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TEACHING SEQUENCE FOR TEACHING ENVIRONMENTAL HEALTH TOPICS: guidelines for construction and validation

SEQUÊNCIA DIDÁTICA PARA O ENSINO DE TEMAS EM SAÚDE AMBIENTAL: diretrizes para construção e validação

SECUENCIA DIDÁCTICA PARA LA ENSEÑANZA DE TEMAS DE SALUD AMBIENTAL: lineamientos para la construcción y validação

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ABSTRACT
This article aims to present and discuss the steps related to the construction and validation of a Didactic Sequence (DS), using Socioscientific Questions (SQs) on thematic intersections in health and the environment, didactically organized in Three Pedagogical Moments (3MPs). Characterized as an action research, the study had as its target audience teachers of Elementary School II, carried out in three stages: assessment of the teacher profile, construction of the DS and validation. The results showed that the methodological integration achieved the intended objectives, offering a holistic and interdisciplinary approach. Finally, after adjustments by peers, the DS was validated, standing out as promising for future approaches to environmental health themes.

KEYWORDS: Teaching strategy; Basic education; Health; Environment.

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Introduction

The area of knowledge in environmental health is a widely consolidated field of study, as it integrates existing interconnections between the themes of health and the environment. However, it was only in the last two decades, with the rise of social and political movements aimed at promoting awareness, conservation and recovery of the environment, that the importance of integrating discussions between the axes of health and the environment emerged with greater emphasis (Alves, 2021).

The World Health Organization (WHO) stood out as the body responsible for conceptualizing the integration of themes, defining environmental health as an area of public health responsible for addressing the interrelationships that exist in health and the environment, concerned with the forms of life and conditions surrounding human beings (Brazil, 1999a). In the years following the conceptualization, debates around the topic of environmental health intensified, and, among the main agendas, the need to integrate it as a cross-cutting theme stood out, especially in educational training processes (Machado Filho et al., 2023).

In basic education, the first advances in the scope of the theme occurred in the National Curricular Parameters (PCNs) and in the National Environmental Education Policy (PNEA - Law 9.795), providing subsidies for innovative approaches to the theme classified as emerging. However, despite the efforts, the documentary norms of the PCNs and PNEA did not specify educational guidelines and orientations on how the integration of health and environmental themes should happen, weakening their approach in pedagogical praxis[1] (Brazil, 1999b; Pinhão & Martins, 2012; Machado, 2018; Machado Filho et al., 2022).

The time frame of research carried out in the last decade shows that, despite constant concerns for the integration and discussion of the thematic axes in health and the environment, advances are minimal, especially in the basic education segment (Suarte et al., 2022; Machado Filho et al., 2023; Araújo et al., 2024). The concept itself, described as "environmental health", is hidden in the main and most current document guiding education in the country, the National Common Curricular Base (BNCC) (Brazil, 2018). For Suarte et al. (2022), Machado Filho et al. (2023) and Araújo et al. (2024), the BNCC, in its capacity as a normative document, does not directly address the

[1] The concept of pedagogical praxis is presented here as the practice of educational theory presented by the teacher in the classroom, including the development and its constant adaptation between theory, practice and reflection, in order to better meet the needs of students (Fortuna, 2022).

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environmental issue, nor does it unequivocally promote its intrinsic connection with health.

In addition to the weaknesses present in the official documents of basic education, other gaps can negatively compromise the didactic-pedagogical progress of the focus on environmental health. Among the obstacles identified in the literature, the following stand out: emphasis on conceptual and mechanistic approaches; teaching strategies anchored in traditional pedagogical practices; teaching materials with a limited and deficient approach; and a shortage of pedagogical support instruments (Machado Filho et al., 2022).

Machado Filho et al. (2023), Araújo et al. (2023, 2024) agree that certain didactic-pedagogical adversities result in demotivation in students and, consequently, make the benefits that the field of knowledge in environmental health can provide distant, namely, skills and competencies related to the prevention of diseases resulting from environmental pollution, the promotion of sustainable practices, and the effective management of natural resources.

To overcome these educational obstacles, there are numerous paths that range from a reassessment of the teacher's didactic-pedagogical planning to the use of different teaching-learning methodological strategies. However, for the teacher, adopting a proactive educator profile and engaging with active teaching methodologies and practices requires, in most cases, making changes in their pedagogical activities (Bacich & Moran, 2017).

In terms of innovative education[2], there are several approaches and teaching strategies that aim to improve the teaching-learning process. Among them, the content-based approach stands out, through Socio-Scientific Questions (SSIs), proposed by Conrado and Nunes-Neto (2018), and the use of the Three Pedagogical Moments (3MPs), discussed by Delizoicov et al. (2002). Both tend to be enhanced when structured and organized through Didactic Sequences (DS) (Zabala, 1998).

From this perspective, considering the gaps presented and the possibilities described to better advance the study of the environmental health theme in basic education, this article aims to present and discuss the steps related to the construction and validation of an interdisciplinary SD, using QSCs on thematic intersections in health and the environment, organized didactically along the lines of the 3MPs.

[2] In the book "Active Methodologies for Innovative Education: a theoretical-practical approach", the authors Bacich and Moran (2017) define innovative education as the adoption of approaches and practices that integrate new ideas, technologies and methodologies to provide more relevant and effective learning experiences for students.

