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THE USE OF RECYCLABLE MATERIALS IN CHEMISTRY TEACHING AND LEARNING: PROPOSAL OF AN ACTIVE METHODOLOGY

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ABSTRACT

This article aimed to analyze the contributions of recyclable materials to the chemistry teaching-learning process through the development of an active learning methodology. To this end, a scale was constructed with the research participants—an experiment using recyclable materials—providing them with the basis to respond to an interview using an open-ended questionnaire. Thus, the research sought to understand and develop the use of active methodologies in chemistry classes to support the teaching-learning process of a subject often considered difficult to grasp because students fail to see its connection to real life. Another factor addressed was the choice of teaching methodology, which is frequently rooted in conservative paradigms. Ultimately, the study demonstrated that new methodologies should guide the teaching-learning process and be integrated into the teacher's pedagogical practice to foster greater interest in the subject matter and increase class participation. This innovates the approach to chemistry content, showing that the use of recyclable materials can benefit learning through action and practice. This contributes to the development of cognitive and socio-emotional skills, which are crucial for shaping critical citizens.

Keywords: Innovative Education. Chemistry Teaching. Alternative Experiment. Sustainability.

INTRODUCTION

In light of the changes taking place in schools, new tasks and challenges are emerging, particularly regarding methodological innovations. New interpretations and the incorporation of active methodologies into contemporary education tend to foster knowledge construction based on socio-emotional competencies and new pedagogical practices—which may include hands-on lessons and questionnaires (Moran, 2016).

The use of active methodologies in science education has become increasingly common. In Brazil, education based on teaching practices that encourage greater student participation—through moments of reflection and the critical examination of reality—emerged in the late 19th century. Since then, education has undergone changes in how teaching and learning occur; it is now understood as a process wherein the learner reconstructs and reorganizes their experience. This approach is characterized by the interrelationship between education, culture, society, politics, and the school environment, representing pedagogical practices that offer an alternative to traditional instruction by centering on student activity—engaging learners through discovery, inquiry, or problem-solving (Valente, 2018).

Conducting a practical class requires several factors, such as school facilities, available materials and reagents, and the selection of experiments (Bueno & Kovaliczn, 2008); practical activities should not be chosen haphazardly, as they must have a clear purpose and a specific objective. In public schools, laboratories intended for these classes are often in poor condition and lack the necessary materials for the proposed activities. This hinders—or even prevents—the achievement of the intended learning outcomes and puts everyone involved at risk due to the lack of on-site safety equipment (Salesse, 2012).

Therefore, it falls to the teacher to seek adaptable methods—such as using alternative materials and reagents, including recyclables from their own or the students' homes—during practical classes. The goal of experimentation is to enable students to create models that are meaningful to them based on their own observations (Hess, 1997), without necessarily requiring a laboratory setting, thereby making the understanding of chemistry concepts a more enjoyable experience. Experimentation should be viewed as a pedagogical tool for teaching chemistry (Bueno et al., 2018), as it can influence how students learn, provided the activities foster discussion and critical inquiry regarding the results and observations obtained.

Given these observations, conducting experimental activities—alongside other active learning methodologies—holds great potential to transform how students relate to the subject and how chemical concepts are addressed in the classroom, thereby contributing positively to the students' education.

METHODOLOGY

To achieve the primary objective of analyzing the contributions of recyclable materials to the chemistry teaching-learning process—with a view to developing an active learning methodology—this thesis adopted an action research approach. This type of study involves interventions based on teaching proposals that incorporate alternative materials—specifically, recyclables—into the instructional process.

Thus, the study is classified as action research, as it addresses a problem affecting society as a whole: excessive waste and its environmental impact.

