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Geology Learning in East Timor: From the STS Approach in Secondary Education

Aprendizagem de Geologia em Timor-Leste: Da Abordagem CTS no Ensino Secundário

Aprendizaje de Geología en Timor Oriental: Desde el Enfoque CTS en la Educación Secundaria

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Abstract: The Science, Technology, and Society (STS) approach in science education is crucial for fostering a more critical and contextualized understanding of the role of science and technology in society. The aim of this study is to analyze the explicit STS approach in the official curricular materials for teaching Geology in the 10th grade of secondary education in East Timor. A documentary study and an exploratory analysis of the Geology textbook and its accompanying teacher's guide, developed as part of the General Secondary Education Restructuring Project in East Timor, were conducted. A research tool with 2 dimensions and 14 pre-tested indicators was applied, followed by a subsequent analysis concerning the STS approach. The results show that all indicators, except one, were covered in the student textbook. The teacher's guide explicitly and implicitly presents the STS approach. It can be concluded that this study demonstrates that the STS framework is evident in the analyzed documents.
Keywords: STS. Geology. Textbook.

Resumo: A abordagem Ciência, Tecnologia e Sociedade (CTS) na educação científica é fundamental para promover uma compreensão mais crítica e contextualizada do papel da ciência e da tecnologia na sociedade. O objetivo deste trabalho é analisar a abordagem explícita CTS nos materiais curriculares oficiais para o ensino da Geologia no 10.º ano do ensino secundário de Timor-Leste. Foi desenvolvido um estudo documental do livro didático de Geologia e do respectivo guia do professor, elaborado no âmbito do projeto de Reestruturação do Ensino Secundário Geral em Timor-Leste. Aplicou-se uma ferramenta de pesquisa com 2 dimensões e 14 indicadores, previamente testada, e realizou-se uma análise subsequente em relação à abordagem CTS. Os resultados mostram que todos os indicadores, exceto um, foram contemplados no livro didático do aluno. O guia do professor apresenta explícita e implicitamente a abordagem CTS. Pode-se concluir que este estudo demonstra que, nos documentos analisados, a raiz CTS é evidente.
Palavras-chave: CTS. Geologia. Livro didático.

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Resumen: El enfoque de Ciencia, Tecnología y Sociedad (CTS) en la educación científica es fundamental para fomentar una comprensión más crítica y contextualizada del papel de la ciencia y la tecnología en la sociedad. El objetivo de este estudio es analizar el enfoque CTS explícito en los materiales curriculares oficiales para la enseñanza de Geología en el 10.º grado de la educación secundaria en Timor Oriental. Se realizó un estudio documental y un análisis exploratorio del libro de texto de Geología y su correspondiente guía para el profesorado, elaborados en el marco del Proyecto de Reestructuración de la Educación Secundaria General en Timor Oriental. Se aplicó una herramienta de investigación con 2 dimensiones y 14 indicadores previamente testados, y se llevó a cabo un análisis posterior en relación con el enfoque CTS. Los resultados muestran que todos los indicadores, excepto uno, fueron contemplados en el libro de texto del alumno. La guía del profesorado presenta explícita e implícitamente el enfoque CTS. Se puede concluir que este estudio demuestra que, en los documentos analizados, la raíz CTS es evidente.
Palabras-clave: CTS. Geología. Libro de texto.

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Introduction

Science represents a collective effort, to contribute to a longer, healthier, and sustainable life through the creation of knowledge (UNESCO, 2022). Recently, the Covid-19 pandemic confirmed the importance of science and technology for the well-being of global populations (Silva; Chammas; Novaes, 2021; United Nations, 2021). A recent Eurobarometer study (European Commission, 2021) found the global influenced of science and technology to be positive (86%), with a level of interest in these two levels high (82%) and greater learning was needed (54%).

The Fourth Industrial Revolution has had a positive impact on the field of education, particularly in the domain of didactics. The Science-Technology-Society (STS) approach has been highlighted as highly significant for engaging students in solving everyday problems closely associated with the concept of science, and it has been positively received by educators (Oliveira; Silva, 2012). Martins and Paixão (2011) argue that scientific education with the STS approach should be considered within a framework of human development, taking into account guidelines for implementing Education for Sustainable Development, taught intentionally and systematically (Bordoni; Silveira; Vieira, 2022).