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Finally, it is worth highlighting that this research does not intend to focus on the analysis of the development of the students' learning process based on the execution of the SD. The approach of this article is focused on the process of idealizing the teaching material, covering: teaching strategies adopted for the structuring and validation of the SD; and initial and final perspectives of teachers on the pedagogical instrument in the classroom context.

2 Metodology

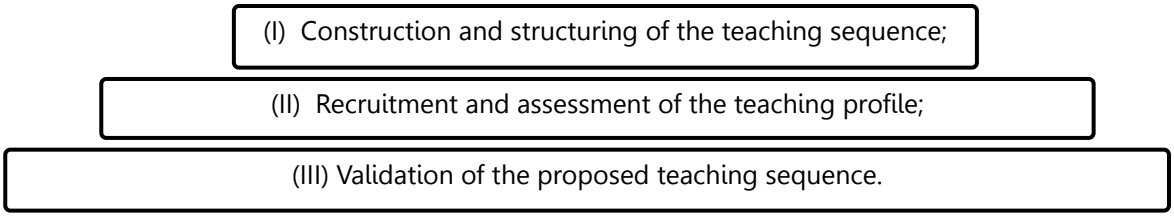
2.1 Methodological path: target audience and stages

This research was carried out in person between March and August 2024, in the cities of Lajes Pintadas and Santa Cruz, located in the Borborema Potiguar microregion, state of Rio Grande do Norte (RN). The target audience was composed of teachers working in basic education, elementary school level II, final years. The choice of the audience and educational segment was justified because these are the formative series in which the theme of environmental health, the object of this study, is addressed with greater emphasis within the curricular matrix, according to the BNCC (Brazil, 2018; Araújo et al., 2024).

Regarding the number of participants, it is clear that the proposal was presented to the 10 schools in the network that constitute the previously designated public. Regarding participation, there was full collaboration from the school units, 6 from the city of Santa Cruz/RN and 4 from the city of Lajes Pintadas/RN. With a complete professional staff, formed by 10 teachers from different curricular disciplines, involvement and/or adherence to the initiative happened randomly, according to availability, disciplinary and curricular interest of the teachers.

To achieve the proposed objectives, the methodological path was divided into three (3) stages (Figure 1).

Figure 1
Stages of the methodological path



Fonte: Prepared by the authors (2024).

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Regarding the methodological approach, this is a predominantly qualitative and applied study, whose purpose is to discuss and generate relevant knowledge aimed at the application and resolution of local issues. Regarding the outlined objectives, an exploratory research approach was adopted. Regarding the technical procedures, action research was used, highlighting the participatory interaction of the subjects involved, in order to pave the way for the discovery of new learning opportunities (Gil, 2019).

2.2 Details of the research steps

2.2.1 Stage I: recruitment and assessment of the teaching profile

As a method of recruiting participants, the SD proposal was presented to teachers in their respective schools. Once they expressed interest in participating and carrying out the activity, interviews were conducted using a semi-structured pre-questionnaire, containing open and closed questions, previously developed and standardized with the purpose of: knowing the profile of the participating teachers and their sociodemographic characteristics (age, gender, education and others); gathering prior knowledge about environmental health, with specificity in local themes; investigating the didactic-pedagogical exploration of environmental health themes, and mapping the use and knowledge about active/innovative methodologies.

2.2.2 Stage II: construction and structuring of the teaching sequence

Following Fiscarelli's principles (2007), the construction of teaching materials must be conducted under a theoretical foundation that guides teaching actions and strategies. In this sense, the SD was based on QSCs, aiming to address health and environmental issues and their intersections, described as environmental health (Conrado & Nunes-Neto, 2018).

According to authors Conrado and Nunes-Neto (2018), Socioscientific Issues are:

> Controversial and complex problems or situations, which can be transposed to scientific education, as they allow a contextualized approach to interdisciplinary or multidisciplinary content, with scientific knowledge being fundamental for understanding and finding solutions to these problems (Conrado & Nunes-Neto, 2018, p. 15).

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From this perspective, the QSC proposed for the SD under consideration was designed through contemporary contexts, considering problems of social relevance at global, national, regional and local levels. Examples include: inadequate disposal of toxic waste; deforestation and loss of biodiversity; open-air dumps; natural radioactivity, among others.

Additionally, to better structure the DS methodologically, the teaching strategy based on the Three Pedagogical Moments was used, organized into three stages: initial problematization, organization of knowledge and application of knowledge (Delizoicov et al., 2002). It is also stated that, in addition to the three stages (3MPs), a moment was included to assess the students' prior knowledge.

The 3MP methodology seeks to highlight the importance of dialogue and mediation between the scientific knowledge worked on in the classroom and the students' daily experiences. In a broader definition, it is portrayed as:

> Possibilities of establishing a dynamic of teaching performance in the classroom that contemplates aspects that enhance knowledge. Characterized by what has been called pedagogical moments, distinguishing three of them with specific and differentiated functions, namely: initial problematization, organization of knowledge and application of knowledge (Delizoicov et al., 2002, p. 200).