Regarding the nature of the research, it is characterized as basic research. Basic research focuses on deepening the understanding of the field—its origins, key issues, theoretical and methodological

frameworks, development, strengths, challenges, and weaknesses—as described by Moreira (2004, p. 2):

It involves the production of knowledge regarding science education; the search for answers to questions about teaching, learning, curriculum, and the educational context in science, as well as science teachers and their continuous professional development; all within a consistent and coherent epistemological, theoretical, and methodological framework in which specific scientific content is always present.

In basic research, studies do not necessarily require immediate practical application; however, they generate new knowledge that paves the way for scientific advancements in the field. Consequently, this basic research provides the opportunity to organize the obtained data in an academic manner for the article in question.

Figure . Photo of the EEEFM Bernardo Horta School



Source: https://www.google.com/maps/place/EEEFM+Bernardo+Horta/@-20.3462088,-41.6410777,3a,75y,90t/data=!3m8!1e2!3m6!1sAF1QipOL1XoQE1J9xMCFUHJ9TpJoyh1_4LtMUU3FJm_v!2e10!3e12!6shttps:%2F%2Fh5.googleusercontent.com%2Fp%2FAF1QipOL1XoQE1J9xMCFUHJ9TpJoyh1_4LtMUU3FJm_v%3Dw86-h86-k-

The school where the project will be implemented is located in the mountains of the Caparaó region—in the southern part of the state, at the foot of Pico da Bandeira—where the majority of the population is rural and relies on agriculture, with the local economy driven primarily by coffee production. Additionally, the municipality boasts tourist attractions such as stunning waterfalls and trails for nature enthusiasts; rural tourism is gaining momentum each year and creating jobs for the local population.

RESULTS AND DISCUSSION

STATE SCHOOL OF ELEMENTARY AND HIGH SCHOOL EDUCATION “BERNARDO HORTA”

Rua João Mariano, nº 27 – Centro – Irupi – ES – CEP: 29398-000 – Tel.: 28-3548-1665

IDENTIFICATION OF THE PRACTICE DEVELOPMENT PLAN

School: EEEFM BERNARDO HORTA

Researcher: BRUNA NUNES MONT'MOR

Curricular Component: CHEMISTRY

Stage/Modality: HIGH SCHOOL Grade: 2nd YEAR – HIGH SCHOOL

Class: 2°IM01-EM-ESP Semester/Trimester: 1st TRIMESTER Lesson Dates: 08/12/2023 and 08/19/2023

1. LEARNING OBJECTIVES

Study the types of materials that PET bottles are made of;

Better understand the concept of recycling and its importance;

Build a scale using recyclable materials (PET bottle).

2. CONTENTS

Polymers.

3. METHODOLOGY/DIDACTIC STRATEGIES

List of review exercises.

4. BIBLIOGRAPHICAL REFERENCES

Mortimer, Eduardo Fleury. Chemistry: high school / Eduardo Fleury Mortimer, Andréa Horta Machado. -- 3rd ed. -- São Paulo: Scipione, 2016.

Franco, Dalton Sebastião. Everyday Chemistry and Transformations, 1st year / Dalton Sebastião Franco. - .ed. – São Paulo: FTD, 2016. – (Everyday Chemistry and Transformations Collection.

Table. Active methodologies in chemistry teaching

Question: How does the use of active learning methodologies in chemistry education contribute to students' full development?	
Participants: S = students	
Estudantes	Respostas
E1	"It contributes, because it enables us to learn how to do many interesting things".
E2	"It contributes. It adds more meaning to the content being studied".
E3	"The practical classes go much further, as they show how the theories work".

E4	"When the class is different, I'm able to pay more attention, thanks to a new way of learning".
E5	"It contributes. We learn many things with these methodologies".
E6	" It contributes. We learn to do many things. ".
E7	" It contributes to the understanding of the process of constructing new knowledge ".
E8	" Enables an understanding of chemical processes ".
E9	" Enables an understanding of chemical processes ".
E10	" It helps with understanding; for example, the teacher might explain something on the board and I can't grasp it, but during the practical class, I am able to understand the explanation ".
E11	" Build scientific knowledge ".
E12	" I tend to learn more from summaries; I struggle a bit when a class uses a different teaching method ".
E13	" It helps break the routine a bit ".