The STS approach fosters a critical understanding of the implications of science and technology. By analyzing concrete cases and ethical dilemmas, students develop skills to assess the consequences of technological innovations and scientific advancements. Furthermore, integrating the STS approach into scientific education is crucial for the development of active and responsible citizens (Paiva; Araújo, 2022). Through the STS approach, students are encouraged to engage in public debates and make informed decisions on issues affecting the community and the planet. Understanding the intersection of science, technology, and society prepares students to actively participate in public policy discussions and contribute constructively to solving global problems such as climate change and social inequalities (Martins, 2020).

The STS approach also ensures that the scientific curriculum is relevant and applicable to the real world. Instead of focusing solely on abstract theories and concepts, STS education engages students in real-world contexts, demonstrating how scientific and technological knowledge is used to address concrete challenges. This practical relevance enhances student

engagement and facilitates the application of knowledge to everyday situations (Kamizi; Iksan, 2021).

The integration of the STS approach into education is based on the assumption that the first two components – science and technology – serve as structuring forces to empower individuals and enable them to make decisions in society. To achieve this, students need to understand the nature, causes, and social consequences of scientific and technological development, along with an awareness of the social forces at play that, due to conflicting interests, shape and control technical-scientific knowledge for their benefit or simply disregard it. Geraldo and Lorenzetti (2022) emphasize that when planning and implementing STS approaches, it is important to consider the selection of social themes that engage students, seek mechanisms for democratic participation, include experimental activities related to social/socio-scientific topics, and allow for self-assessment and peer evaluation.

Insights gathered from the annual 6th Multi-Stakeholder Forum on Science, Technology, and Innovation for Sustainable Development Goals, held on May 4, 2021, and organized by the UN Interagency Task Team in collaboration with UNESCO, highlighted a clear need to build community resilience through the convergence of science, technology, and social sciences, with contributions and involvement from civil society. It was deemed essential to ensure that an appealing technical solution to a specific problem does not inadvertently create a challenge for the community being served (Society of Women Engineers, 2021).

In 2010, the authorities of the young nation of East Timor demonstrated their commitment to the nature and quality of formal curricula and their implementation. The Ministry of Education of East Timor requested support from the Calouste Gulbenkian Foundation to restructure the General Secondary Education curriculum. This request led to a project developed with technical support from the University of Aveiro, Portugal, and cooperation from the Portuguese Institute for Development Support. The project was submitted to the Portuguese Language Fund and approved for funding.

The curriculum restructuring in East Timor was guided by three main orientations: recent developments in the country's educational system, alignment with international programs such as “Education for All” and the “Millennium Development Goals”, and internal realities, including normative principles (Constitution and Education Framework Law), educational policies, structural reforms, and the Basic Education curriculum reform. Adopting a social

construction perspective (Roldão, 2000) and considering that the acquired knowledge will be beneficial for societal life, the selection of subjects and didactic resources for both students and teachers was a key concern in restructuring secondary education in East-Timor. This three-year educational cycle was designed with two pathways: one in Science and Technology and another in Social Sciences and Humanities. The Science and Technology course includes core subjects such as Biology, Physics, Geology, Chemistry, and Mathematics, essential for both future professional training and scientific literacy of citizens. The aim is for students to understand scientific concepts, principles, and methodologies, and to draw evidence-based conclusions that aid in decision-making regarding the natural world and its changes, many of which are driven by human activity. Additionally, there was an effort to integrate these subjects with the reformed basic education curriculum.

The Geology Program (Rebelo et al., 2011) emphasizes that science and technology are increasingly present in everyday life, making scientific education a crucial tool for promoting citizenship and sustainable development. It is evident from the authors' intention that when scientific and technological knowledge is well-integrated and related to familiar situations for students, it enhances scientific literacy levels.