Therefore, for the context of the suggested SD, this methodological strategy appeared to be promising, given that, in its stages, there is a wide possibility of including and structuring diverse curricular content, including topics in environmental health.

2.2.3 Etapa III: validação da proposta de sequência didática

To validate the SD, the contribution of the participating teachers was counted on, using the instrument proposed by Guimarães and Giordan (2011), which comprises four phases: prior analysis (I), a priori validation (II), experimentation (III) and a posteriori validation (IV). This type of validation is based on the confrontation between the preliminary evaluation, based on the theoretical aspects of the material (phases I and II) and the final evaluation, which refers to the analysis of the results obtained by applying the teaching sequence (phases III and IV).

The validation instrument used has 16 evaluation items, divided into 4 categories, namely: I) structure and organization; II) problematization and teaching

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approach; III) contents and concepts, and IV) evaluation of activities and feedback (Table 1).

Table 1

Descriptors for peer validation analyses regarding DS. Grade 1 (poor), grade 2 (regular), grade 3 (good) and grade 4 (excellent)

I - Structure and Organization				
Sufficiency value assigned regarding coherence	1	2	3	4
A1. Quality and originality of the SD and its articulation with the discipline's themes				
B1. Clarity and intelligibility of the proposal				
C1. Adequacy of time according to the proposed activities and their executability				
D1. Support Material/Theoretical Reference/Bibliography				
II - Problematization and Teaching Approach				
Sufficiency value assigned regarding coherence	1	2	3	4
A2. Articulation between themes, concepts and problematization				
B2. Approaching the problem in light of the teaching strategies used				
C2. Articulation between the presented theme and the SDGs				
D2. SD's contribution to the promotion of Scientific Education				
III - Contents and Concepts				
Sufficiency value assigned regarding coherence	1	2	3	4
A3. Alignment between objectives and content				
B3. Exploration of Conceptual, Procedural and Attitudinal Knowledge				
C3. Logical organization in the sequence of contents				
D3. Proposed interdisciplinarity				
IV - Activity assessment and feedback				
Sufficiency value assigned regarding coherence	1	2	3	4
A4. Assessment methods				
B4. Level of assessment and suitability for the activities carried out				
C4. I would use SD				
D4. I would recommend SD to other teachers.				

Source: Adapted from Guimarães and Giordan (2011) and Vasconcelos et al. (2022).

2.2.3.1 Phases I and II: prior analysis and a priori validation

In the preliminary analysis phase (I), the first version of the SD in its entirety was made available to teachers, so that they could subsequently analyze and infer an a priori validation process (II), using the form described in Table 1 as an evaluation instrument. A total of 10 days was made available to carry out phases I and II.

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After analyzing the previous evaluations carried out by peers (phases I and II) and the consequent contributions to the teaching material under consideration, the adaptation, completion and implementation of what was consolidated as the second version of the SD were carried out.

2.2.3.2 Phases III and IV: experimentation and a posteriori validation

The experimentation phase (III) concerns the application of SD in the classroom. To this end, in partnership with the SD design team, teachers used the second version of the teaching instrument (adjusted) in their teaching practices, aiming to observe its effectiveness and identify possible new adaptations.

Once the SD experimentation was completed, the a posteriori validation phase (IV) was carried out by the participating teachers. For this moment, the same instrument applied in phase II "a priori validation" was used (Table 1). However, in the final evaluative inference, the teachers received guidance on the importance of paying attention to the critical-investigative approach of SD, emphasizing the way in which content and activities were organized and the learning indicators used. The need to carry out a comparative analysis between the prior evaluation (a priori validation) and the implementation of SD in practice (a posteriori validation) was also highlighted (Guimarães & Giordan, 2011).

Observations and recommendations provided by teachers in phase IV were incorporated into the development of the third and final version of the SD. For better illustration, Figure 2 presents the evolutionary flowchart of the three versions of the SD, highlighting their alignment with validation phases I, II, III and IV.