Source: Researcher's data, 2024.

Based on the data, when asked whether the use of active methodologies in chemistry instruction contributes to their full development, we can see that nearly all participants—12 (twelve) in total—affirmed that it does, as evidenced by the following statements:

"When the class is different, I'm able to pay more attention, thanks to a new way of learning." (E4)

"It aids understanding; for example, the teacher might explain something on the board and I don't grasp it, but during the practical class, I'm able to understand the explanation." (E10)

"It helps break the routine a bit." (E13)

Only 1 (one) student disagreed, taking a stance contrary to that of their peers, as shown in the statement below:

"I usually learn better from summaries; when there's a class using a different methodology, I struggle a bit."

The participants responses reinforce the benefits of practical classes for the teaching-learning process. We can conclude that the student who disagreed has specific learning needs that differ from those of the others.

Participant responses revealed that exposure to chemistry occurred at different stages; some reported encountering the subject in high school, while others did so in middle school. Among those who encountered it in middle school, the specific timing of this exposure varied.

According to the BNCC (2017), chemistry instruction begins in the 9th grade of middle school, serving as an initial introduction to the subject, which is then explored more extensively during the

subsequent three years of high school.

Through the study of chemistry, students are expected to gain a comprehensive and integrated understanding of the chemical transformations occurring in the physical world (PCNs, MEC/SEMTEC, 1999, cited in Santos et al., 2011).

However, Patané (2022) argues that the introduction of chemistry occurs quite late, given that chemical phenomena are part of students' daily lives, even though the underlying concepts and knowledge have not yet been revealed to them.

The responses revealed that the vast majority agreed that practical classes have a positive influence on learning, given that many students find the subject difficult and encounter challenges.

Regarding the difficulties of learning chemistry, Mortimer and Miranda (1959) point out that the issues demonstrated by students indicate an inability to interpret the various interactions between substances involved in physicochemical processes or to recognize similarities across different phenomena.

Authors such as Almeida et al. (2008), Marinho et al. (2023), and Toledo (2021) highlight that students often need to experience certain concepts firsthand—for instance, through laboratory experiments and activities that make these concepts more tangible and real to them. They further note that chemical and scientific language becomes more accessible to the students' senses, making the introduction to the scientific realm—facilitated by the chemistry course—clearly perceptible.

The participants' responses revealed the benefits of the practical class for the teaching-learning process, with the majority stating that the practical session greatly aided their understanding of the subject matter.

We observed a consensus regarding the benefits, with each individual highlighting a different advantage. Once again, the benefits of active learning methodologies are evident; Moraes (2016) notes that this type of class—which incorporates coworking—brings concepts from outside the classroom into the school environment, fostering student collaboration and stimulating learning. The benefits are numerous, starting with the development of skills that will be necessary for working in the job market.

In the second and final question—regarding the third objective—participants were asked about their understanding of recyclable materials and how these materials might relate to learning chemistry.

Regarding the participants' responses, some were able to correctly define recyclable materials, while others failed to link the use of such materials to chemistry learning, despite having just attended a practical class. Valle (1995) defines recycling as the act of restarting the cycle by recovering materials that do not degrade easily, allowing them to be reprocessed.

Campos and Epifânio (2017) state that education is of utmost importance, as it aids not only in national development but also in preparing individuals for life, enabling them to participate in and intervene within society. Thus, the importance of environmental education and social responsibility—fostered in individuals from an early age at school—is highlighted.

Practical classes using recyclable materials help visualize abstract chemical concepts. For instance, transforming plastic packaging into reusable products can illustrate chemical processes such as polymerization and decomposition, providing students with a deeper, more concrete understanding of these phenomena (Casteleins, 2011).

