical knowing and their local context, without disregarding the global context"* from the Methodology element, and *"22. It encourages the students' own experiences to structure themselves and act through meaningful learning"* from the Teaching-learning relationship element (Table 1). Calling to mind and valuing students' socio-historical knowing and knowledge are based on the emancipatory concept that the students are not something empty but rather conscious individuals who problematize their relationships with the world (Freire, 1987). The concern with popular culture in educational processes is common to the emancipatory paradigm, hence why it is not considered in constructivist methodologies, such as PBL and TBL.

Step 2 - Study the material about the theme (individual):

It is the moment to individually prepare for the teamwork that will take place in Step 3. Professors should provide materials, such as books, articles, videos, among others, that they find relevant for the study of the themes in the units in such a way that they do not eliminate the students' autonomy for content research.

After studying the contents, the student should redraft the text, the conceptual map, or the glossary created in Step 1 to validate, add, correct and build up on the reflection of concepts, terms, and definitions.

Step 2 of the AMPC can be characterized as a synthesis of Step 1 in Phase I of TBL and Step 5 in Moment II of PBL (Figure 2). However, it goes beyond what is proposed in PBL and TBL, as it enables the reframing of students' socio-historical knowing and knowledge via reflective assignments. In TBL, the professor oversees the material assigned for study, and the students are responsible for their individual preparation and content learning. This way, students should study what is determined by the