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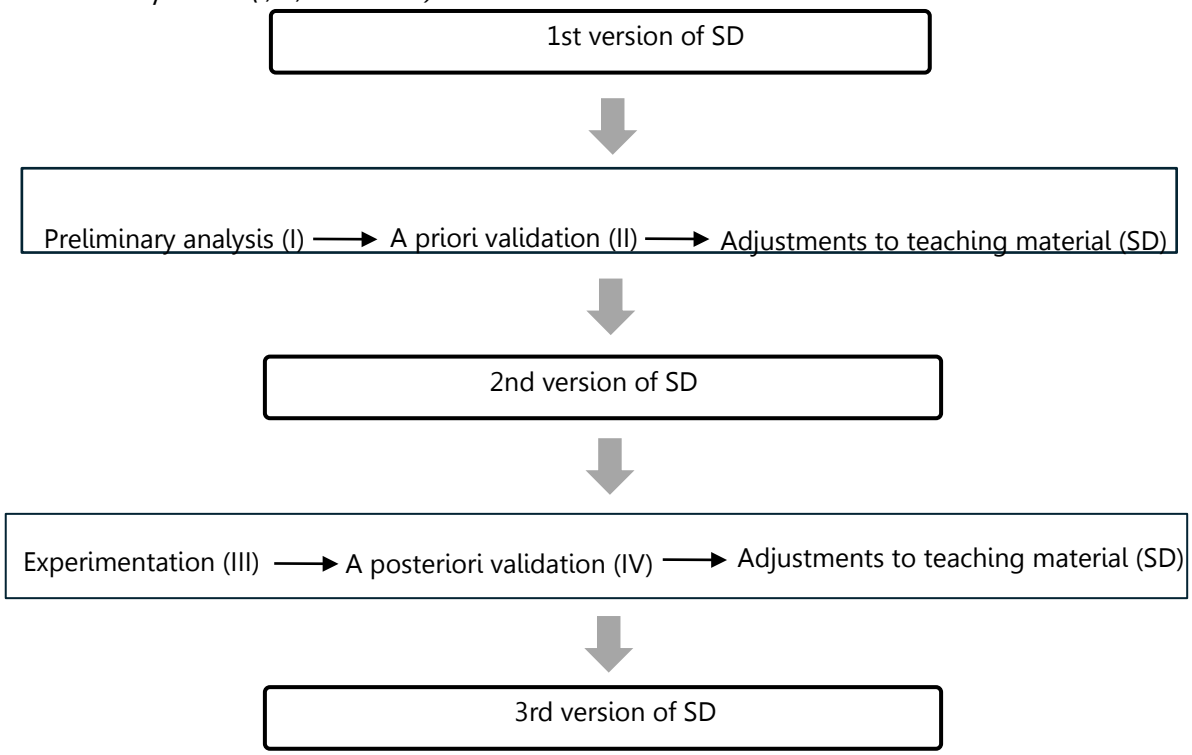
Figure 2
Evolutionary flowchart of the three SD versions and their correspondence with the validation phases (I, II, III and IV).



Source: Prepared by the authors (2024).

2.3 Data analysis and ethical aspects

In order to improve the comparison, discussion and presentation of results, descriptive statistics were used using Microsoft Excel® software. It should be noted that the collection of data, as well as the implementation of this research, was approved by the Ethics Committee of the Federal University of Rio Grande do Norte - UFRN (CAEE: 70257823.8.0000.5568). All participants were duly informed about the data collection procedures and signed the Free and Informed Consent Form, as required by the aforementioned Ethics Committee.

3 Results and Discussion

3.1 Profile of study participants

Of the 10 participating schools, only 1 teacher per school unit was involved, totaling 10 members, all from the Science curricular component. It is pertinent to mention that, despite the interdisciplinary bias of DS, the established disciplinary

tendency is understandable, given that the thematic scope of health and the environment presents itself as a predominant theme in Natural Sciences, especially for the disciplines of Science and Biology. In line with this, studies conducted by Silva and Garcia (2020), Lustosa et al. (2023) and Araújo et al. (2024) discuss similar results.

Regarding the profile of the teachers, all had a single degree, a degree in Biological Sciences, complemented by postgraduate studies (specializations) in the areas of Biology and Education. The age of the participants ranged from 28 to 47 years, with a balanced distribution between the sexes, being 06 men and 04 women. Concerning professional experience, there was a variation of 5 to 17 years, indicating a considerable diversity of experiences and practices in the educational context.

Furthermore, when questioned about the curricular approach to topics in environmental health, health and the environment, environmental quality and related topics, in general, they argued that there was little curricular exploration in educational practice, attributing difficulties in finding didactic guidelines, mainly in books and teaching materials. And, regarding the knowledge or use of didactic sequences and active/innovative methodologies, in accordance with Santos et al. (2020), they reported knowing and understanding their importance for improving the teaching-learning process, however, they reported limitations in initial training, time and planning for incorporation into daily practice.

3.2 Construction and structuring of the teaching sequence "Environmental health: what is it?"

In compliance with the discussions by Monteiro et al. (2019), it was considered pertinent to address detailed descriptions of the construction and structuring of the SD as a result, as the outcomes obtained may be crucial for subsequent transparency, stimulation and replicability of the study.

To this end, similar to the guidelines of Fontoura et al. (2020), regarding the challenges and perspectives for promoting scientific education in basic education, the SD stages and activities focused on providing guidelines for teachers to carry out pedagogical practices aimed at enabling their students to apply the scientific knowledge obtained, in order to train them to constantly and routinely integrate scientific conceptualization in real situations, instead of just looking for a solution without scientific support or basis.

From this perspective, the activities of the teaching sequence were based on working on concepts and themes in health and the environment, in addition to their

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integration described as environmental health. As a result, the organization contextualized subjects aligned with the BNCC and interrelated them in a global, national, regional and, especially, local perspective, so that during the execution of the SD, students could know and relate the knowledge acquired to their daily reality.

In terms of methodological foundation, the combination of pedagogical strategies used in SD, QSC approach and 3MPs, proved to be didactically positive. This configuration, guided by the guidelines of Conrado and Nunes-Neto (2018) and Delizoicov et al. (2002), showed that exploring content through a QSC developed based on the reality of the participants constitutes a fundamental step towards a better development and application of scientific concepts, namely, themes in environmental health.