According to various authors, practical classes facilitate interaction and the appropriation and development of scientific concepts. They enable students to gain a more objective understanding of the world around them and to develop solutions for situations involving multiple variables.

Consequently, practical classes hold pedagogical potential for students' acquisition of scientific knowledge.

CONCLUSION

The use of recyclable materials in practical classes contributed to chemistry learning by fostering greater student interaction and engagement—both in constructing the experimental apparatus and in building their own knowledge. This approach aligns with the concept of active learning methodologies.

Regarding the training of chemistry teachers, the discussion highlighted the decline in the profession's status over the years, the underutilization of chemistry laboratories—often left unused due to a lack of organization—and the difficulty of incorporating innovative methodologies and real-life situations into chemistry instruction.

Among the types of active methodologies, we can highlight Problem-Based Learning, Flipped Classroom, Cooperative Learning, Gamification, Design Thinking, Project-Based Learning, Peer Instruction, Meaningful Learning, Peer Learning, Hybrid Learning, Case Studies, Maker Culture, Seminars and Discussions, Field Research, Storytelling, Peer and Team Learning, and Station Rotation.

Regarding student development, the school plays a crucial role in teaching environmental practices, which is essential for fostering a conscious society. It is vital that students truly grasp the necessity of environmental preservation and understand how to help mitigate environmental problems.

Environmental issues encompass far more than just the relationship between humans and their surroundings; reflecting on the link between the environment and our habits and customs is decisive for our quality of life—both now and in the future—and practicing environmental awareness secures a future for generations to come.

REFERENCES

ALMEIDA, E. C.S de, et al. **Contextualização do ensino de química: motivando alunos de ensino médio** In. **X Encontro de Extensão UFPB-PRAC**. Centro de Ciências Exatas e da Natureza/Departamento de Química/ PROBEX [Anais] . Disponível http://www.prac.ufpb.br/sistemas/anais/xenex_xienid/x_enex/ANAIS/Area4/4CCEND QPEX01.pdf

CAMPOS, S.K.R; EPIFÂNIO, M.L.F.G. **Uso de modelos didáticos construídos com materiais recicláveis para o ensino de Ciências no Ensino Fundamental**. IV Congresso de Ensino, Pesquisa e Extensão. Universidade Estadual de Goiás. Pirenópolis (GO) 18-20 out 2017. Available at: <https://www.anais.ueg.br/index.php/cepe/issue/view/281>

CASTELEINS, V. L. **Dificuldades e benefícios que o docente encontra ao realizar aulas práticas de química**. In: Congresso Nacional de Educação, 10.2011, Curitiba. Seminário Internacional de Representações Sociais, Subjetividade e Educação. Curitiba: PUCPR, 2011. p. 16399 -16407.

DE FATIMA BARTOLOMEU, T.; DA SILVA, H. Z. S.; LOZZA, S. I. **Metodologias ativas: um**

caminho para inovar as práticas pedagógicas. Caderno PAIC, v. 18, n. 1, p. 560-574, 2017.

DEMO, P. **Aprendizagem e novas tecnologias.** Revista Brasileira de Docência, Ensino e Pesquisa em Educação Física, Cristalina, v. 1, n. 1, p. 53-75, ago. 2009. Available at: < <https://cadernopaic.fae.edu/cadernopaic/article/view/247/229> >. Accessed on: December 11, 2023

DIESEL, A.; BALDEZ, A. L. S.; MARTINS, S. N. **Os princípios das metodologias ativas de ensino: uma abordagem teórica.** Revista Thema, v. 14, n. 1, p. 268-288, 2017.

DURAZZINI, A. M. S., et al. **Ensino de Química—algumas aulas práticas utilizando materiais alternativos.** Revista de Ensino de Ciências e Matemática, v. 11, n. 6, p. 330-349, 2020.