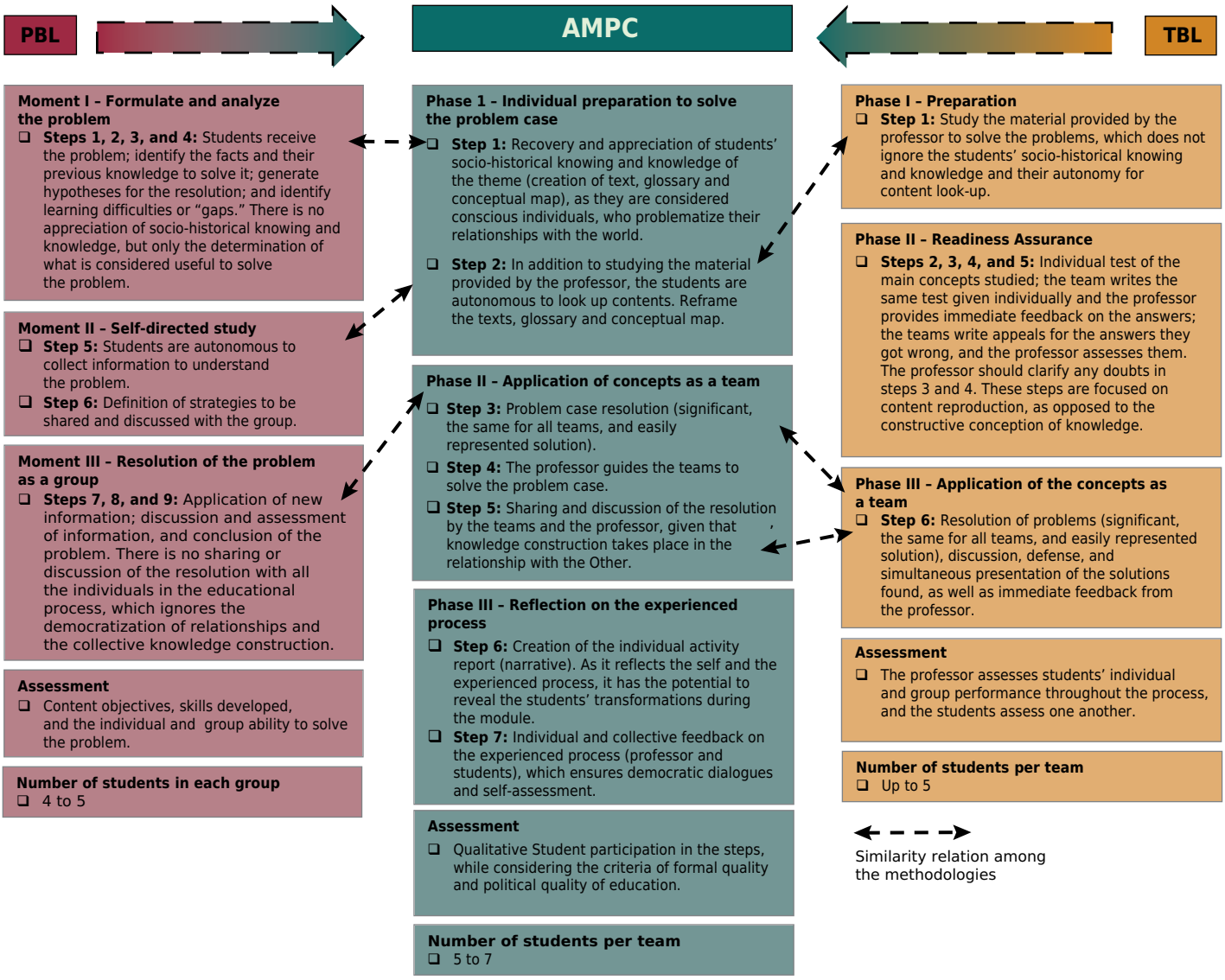

Figure 2. Synthesis of moments, steps, and stages of the Problem-Based Learning (PBL) methodologies as modified and presented by Lopes et al. (2019), Team-Based Learning (TBL), as presented by Michaelsen and Sweet (2008), and the Alternative Methodology of Problem Cases (AMPC), identifying the similarities between PBL and TBL concerning the AMPC.

professor only, without any autonomy for research. In contrast, in PBL, students are autonomous to look up important information to understand the problem (Lopes et al., 2019; Michaelsen and Sweet, 2008).

Step 2 in the AMPC aims to promote the student's ownership of the individual study and to be instrumental in creating that autonomy since the assignment also encourages research and the search for other sources of information on the themes from the Units. In this case, according to the principle "*32. The University enables students to be autonomous and offers conditions for them to develop themselves in their becoming process*" from the element A vision of the University that the process makes it possible to think about (Table 1). Therefore, the professor should encourage the creation of students' autonomy via content research as, according to Freire (1996) and Demo (2005, 2011), the search for autonomy is an educational principle for the emancipation of the individual.

Re-creation of the assignment in Step 1 (text, conceptual map, or glossary) is a strategy exclusive to the AMPC, and it considers the emancipatory principle *"5. It encourages reflective analysis by proposing the conceptual construction and reframing of information, data, arguments, and ideas"* from the Course Content element (Table 1). The intent is

to reframe socio-historical knowing and knowledge and ensure preparation to solve the problem case in Step 3. While drawing on Demo (2011), we point out that this principle breaks with the reproductive conception of knowledge transmission, and enables a constructive process through the student's own creation.

In TBL, Phase II, called "Readiness Assurance," has four Phases (2, 3, 4, and 5) that revolve around tests to assess students' readiness to solve the problem as a team (Figure 2), was completely ignored in the AMPC. In this phase, an individual test is performed, and then the same test is taken as a team, without opening any books, as presented by Michaelsen and Sweet (2008), Bollela et al. (2014) and Krug et al. (2016). The test consists of 10 to 20 multiple-choice questions that cover the most relevant concepts of the previously assigned readings (Krug et al., 2016).

Instead of using the individual and team multiple-choice tests from Steps 2 and 4 in Phase II of TBL, as described by Michaelsen and Sweet (2008), the AMPC delivers more reflective practices designed in the recreation of the assignments (text, glossary, and conceptual map) (Figure 2), as the use of tests, via quantitative assessment, emphasizes the reproduction of concepts and information, which is an aspect that contradicts the Demo's concept (1999, 2005, 2011) of knowledge construction and qualitative assessment of education that prevails in emancipatory educational processes.

Phase 2 –Application of team concepts:

Phase 2 corresponds to the application of knowledge built and reframed in Phase 1. It is divided into three steps, with team activities (Figure 1).

For the preparation of this phase, we considered three of the four basic principles described by Michaelsen and Sweet (2008) for TBL, Step 6 of Phase III: the problem must be significant to the students; all teams must work on the same problem case, and each team must present a specific solution through an easily represented answer (Figure 2).