Regarding the use of 3MPs, parallel to the reflections of Delizoicov et al. (2011) on the teaching of Science, fundamentals and methods, the content exploration programmed for SD showed potential for application, since the organization of the methodological stages along the lines of 3MPs provided a flexible structure, capable of being adapted to different contexts and disciplines, assisting in the planning of classes in a more integrated manner and allowing a broader approach to the explored contents. Thus, more than simply acquiring scientific knowledge, in both teaching strategies adopted (QSC and 3MPs), the activities were directed towards improving the skills necessary to obtain, produce and analyze content in a critical manner.

However, despite the potential highlighted for the methodological strategies used in SD, there are limitations in the literature regarding their associations and benefits. However, in the context of this research, the unification between QSC and 3MPs proved to be simple and fluid, especially due to the alignment and complementarity between their methodological steps.

In summary, the QSC enabled an interdisciplinary contextualization of curricular content, encouraging critical understanding of real problems, while the structuring by the 3MPs facilitated the mediation between scientific knowledge and life experiences (prior knowledge), contributing to meaningful learning[3]. In agreement, for Fonseca and Duso (2024) in their work on the diversification and association of pedagogical strategies in curricular organization, the authors highlight the relevance of varying,

[3] The theory of meaningful learning, by author David Ausubel, is based on the importance of cognitive storage of information and the connection of new knowledge with pre-existing concepts, taking into account the social, cultural and economic context of the learner to create relevant and participatory learning conditions (Moreira, 2023).

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unifying and testing teaching methodologies in teaching practice, aiming to increase engagement and improve the teaching-learning process.

3.3 Validation of the proposed teaching sequence

Given the importance of teachers in the processes of knowledge, assessment and validation of teaching materials (Fiscarelli, 2007), the results in sequence focus on presenting initial and final perspectives of this public on the DS under analysis and its effectiveness in the classroom context.

Taking the peer validation process as a parameter, Table 2 presents a comparison of the scores given to the SD under evaluation. The scheme considers the instrument proposed by Guimarães and Giordan (2011), described previously in Table 1, with emphasis on the preliminary evaluation (prior analysis and a priori validation), before the implementation of the SD (first version), and the final evaluation (experimentation and a posteriori validation), subsequent to the application of the teaching material (second version), Table 2.

Table 2

Results of the preliminary evaluation (preliminary analysis and a priori validation) and final evaluation (experimentation and a posteriori validation) carried out by peers regarding DS. Highlight on items C1, A2, C3 and D4 (preliminary and final evaluation, respectively)

Preliminary assessment I - Structure and Organization					Final assessment I - Structure and Organization				
Sufficiency value assigned regarding coherence	1	2	3	4	Sufficiency value assigned regarding coherence	1	2	3	4
A1.			9	1	A1.			3	7
B1.				10	B1.				0
C1.		**9**	**1**		C1.			**2**	**8**
D1.			3	7	D1.			1	9
II – Problematization and Teaching Approach					II – Problematization and Teaching Approach				
A2.		**5**	**4**	**1**	A2.			**2**	**8**
B2.				10	B2.				10
C2.				10	C2.				10
D2.				10	D2.				10
III - Contents and Concepts					III - Contents and Concepts				
A3.			5	5	A3.			1	9

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B3.			4	6	B3.			2	8
C3.		**6**	**3**	**1**	C3.			**1**	**9**
D3.			2	8	D3.			1	9
IV- Activity evaluation and feedback					IV- Activity evaluation and feedback				
A4.			1	9	A4.				10
B4.			2	8	B4.				10
C4.			4	6	C4.			1	9
D4.		**3**	**6**	**1**	D4.				**10**

Source: Research data (2024).

For all topics analyzed (I, II, II and IV), there was a positive variation in the grades awarded between the preliminary evaluation (prior analysis and a priori validation) and the final evaluation (experimentation and a posteriori validation), Table 2.

In topic I (Structure and Organization), the greatest fluctuation occurred in item C1. Before the SD experiment, item C1, which refers to the adequacy of time, according to the proposed activities and their executability, received a predominantly low evaluation, with 9 indications of grade 2 (regular) (Table 2). Among the points for improvement for this item, planning and time management of activities were mentioned. As strategies, the evaluating teachers suggested for the first version of the SD a better allocation of time for each activity, proposing a more flexible and balanced meeting schedule, in order to consider the students' learning pace.

Notes were also made to include strategic intervals for review and feedback. Thus, in line with the work of Freitas et al. (2022), the suggestions made were accepted in the composition of the second version of the SD, because in addition to considering the place of speech, the teacher has expertise in praxis and must feel part of the process for better immersion and involvement in the proposed activities.

After making the adjustments, changing from 04 meetings (first version of the SD) to 06 (second version of the SD), following the SD experimentation, the data reveal that, considering the final evaluation, the evaluators increased the score of item C1, going from 0 indications of maximum score (4 - excellent) to 8 (Table 2). These results showed improvements in the adequacy of time and in the executability of the proposed activities, resulting in a more efficient execution perspective aligned with the teachers' expectations.

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In topic II (Problematization and Teaching Approach), in item A2, which deals with the articulation between themes, concepts and problematization, a variation similar to the scores given to item C1 was recorded (Table 2). Initially, item A2 received relatively low scores, 5 inferences of scores 2 (regular), which reflected concerns about the coherence and connection of the contents for understanding and solving the proposed problematization (QSC). However, with the collaboration of the evaluating teachers, it was possible to review the sequence of contents of the first version of the DS, identify and correct gaps that hindered the resolution of the problem (QSC).