ECOSSISTEMA EDUCACIONAL. **Metodologias ativas de aprendizagem: 12 tipos e como adotá-las. 2023.** Available at: <https://educacional.com.br/praticas-pedagogicas/metodologias-ativas-de-aprendizagem/> Accessed on: January 24, 2024

FERNANDEZ, C. **Formação de professores de Química no Brasil e no mundo.** Estudos Avançados, v. 32, p. 205-224, 2018. Available at: <https://www.scielo.br/j/ea/a/8wzGrXHcTNc5WqY9NgTPMjm/?lang=pt> . Accessed on: December 11, 2023.

FERNANDEZ, C. **Formação de professores de Química no Brasil e no mundo.** Estudos Avançados, v. 32, p. 205-224, 2018. Available at: <https://www.scielo.br/j/ea/a/8wzGrXHcTNc5WqY9NgTPMjm/?lang=pt>. Accessed on: March 4, 2023.

FERNANDEZ, C. **Formação de professores de Química no Brasil e no mundo.** In. Estudos Avançados v. 32, n. 94, p.: 2018. Available at: <https://www.scielo.br/j/ea/a8wzGrXHcTNc5WqY9NgTPMjm/?format=pdf>

LEÃO, D F; SANTOS, T.M.M; SOUZA, R.R. **O olhar do aluno sobre o contexto do estudo da química e a possibilidade de transformação** Revista de Educação Pública, v. 29, p. 1-20, jan./dez. 2020 DOI: <https://periodicoscientificos.ufmt.br/ojs/index.php/educacaopublica/article/view/4198/pdf>

LEÃO, M. F. **Oferta de Cursos de Licenciatura em Química no Brasil e Breve Histórico desses Cursos em Mato Grosso.** EaD Em Foco, v. 7, n. 3. 2017. Available at: <https://eademfoco.cecierj.edu.br/index.php/Revista/article/view/631> Accessed on: February 12, 2024

LIMA, V. M. R. .; SOUZA, K. dos S. de . **Strategies for remote Chemistry teaching: A systematic review of the literature.** Research, Society and Development, [S. l.], v. 11, n. 9, p. e444911932091, 2022. DOI: 10.33448/rsd-v11i9.32091. Available at: <https://rsdjournal.org/index.php/rsd/article/view/32091>. Accessed on: June 8, 2023.

MARINHO, A. R; et al. **Uso de materiais recicláveis como recurso didático para o ensino de ligações químicas.** In Kiri-kerê: Pesquisa em Ensino, n. 15, jul. 2023. P.236-53 Available at: <https://periodicos.ufes.br/kirikere/article/view/40125/27682>

MELLO, D. **Em 2024, o Brasil poderá ter carência de 235 mil professores, diz estudo. Pesquisa aponta para risco de falta de professores no ensino básico.** Agência Brasil. Educação. Notícias. São Paulo (SP). 29 set 2022. Available at: <https://agenciabrasil.ebc.com.br/educacao/noticia/2022-09/em-2040-brasil-podera-ter-carencia-de-235-mil-professores-diz-estudo>

MORÁN, J. **Mudando a educação com metodologias ativas.** In: SOUZA, Carlos Alberto de; MORALES, Ofelia Elisa Torres (orgs.). Coleção Mídias Contemporâneas. Convergências Midiáticas, Educação e Cidadania: aproximações jovens. Vol. II. PG: Foca Foto-PROEX/UEPG, 2015. Available at: http://www2.eca.usp.br/moran/wp-content/uploads/2013/12/mudando_moran. Accessed on: March 5, 2023.

OKIL, M da C M; MORADILLO, E F de. **O ensino da história da química: contribuindo para a compreensão da natureza da ciência.** Ciênc. educ. (Bauru) v. 14, n. 1. 2008. DOI: <https://doi.org/10.1590/S1516-73132008000100005>

PERRENOUD, P. **A prática reflexiva no ofício de professor: profissionalização e razão pedagógica.** Porto Alegre: Artmed, 2002.