Step 3: Problem case resolution (team):

Students must work in a team (from 4 to 5 members) to solve a problem case that they are likely to encounter in their professional practice. Each team must study the problem case and raise hypotheses about possible solutions. If students identify gaps in learning, they should return to materials studied in Step 2 or search for new sources.

The problem case is a hypothetical situation in a complex context, which is characterized by the connections of the relationships and interactions between the contents prepared by the professor, and which demands an equally complex solution. It needs to be meaningful to students, authentic, contextualized, multifaceted, and not have a right or wrong answer or found in course materials, but present multiple possibilities for answers.

The resolution of the problem case is a step that contemplates the principle *"14. Interactionist approach, with an emphasis on the individual as a maker and creator of knowledge,"* of the Agents of the learning process element (Table 1) as the AMPC is *"3. Implemented by students, based on research (experiments made by students),"* which is a principle of the Methodology element (Table 1). These two principles are essential in emancipatory educational processes since students become the central point, producing knowledge of their own. Demo (2011) suggests that the professor must fulfill the role of motivator, someone at the service of student emancipation.

Based on the practice of solving problem cases, AMPC contemplates two other emancipatory principles: "*6. It encourages and values curiosity, problematization, questioning, doubt, and uncertainty"* of the Course Content element*; "4. It proposes existential situations concerning content research that will be reframed by students"* of the Methodology

element (Table 1). In this case, relying on Freire (1987), we understand that the content approach will start from an existential, concrete situation, from a problem that challenges students to an intellectual response and urges them to think about political action.

In formulating the problem cases for the AMPC, we followed the guidelines of Michaelsen and Sweet (2008) and Parmelee et al. (2012) for the TBL. In this case, reaching a solution will only be possible through critical thinking, in-depth discussion, and debate among team members. Thus, the AMPC considers the principles from the elements Knowledge in itself and Course content that *"11. There are no standard models for answers, but as many answers as there are problematizations, and it is possible to find different answers for the same problematization"* and *"7. Doubt and error are integral parts of the learning process and can propel thinking,"* respectively, address table 1. Based on Demo's (2011) ideas, a proposal like this moves away from the transmission and reproduction of information approaches and addresses a constructive perspective of knowledge.

Construction of knowledge in the relationship with the Other is a principle that underlies emancipatory educational processes (Freire, 1987; Demo, 2005). Therefore, the professor must understand the AMPC team steps as a crucial moment in the students' learning process. For the TBL methodology, Michaelsen and Sweet (2008) emphasize that the heterogeneity of team members is essential for the methodology to work effectively. Bollela et al. (2014) recommend a strategic distribution of students in teams to ensure sociodemographic diversity, academic performance, professional and extracurricular experience, and personality. However, this attitude is imposing and authoritarian from the point of view of emancipatory educational processes. Therefore, at AMPC, students must form teams based on their own criteria.

Another vital point that must be considered concerning AMPC is the number of students per team. The number of students per team is quite varied in studies on PBL and TBL. Typically, they range from four to five in the PBL (Souza and Dourado, 2015) and five to seven in the TBL (Bollela et al., 2014; Krug et al., 2016). We assume that a team with up to five students is ideal for teamwork, as a bigger team can make the professors guidance work unfeasible (Figure 2).

Step 4: Guidance to teams (team):

In step 4, the professor will guide each team in solving the problem case. In the context of educational and communication technologies, any tool that allows direct, fast, and uncomplicated communication between students and professors will be helpful at this step to support guidance.

Professor should guide the teams concerning questions to solve the problem case, considering the principle *"17. Horizontal and non-imposed professor-student relationship"* of the Professor-Student Relationship element (Table 1). The professors role is not to deliver a ready answer but to urge the team to think, reflect, articulate ideas, and reformulate hypotheses to arrive at the solution. In this context, it leaves the condition of the holder of knowledge and fulfills the function of following up on students' learning process. Thus, AMPC encompasses principles *"19. The* professor *has the role of demystifying and questioning the dominant culture with the student, valuing their language and culture, and creating conditions for each one to analyze the contents and produce culture,"* and *"20. The student has an active role, responsible for constructing the learning processes"* of the Professor-Student Relationship element (Table 1). Based on Demo (2011), we sustain the concept that in the educational context for which AMPC was proposed, professors must guide students towards learning how to create and develop their own ability to produce knowledge and not to "pass on" someone else's knowledge.