The correlation of results described in Table 2 demonstrates that the efforts to improve the teaching material were rewarded. After improving the first version of the SD and consecutively testing the second SD version, the scores given to item A2 increased significantly. Of the 10 evaluators, 2 gave a score of 3 (good) and 8 gave a score of 4 (excellent). In view of this, the progress in the scores indicates that, in addition to the theoretical contributions, in practice the teachers were able to observe a good articulation of the themes and concepts, perceiving a clear and effective integration for the understanding and unfolding of the problematization (QSC) described in the SD (Vasconcelos et al., 2022).

Regarding topic III (Contents and Concepts), the comparison between the preliminary and final evaluations revealed a greater variation in the scores for item C3, which addresses the logical organization in the sequence of contents. In the preliminary analysis, the item received lower scores, with 6 evaluations of inference 2 (regular) and only 1 indication of grade 4 (excellent) (Table 2). In the view of the evaluating teachers, similarly to what was discussed for item A2, there were weaknesses regarding the structure and coherence of the contents presented and the objectives overlooked in the first version of the SD.

To fill these gaps, the following adaptation strategies were proposed: review the content to ensure a logical sequence, in accordance with the BNCC; develop a schedule, aligning learning objectives with activities; include more practical examples and interactive activities at different geographic scales; and ensure continuous feedback during implementation, allowing dynamic adjustments based on students' perceptions.

After the peer reviews and subsequent implementations in the second version of the SD were carried out, the analysis after the SD experimentation shows that the scores given to item C3 improved significantly, going from 1 to 4 (excellent) to 9 (Table 2). In view of the results, it was clear that the improvements implemented as a result of

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the preliminary evaluation were effective, contributing positively to the qualification of the SD under evaluation. In agreement with Silva and Andrade (2020) and Santos et al. (2023), evaluation processes and adjustments such as these are essential, especially when seeking to ensure the effectiveness and relevance of an educational proposal aligned with the reality and needs of students.

In the fourth and last topic evaluated (Activity assessment and feedback), item D4, which asks whether teachers would recommend DS to other education professionals, recorded the greatest variation (Table 2). In the preliminary analysis, the item received regular evaluations, with 3 indications of a score of 2 (regular), 6 scores of 3 (good) and only 1 score of 4 (excellent), reflecting a possible hesitation by the evaluators in recommending the first version of the pedagogical instrument. However, after the experimentation of DS (second version) the scores attributed to the same item increased considerably, with all evaluations (10) receiving scores of 4 (excellent). The results obtained indicate a significant improvement in the evaluators' perception of the effectiveness and quality of DS, especially regarding the adjustments made after the preliminary evaluation of the first version.

In addition to the topics emphasized, it is worth highlighting that during the experimentation of the second version of the SD, new notes emerged from the evaluating teachers, which were fundamental for the elaboration of the third and final version of the teaching resource, Figure 3.

Figure 3

QR Code and access link to the full teaching sequence (third version)

Access link:
https://drive.google.com/file/d/1GEvGY78rEc1- O12RrqDOQp5CJkns7QD1/view

Source: Prepared by the authors (2024).

Among the main feedbacks raised for the latest version of the SD (Figure 3), the importance of including more frequent formative assessments to monitor students' progress in a continuous manner and adjusted to their difficulties and advances, as well as alternatives for carrying out practical laboratory activities provided for in the SD, stood out. Both requests were accepted, reinforcing the ongoing commitment to improving the quality of teaching and adapting teaching materials to the real needs of students and teachers. As a result, the participating teachers stated that they would recommend the third version of the SD to other educators.

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Based on what has been exposed, for Verdério and Souza (2024), in the construction and validation of a didactic sequence, the entire preliminary and final evaluation process carried out by peers is essential, considering not only the improvements achieved for the teaching tool, but also for the continued training of employees.

4 Final considerations

This study presented a proposal for a teaching sequence aimed at strengthening and teaching the theme of environmental health. Therefore, this article brought important strategies and reflections on the teaching product, based on the construction and validation procedures.

From all of the above, it was observed that the construction of the SD, through the methodological integration between the QSC and 3MP strategies, incorporated activities in a contextualized and interdisciplinary way, achieving previously established objectives. In detail, the unification not only provided a logical and coherent structure for the SD activities, but also facilitated the articulation between themes and concepts. Given the observation, it is suggested that this combination be reproduced and expanded in other educational proposals.

For teachers, it is worth highlighting that participating in the validation process provided an enriching experience, combining personal contributions from daily practice with knowledge acquired in action. Thus, among the main contributions, it is worth emphasizing that, with the experimentation of DS, it was possible to encourage, explore and apply diverse teaching methodologies, allowing them to reflect on their pedagogical practices and curricular exploration of environmental health topics. At the same time, teachers also contributed to the DS, inferring improvements/adjustments, in addition to validating the material as a promising tool for pedagogical practice. Consequently, both situations reinforce the importance of integrating basic education professionals as active collaborators in the development of teaching materials.