Guided by the objective of education for sustainable development, as outlined in the Geology Programs for secondary education in East Timor, a team of authors was commissioned to develop student textbooks for each subject. For the Geology course, a team from the University of Aveiro, consisting of a geologist, a basic and secondary education teacher, and two science educators, was invited to oversee the scientific, technical, and pedagogical management of the Geology curriculum development for secondary education in the Democratic Republic of East Timor, as well as the associated educational resources (student textbooks and teacher guides).

The Geology program proposal was developed from scratch, aiming to align with the natural and sociocultural realities of East Timor. It took into account documents such as the United Nations Millennium Development Goals, the European Union Agenda for Change, the Global Partnership for Effective Development Cooperation from the Organization for Economic Cooperation and Development, and the New Deal for Engagement in Fragile States from the International Dialogue, all of which were considered in the program design.

The student textbook continues to serve, generally, as a structural element of learning within a school subject, while still allowing access to other sources of information and training, particularly through the use of Information and Communication Technologies (Carvalho; Fadigas, 2009; Clement, 2008; Koppal; Caldwell, 2004; Taber, 2015;). It should be noted, however, that in East Timor there is only one official textbook for each subject, published by the Ministry of Education itself.

In the development of the Geology textbooks, the authors aimed to ensure that each unit included an introduction, development, application, and integration, following the recommendations of Gérard and Roegiers (1998). The student textbook is organized according to the thematic units of the Programs, providing detailed and varied information to help students address a guiding question for each unit. In the Geology course, each unit begins with a text that contextualizes the topic within East Timor and poses guiding questions. Key concepts and learning objectives are outlined for each subtopic, which is explored through simpler questions and diverse activities involving student participation. At the end of each unit, a summary of the main ideas is provided, along with open-ended questions and suggested websites for further research. Additionally, reflection topics are included for assessing the learning outcomes.

In addition to the student textbook, the teacher's East-Timor, the guide includes additional materials not found in the manual, which are useful for teachers in preparing their activities. Teachers play a crucial role in selecting the methodological approaches that best fit local contexts and the competencies and learning objectives of the program. The design of the Geology teacher's guide was based on two main options: a) a systematic presentation of a simplified theoretical framework on central topics in scientific education, such as practical activities and the STS approach; b) methodological suggestions for addressing each curricular thematic unit, aligned with the references presented in the first part.

The aim of this work is to analyze the explicit STS approach in the 10th grade Geology textbook for secondary education in East Timor (Rebelo et al., 2012a) and in the teacher's guide (Rebelo et al., 2012b).

Methods

This paper is based on an exploratory study of a 10th grade Geology student textbook and the respective teacher's guide, used in the educational system of East Timor. The scope of the research was limited by the country's limited choice of textbooks, there being only one prescribed for Geology, and by some of its original authors also being involved in the study. Acknowledging these limitations, it was considered that one textbook would be sufficient for analysis and that the 12 year that had elapsed following publication of the curricular materials would not impact significantly upon its relevance.

For the analysis, the framework developed by Oliveira et al. (2018) was adapted, including its 2 dimensions and 14 indicators (Table 1).

Table 1 – Analysis tool of the STS approach in the 10th grade Geology student textbook

Dimension	Indicators
A – Speech / information	A1 - Explores geological topics based on their social utility. A2 - Shows that the work of scientists is often influenced by social, political, religious, and economic pressures. A3 - Regarding Science and Technology, encourages students to: *i)* raise ideas autonomously and voluntarily; *ii)* change their opinions; *iii)* make analogies; *iv)* provide explanations. A4 - Allows the development of a critical and scientifically informed attitude towards social and environmental issues. A5 - Provides examples of recent technologies and products applied in daily life. A6 - Informs the student about the advantages and limitations of the application of science and technology and their impacts on society and the environment. A7 - Identifies different technological realities, highlighting how they change people's way of life and how these changes originate other social realities.