Both in PBL and TBL, there is guidance on the procedures and implementation of methodologies before their application, but there is no specific step to guide the team

to solve the problem (Michaelsen and Sweet, 2008; Lopes et al., 2019), as occurs in AMPC in Step 4 of Phase II (Figure 2). AMPC's team-guidance step is essential for student learning. It is a moment of dialogue in which the professor must guide the teams to research, autonomous thinking, and reframing knowledge and knowing. It is also when the professor can present more systematic information about the themes, if necessary, but taking care not to provide answers or induce the team to a specific solution.

Step 5: Sharing the solution to the problem case (teams):

Teams must meet during the virtual class and put together a presentation containing the solution to the problem case and the route taken to reach it and socialize with all classmates and the professor.

Following the guidance of Michaelsen and Sweet (2008) for TBL, we adopted the strategy that teams must present the specific solution to the problem case through an easily represented but not simplified answer. This sharing step only takes place in TBL, at Step 6 of Phase III (Figure 2), in which each team's answers are presented simultaneously, and professor feedback is immediate (Krug et al., 2016). Simultaneous presentation, directly and indirectly, can generate competitiveness between teams — an aspect that does not match the emancipatory conception of education since, according to Demo (2005), the individual learns collaboratively.

Considering that the construction of knowledge occurs in dialogue with the Other (Freire, 1987), the team presentation step is also a learning moment, as it seeks to meet the principle *"35. Process of socialization and democratization of relationships"* of the element A vision of education that the process makes it possible to think about (Table 1). Therefore, professors must urge the group of all students to discuss solutions built by each team to reflect on and reframe their knowledge and knowing.

Phase 3 - Process reflection

This phase is divided into two steps; none occurs or is similar to PBL and TBL steps (Figure 2).

Step 6: Individual activity report (individual)

It consists of the reflection of the process experienced by the student in the previous steps. The student must build an individual activity report (critical and reflective text) about their learning process during the module, covering three aspects: relevance of the themes and contents studied in the module; challenges and potentialities of the AMPC methodology perceived for the construction and reconstruction of knowledge and knowing; analysis of activities carried out through the AMPC methodology, concerning the contribution to the foundation and exercise of citizenship for conscious actions/practices in reality. Chart 1 shows an example of how to present the instructions for this step to students.

The reflection phase of the educational process is exclusive to AMPC (Figure 2). It was proposed to meet an educational context based on emancipatory principles, in which the critical reflection of individuals is inherent to their formative process.

The construction of the individual activity report is a process of reflection by students about themselves and their learning process in the module. Therefore, students' narratives in the report can reveal the transformations they underwent during the educational process. The idea of legitimately listening to what the student says about themselves and the experiences lived during the module is supported by Passeggi (2020, p. 68, free translation) statement that to understand the changes brought about by education, it is necessary to consider the "narratives of those who learn, in which knowing, wishes, duties, and powers thrive. Storytelling is necessary! Listening is even more so".

Chart 1. Example instruction of Phase III, Step 6 – Reflections about the Alternative Methodology of Problem Cases (AMPC) presented to students.

Step 6. Individual Activity Report

Prepare an analytical-critical text about the activities *[number of activities]*, which encompassed the contents of *[describe the name of the contents provided for in the course syllabus]*, which includes its reflection on the following aspects:

1. The main themes and contents related to the *[course name]* worked on in the Activities you performed. Present your point of view on the importance of these topics and contents for your personal and professional formative process.
2. The main challenges and potential of the learning methodology adopted in these activities for the construction of knowledge[1] and reconstruction of knowing[2] about *[course name]*. Which aspects of the learning methodology do you consider to have contributed the most and which have contributed the least to your learning in the course? Justify your answer.
3. How these activities helped you establish and exercise citizenship[3] for conscious actions/practices in *[the course's focus topic]*. Present, in your text, how you would apply what you learned during the activities in your professional performance.

Note: the three aspects above guide the preparation of the Individual Activity Report. However, you must build a reflective and consistent text and not just answer the questions punctually.

[1] Knowledge is the act or effect of abstracting the idea or notion of something. Its construction requires the ability to self-elaborate, which involves creativity, curiosity, critical-reflective thinking, and autonomy.