Therefore, it is concluded that in addition to presenting pedagogical potential to be applied in the classroom, the validated SD emerges and reaffirms the importance of working on themes in environmental health, environmental quality and other nomenclatures that integrate the association of contexts in health and environment, in order to promote environmental awareness, encourage sustainable behaviors and prepare students to face future environmental challenges.

As a long-term perspective, it is hoped that this work can serve as a research source for teachers seeking didactic guidance to approach environmental health topics. At the same time, by providing insights into the process of developing and validating educational products, it is also intended to be used as a model for other themes and/or areas of study, culminating in didactic support materials that strengthen teaching and learning in basic education.

Ultimately, despite the benefits highlighted, and given the limits of this discussion space, it is necessary to continue this research, in order to present in detail the potentialities and limitations of experimenting with DS in the classroom, however, with a focus on the context of experiencing and analyzing the development of the students' learning process.

Referências

Alves, A. F. (2021). *Saúde ambiental em debate*. Editora IFPB.

Araújo, R. S., Navoni, J. A., & Amaral, V. S. (2023). Saúde ambiental *in loco*: Estratégias iniciais para uma educação científica. *Revista Conexão UEPG, 19*(1), 1–21. https://doi.org/10.5212/Rev.Conexao.v.19.22235.045

Araújo, R. S., Navoni, J. A., & Amaral, V. S. (2024). Desafios e perspectivas para a temática saúde ambiental na educação básica: Analisando a BNCC. *Vivências, 20*(41), 177–197. https://doi.org/10.31512/vivencias.v20i41.1217

Bacich, L., & Moran, J. (2017). *Metodologias ativas para uma educação inovadora: Uma abordagem teórico-prática*. Penso.

Brazil. (1999b). *Lei 9.795, de 27 de abril de 1999. Dispõe sobre a educação ambiental, institui a Política Nacional de Educação Ambiental e dá outras providências*. http://www.planalto.gov.br/ccivil_03/leis/l9795.htm

Brazil. Ministério da Educação. (2018). *Base nacional comum curricular*. Ministério da Educação.

Brazil. Ministério da Saúde. (1999a). *Política nacional de saúde ambiental para o setor saúde*. Ministério da Saúde.

Conrado, D. M., & Nunes-Neto, N. (2018). *Questões sociocientíficas: Fundamentos, propostas de ensino e perspectivas para ações sociopolíticas*. EDUFBA.

Delizoicov, D., Angotti, J. A. P., & Pernambuco, M. M. C. A. (2002). *Ensino de ciências: Fundamentos e métodos*. Cortez.

Delizoicov, D., Angotti, J. A. P., & Pernambuco, M. M. C. A. (2011). *Ensino de ciências: Fundamentos e métodos* (4ª ed.). Cortez.

Fiscarelli, R. B. O. (2007). Material didático e prática docente. *Revista Ibero-Americana de Estudos em Educação, 2*(1), 1–9. https://doi.org/10.21723/riaee.v2i1.454

Fonseca, E. M., & Duso, L. (2024). Proposta de organização curricular sobre resíduos baseada em questões sociocientíficas para o ensino de ciências. *Vivências, 20*(41), 199–219. https://doi.org/10.31512/vivencias.v20i41.1162

Fontoura, H. A., Pereira, E. G. C., & Figueira, S. T. (2020). Formação de professores de ciências no Brasil e alfabetização científica: Desafios e perspectivas. *Uni-pluriversidad, 20*(1), 104–126. https://doi.org/10.17533/udea.unipluri.20.1.07

Fortuna, V. (2022). *Epistemologia, ética e práxis pedagógica em Paulo Freire*. Conhecer.

Freitas, C. J. S., Silva, A. F., & Costa, V. S. O. (2022). Sequência didática - resíduos sólidos: Atividades lúdicas como proposta pedagógica. *Debates em Educação, 14*(34), 186–211. https://doi.org/10.28998/2175-6600.2022v14n34p186-211

Gil, A. C. (2019). *Métodos e técnicas de pesquisa social* (7ª ed.). Atlas.

Guimarães, Y. A. F., & Giordan, M. (2011). Instrumento para construção e validação de sequências didáticas em um curso a distância de formação continuada de professores. *Anais do Encontro Nacional de Pesquisa em Ciências*, Campinas.

Lustosa, T. P., Gomes, P. N., & Carvalho, C. S. (2023). A abordagem da educação ambiental na Base Nacional Comum Curricular (BNCC): O que se mostra na etapa do ensino médio. *Revista Gestão & Sustentabilidade Ambiental, 12*(1), 1–14. https://doi.org/10.59306/rgsa.v12e12023e18293

Machado, A. A. (2018). Educação ambiental construindo elos entre saúde e meio ambiente: Relato de experiência numa escola pública em João Pessoa (PB). *Revista Brasileira de Educação Ambiental, 13*(2), 264–281. https://doi.org/10.34024/revbea.2018.v13.2412

Machado Filho, M. M., Ávila, M. C. N., Cunha, F. I. J., & Pessano, E. F. C. (2022). A relação meio ambiente e saúde através das concepções de estudantes e professores(as) dos anos finais do ensino fundamental. *Ensino, Saúde e Ambiente, 15*(3), 423–462. https://doi.org/10.22409/resa2022.v15i3.a48485

Machado Filho, M. M., Ávila, M. C. N., Pereira, K. B., Cunha, F. I. J., & Pessano, E. F. C. (2023). O ensino do meio ambiente e saúde nos documentos orientadores educacionais para os anos finais do ensino fundamental. *Revista de Educação da Universidade Federal do Vale do São Francisco, 13*(30), 33–60.