PORTO, P.A; QUEIROZ, S.P; SANTOS, L.P. **Desafios para a formação de professores de química.** In. Quím. nova esc. – São Paulo(SP). v. 36, n4, p. 251, NOVEMBRO 2014. http://qnesc.sbq.org.br/online/qnesc36_4/02-Editorial-36-4.pdf

RIGUE, F. M. **Uma genealogia do ensino de química no Brasil.** 2017. Available at: https://repositorio.ufsm.br/bitstream/handle/1/13153/DIS_PPGEDUCACAO_2017_RIGUE_FERNANDA.pdf?sequence=1&isAllowed=y>. Accessed on: December 8, 2023.

SALES, L B V. **A Química no Ensino Médio: O Ensino de conceitos e da linguagem química nas escolas públicas da cidade de Gravatá – PE.**[Monografia] Centro Acadêmico do Agreste, da Universidade Federal de Pernambuco, Caruaru (PE) 2015 80f.

SANTANA, E.A., et al. **A RECICLAGEM COMO FERRAMENTA DE ENSINO** Revista Ibero-Americana de Humanidades, Ciências e Educação. São Paulo, v.8.n.06. jun. 2022: 1733-46. Available at: <https://periodicorease.pro.br/rease/article/download/6119/2362/8939#:~:text=Principamente%20no%20ensino%20fundamental%2C%20trabalhos,rela%C3%A7%C3%A3o%20%C3%A0%20din%C3%A2mica%20do%20todo>.

SANTOS, P.T.A; et al. **Lixo e Reciclagem como tema motivador no ensino de Química.** Ecl. Quím., São Paulo, 36 ,2011: p.78-92. Available at: <https://www.scielo.br/j/eq/a/vrpVS8BtNwXCyTPzwBHhrMt/?format=pdf&lang=pt>>

SCHÖN, D. A. **Formar professores como profissionais reflexivos**. In: NÓVOA, António (Coord). Os professores e a sua formação. 2. ed. Lisboa: Dom Quixote, 1995.

SILVA NETO, C de S; GARCÊS, I.B.F.; RIBEIRO, C.M. **Reciclagem e geografia: o uso de materiais recicláveis como recurso didático no ensino de geografia na escola estadual Duque de Caxias – Belém - PA**. IX Encontro Nacional de Licenciaturas. (ENALIC). Universidade do Vale de Taquari. Lajeado (RS) 06 a 08 dez 2023. Available at: https://editorarealize.com.br/editora/anais/enalic/2023/TRABALHO_COMPLETO_EV_190_MD3_ID5316_TB886_17112023160619.pdf

SOUSA, J. A. de; IBIAPINA, B. R. S. **Contextualização no ensino de química e suas influências para a formação da cidadania**. Revista Ifes Ciência, [S. l.], v. 9, n. 1, p. 01-14, 2023. DOI: 10.36524/ric.v9i1.1510. Available at: <https://ojs.ifes.edu.br/index.php/ric/article/view/1510>. Accessed on: June 28, 2023

SOUZA, C. S.; IGLESIAS, A. G.; PAZIN-FILHO, A. **Estratégias inovadoras para métodos de ensino tradicionais –aspectos gerais**. Medicina, v. 47, n. 3, p. 284-292, 2014.

TOLEDO, M. P. **A reciclagem como tema gerador no ensino de química no EJA**. [Produto Educacional - Mestrado] Universidade Cruzeiro do Sul São Paulo, 2021: 31f. Available at: <https://www.cruzeirodosul.edu.br/wp-content/uploads/2021/07/Produto-MARCELO-PENTEADO-DE-TOLEDO.pdf>

VALERIANI, T. **Metodologias ativas: veja 6 exemplos e confira os seus benefícios**. 2021. Available at: <https://querobolsa.com.br/revista/metodologias-ativas-veja-6-exemplos-e-confira-os-seus-beneficios> Accessed on: January 24, 2024.