[2] Knowing is what we do with knowledge and how to use it in a prudent, moderate, fruitful, and useful way. As we build knowledge, the knowing is reconstructed.

[3] The set of an individual's rights and duties allows them to intervene in society.

Through the critical reflection on oneself and the educational process experienced, the writing of the individual activity report meets the principles *"36. Stimulating new understanding of reality"* of the element A vision of education that the process makes it possible to think about, *"39. The world in interaction with the individual"* and *"40. The world is subject to transformation by the individual, transforms the individual, and is again contextualized procedurally and continuously"* of the element A worldview that the process makes it possible to think about (Table 1), making students realize that their worldview is not something determined and static and that there is a dialectical relationship between them and the world.

Also, it offers possibilities for the student to be aware of their role in society, thus achieving principle *"27. The participation of persons as agents in society, culture, and history, is done to the extent of their awareness, which implies demythologization, that is, demystifying reality"* of the element A vision of society-culture to be elicited during the process (Table 1).

Step 7: Individual and collective feedback (team):

This Step is also exclusive to AMPC. Similar steps do not occur in PBL and TBL (Figure 2). During the classroom meeting, the professor should be responsible for initiating a dialogue

about the individual and collective assessment of students in the module. The role of the professor is to encourage students to expose their impressions and reflections on the learning process in the previous steps. In addition, professors and students should reflect on their role in the experienced process, the motivations and demotivations, the relationship with the Other, whether the themes and the problem case were significant for the students, and the difficulties perceived, among other aspects that arise, which, of course, will be relevant.

We suggest that professors start by presenting their impressions, anxieties, and insecurities, making a self-assessment of their role during the process experienced, because by placing themselves as agents of the educational process in a relationship of equality with the students, they will feel safe and more at ease to express their feelings, without being judged negatively for it — an aspect related to the principle *"17. Horizontal and non-imposed professor-student relationship"* of the Professor-Student Relationship element (Table 1). The dialogue between the group during the feedback is an opportunity for students to perceive education as a *"35. Process of socialization and democratization of relationships,"* as per the element A vision of education that the process makes it possible to think about (Table 1). It is pertinent to emphasize that the individual learning dimension should not be disregarded. However, in an emancipatory perspective of education, the relationship with the Other and democratic dialogues are the process' focus (Freire, 1987). In this sense, collective work gains importance since "the humans are educated in communion, mediated by the world" (Freire, 1987, p. 44, free translation).

In addition, feedback is a moment for assessment. In this context, assessment is a pedagogical practice, reflective research, as it transmits a message and professors, in addition to being a way to develop student autonomy and critical thinking (Gadotti, 2017).

This step was created at AMPC because we consider that the educational process should not end when students reach a solution to the problem, as in PBL and TBL (Figure 2), but when all individuals (professors and students) collectively reflect on and assess what they experienced and how the educational process had an impact on their personal and professional formative process.

At the end of the AMPC sequence, if the professor wants to adopt it as the sole methodology for the course, the process is restarted, occurring as many times as necessary to contemplate the course syllabus — an aspect that must also occur, whether PBL or TBL is used.

Assessment in the AMPC

Student participation and autonomy constitute the nature of emancipatory educational practice and are a precondition for their learning (Gadotti, 2017). Therefore, we suggest a qualitative assessment (Demo, 1999, 2005), in which the process is more relevant than the product. Thus, taking into account the principle *"41. Procedural and continuous qualitative assessment and/or self-assessment, in which processes are more relevant than products"* of the Assessment Process element (Table 1).

Assessment in the AMPC differs from the proposals for the PBL and TBL (Figure 2). In PBL, the professor assesses content objectives, skill development, and students' individual and group ability to solve the problem. In TBL, the professor assesses students' individual and group performance throughout the process, and they assess each other. We understand that the learning assessment must be constant and constitute a qualitative follow-up of student evolution by the professor. Therefore, in the AMPC, the assessment must occur at each module. In addition, the assessment criteria must be based on students' participation in individual and team activities, considering the formal and political fashion of education, as adapted from Demo (2005) and shown in table 2.