Monteiro, J. C., Castilho, W. S., & Souza, W. A. (2019). Sequência didática como instrumento de promoção da aprendizagem significativa. *Revista Eletrônica Debates em Educação Científica e Tecnológica, 9*(1), 292–305. https://doi.org/10.36524/dect.v9i01.1277

Moreira, M. A. (2023). *Aprendizagem significativa: A teoria e textos complementares*. LF Editorial.

Pinhão, F., & Martins, I. (2012). Diferentes abordagens sobre o tema saúde e ambiente: Desafios para o ensino de ciências. *Ciência & Educação (Bauru), 18*(4), 819–836. https://doi.org/10.1590/S1516-73132012000400006

Santos, A. L. C., Silva, F. V. C., Santos, L. G. T., & Aguiar, A. A. F. M. (2020). Dificuldades apontadas por professores do programa de mestrado profissional em ensino de biologia para o uso de metodologias ativas em escolas de rede pública na Paraíba. *Brazilian Journal of Development, 6*(4), 21959–21973. https://doi.org/10.34117/bjdv6n4-386

Santos, M. H. D., Abreu, B. S. D., & Roldi, A. P. D. P. (2023). Educação ambiental: Construção e validação de sequência didática sobre resíduos sólidos para o ensino médio. In P. R. Serpa (Org.), *Educação e meio ambiente: Possibilidades e desafios em pesquisa* (pp. 67–85). Editora Científica Digital.

Silva, A. F. S., & Andrade, M. A. S. (2020). Validação de sequência didática a partir de uma questão sociocientífica sobre desmatamento na perspectiva CTSA para os anos iniciais do ensino fundamental. *Revista de Estudos em Educação e Diversidade, 1*(2), 231–255.

Silva, M. S., & Garcia, S. N. (2020). Base Nacional Comum Curricular: Uma análise sobre a temática saúde. *Revista Electrónica de Enseñanza de las Ciencias, 19*(2), 320–345.

Suarte, L. B. O., Silva, K. L. F., & Seibert, C. S. (2022). Os desafios da saúde ambiental no currículo de ciências do ensino fundamental anos finais, no estado do Tocantins. *Revista Observatório, 8*(1), 1–24. https://doi.org/10.20873/uft.2447-4266.2022v8n1a5en

Vasconcelos, L. L., Marques, A., Calatrone, J. W., Machado, R. M., & Amado, M. V. (2022). Uso de sequência didática com abordagem CTSA para debater sobre desastres naturais no ensino médio. *Revista Eletrônica Sala de Aula em Foco, 11*(1), 312–324. https://doi.org/10.36524/saladeaula.v11i1.1423

Verdério, L. A. P., & Souza, L. C. A. B. (2024). Construção e validação de uma sequência didática com o tema queimadas baseada em questões sociocientíficas. *Revista Ciências & Ideias, 15*, 1–19. https://doi.org/10.22407/2176-1477/2024.v15.2450

Zabala, A. (1998). *A prática educativa: Como ensinar*. Artmed.

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RESUMO

Este artigo objetiva apresentar e discutir os passos referentes à construção e validação de uma Sequência Didática (SD), utilizando Questões Sociocientíficas (QSC's) sobre intersecções temáticas em saúde e meio ambiente, organizada didaticamente em Três Momentos Pedagógicos (3MP's). Caracterizado como uma pesquisa-ação, o estudo teve como público-alvo docentes do Ensino Fundamental II, realizado em três etapas: avaliação do perfil docente, construção da SD e validação. Os resultados mostraram que a integração metodológica atingiu os objetivos pretendidos, oferecendo uma abordagem holística e interdisciplinar. Por fim, após ajustes pelos pares, a SD foi validada, destacando-se como promissora para futuras abordagens de temas em saúde ambiental.

PALAVRAS-CHAVE: Estratégia de ensino; Educação básica; Saúde; Meio ambiente

RESUMEN

Este artículo tiene como objetivo presentar y discutir los pasos relacionados con la construcción y validación de una Secuencia Didáctica (DS), utilizando Preguntas Sociocientíficas (QSC's) sobre intersecciones temáticas en salud y medio ambiente, didácticamente organizadas en Tres Momentos Pedagógicos (3MP's). Caracterizado como investigación-acción, el estudio tuvo como destinatarios a docentes de la Educación Primaria II, realizado en tres etapas: evaluación del perfil docente, construcción del DS y validación. Los resultados mostraron que la integración metodológica logró los objetivos previstos, ofreciendo un enfoque holístico e interdisciplinario. Finalmente, después de ajustes realizados por pares, el DE fue validado, destacándose como prometedor para futuros abordajes de temas de salud ambiental.

PALABRAS CLAVE: Estrategia docente; Educación básica; Salud; Ambiente.