Table 2. Formal quality criteria and education policy to serve as a basis for evaluating students in educational processes subsidized by the Alternative Methodology of Problem-Cases (AMPC), as adapted from Demo (2005)

Quality	Criteria
Formal	1) Research to establish relationships with reality in a critical way. 2) Knowledge aimed at project construction and reconstruction. 3) Theoretical understanding of practices to creatively intervene in reality. 4) Commitment to permanent updating, to advance in the knowledge. 5) Expression of reflective thought, argumentation, reasoning, and learning.
Political	1) Prioritize the constitution of an individual's autonomy (prepare a project of their own, know how to read reality critically and creatively, and design an alternative future). 2) Act in participatory learning practices (collective actions, taking on collective and common tasks). 3) Prioritize the development of notions and practices of citizenship, human rights, sustainable development, and solidarity. 4) Present intentions to organize processes to encourage the exercise of political competence of the actors involved. 5) Present a prospective vision for change in reality.

As the AMPC was proposed for implementation in educational procedures within a disciplinary structure of the traditional paradigm — in which assigning a grade to students is required —, we suggest assessing students according to the criteria presented in table 2 for each module. The final grade can be composed of a weighted average between the modules. In it, weights are attributed to each module, integrating the course contents. It considers the relevance of the contents covered in each module concerning the whole. Considering that "the assessment qualitative assessment aims to surpass quantitative assessment, without dispensing with it" (Demo, 2005, p. 109, free translation), we propose the number of activities conducted and the number of criteria met by students as parameters for assigning grades on the scale from zero to 100.

In short, the AMPC is more appropriate for use in Soil Education in Higher Education and to achieve the purpose of this educational process than PBL and TBL. Its phases and steps direct students towards the development of autonomy, critical reflection, creativity, curiosity, and critical awareness of their role in the world as political individuals capable of building knowledge of their own and empowering themselves for social transformation.

Still, the AMPC enables a student-centered educational process from the resolution of problem cases and constitutes an alternative for the formative processes on soils in the Remote Teaching modality, as well as in Hybrid Teaching, Classroom and Distance Education, and also in short-term extension courses, as this methodology is subject to adaptations. In Remote Learning, Steps 1, 2, and 5 can be performed asynchronously, and Steps 3, 4, 6, and 7 synchronously, adapting them to the reality of institutions of Higher Education.

FINAL CONSIDERATIONS

It was possible to combine aspects of some of PBL and TBL's steps and propose a methodology to support educational procedures guided by emancipatory principles for Soil Education in Higher Education. Therefore, there were no difficulties in modifying these methodologies and proposing the *Alternative Methodology of Problem Cases* (AMPC). The AMPC differs from PBL and TBL mainly because it considers emancipatory principles besides presenting steps in which students recover, value, and reframe their

socio-historical knowing and knowledge; receive guidance from the professor on the solution of the problem case; reflect individually and collectively about themselves and the educational process experienced, and are assessed qualitatively.

Although they have a constructivist basis, PBL and TBL are methodologies that dialogue with the emancipatory paradigm of education, as they foster curiosity, creativity, and critical thinking, besides considering learning as a constructive, collaborative, and contextual process. However, these methodologies do not value students' socio-historical knowing and knowledge, focusing more on the development of skills than on the construction of knowledge, and restrict student education to what they need to learn to solve a problem — aspects that are overcome using the AMPC.

AMPC's efficiency for students' learning and education on soils lies in placing them in challenges that provide the development of complex, relational, and critical thinking, apply it to professional life situations, confront and reframe knowledge and knowing, build solutions, and plan future scenarios by the practice of problem-case solving.

Although the AMPC considers principles of the emancipatory paradigm, which allow soil education and the concomitant transformation of individuals towards conscious actions related to soils in their experience in and with the world, it does not determine this educational paradigm. In other words, only using the methodology does not ensure an emancipatory Soil Education. For this to occur, the educational structure, the educational procedures in their entirety, and the professors view of education must contemplate the principles of this paradigm. Furthermore, the AMPC is not an attempt to "improve" professors class sessions but is part of a proposal for educational procedures guided by emancipatory principles. The use of AMPC must be preceded by an educational intention on the part of the professor cthat dialogues with the emancipatory principles that underlie it.

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