	A8 - Reports experimental practices by explaining the methods used, clarifying the steps and why decisions were made, and comparing the results with possible uses by society. A9 - Presents information from various fields of knowledge, scientific and technological, that require/promote understanding of the STS interaction.
B - Teaching and learning activities	B1 - Presents proposals that lead to student engagement in projects promoting critical thinking skills on issues where the STS interaction is evident. B2 - Proposes diverse activities simulating reality, encouraging students to consider the perpspectives of others, solve problems, engage in debates, discussions and research on issues where STS interaction is evident, and explicitly appeals to critical thinking skills. B3 - Proposes the implementation of activities (practical, experimental in the laboratory or classroom) to explore, understand, and evaluate STS interrelationships, particularly those that may interfere with students' personal lives and futures. B4 - Presents real-life applications of new knowledge, where the STS interaction is evident at the end of proposed activities. B5 - Presents real-life applications of new knowledge in daily scenarios.

Source: Oliveira et al. (2018).

Results and discussion

Student textbook

In a preliminary, more general analysis, it was observed that in the 10th grade Geology student textbook (Rebelo et al., 2012a), there are no sections specifically designated as STS. The parts labelled “Thematic Unit” correspond to denominations of groups of geological contents that are explored in the subsequent pages. From this result, it is presumed that there is no intentional focus from the manual authors on an explicit and in-depth approach to STS as a guiding principle in the organization of the manual. Upon closer examination, it is possible to identify evidence for the indicators of the manual analysis framework (Table 2).

Table 2 – Number of occurrences per indicator of dimensions A and B identified in the 10th grade Geology student textbook

	Dimensions													
	A									**B**				
Indicators	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**
Frequencies	18	0	19	3	5	4	2	5	17	16	9	12	10	12

Source: Research data.

Analysis of the results from Table 2 reveals that the total sum of frequencies of the STS indicators (N = 132) identified in the manual appears to be higher than the total number of pages analyzed (N = 156), with a page/occurrence ratio of 1:0.85. There is a considerable difference between the frequency of indicators identified in the "Speech/Information" dimension (f = 73) and that in the "Teaching and Learning Activities" dimension (f = 59). This result may suggest that contextualization of STS occurs more frequently when there is content presentation than proposed practical activities, which serve as elements of the teaching and learning process.

With the purpose of understanding, in a more discriminatory manner, the presence of the STS approach throughout the manual, an analysis of occurrences per thematic unit was conducted (Table 3).

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Table 3 – Frequency of STS approach indicators present in the thematic units of the 10th grade Geology student textbook, by analysis dimension

	Dimensions														
	A									**B**					
	Indicators														
TUs	**1** *f* (%)	**2** *f* (%)	**3** *f* (%)	**4** *f* (%)	**5** *f* (%)	**6** *f* (%)	**7** *f* (%)	**8** *f* (%)	**9** *f* (%)	**1** *f* (%)	**2** *f* (%)	**3** *f* (%)	**4** *f* (%)	**5** *f* (%)	**N**
1	3 (20.0)	0 (0.0)	3 (20.0)	1 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (20.0)	2 (13.3)	1 (6.7)	1 (6.7)	0 (0.0)	1 (6.7)	15 (11.4)
2	11 (11.1)	0 (0.0)	12 (12.1)	2 (2.0)	5 (5.1)	3 (3.0)	2 (2.0)	4 (4.0)	12 (12.1)	12 (8.1)	8 (8.1)	8 (8.1)	9 (9.1)	11 (11.1)	99 (75.0)
3	4 (22.2)	0 (0.0)	4 (22.2)	0 (0.0)	0 (0.0)	1 (5.6)	0 (0.0)	1 (5.6)	2 (11.1)	2 (11.1)	0 (0.0)	3 (16.7)	1 (5.6)	0 (0.0)	18 (13.6)
4	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Totals	18 (13.6)	0 (0.0)	19 (14.4)	3 (2.3)	5 (3.8)	4 (3.0)	2 (1.5)	5 (3.8)	17 (12.9)	16 (12.1)	9 (6.8)	12 (9.1)	10 (7.6)	12 (9.1)	132 (100)

Source: Research data. TUs - Thematic Units. 1 – East Timor: living and coexisting; 2 - The Earth: the egg and the shell; 3 - Rocks and minerals: the bricks of the Earth; 4 - Rock deformation: the force of the Earth.

Of the four thematic units comprising the 10th grade Geology student textbook, the unit "The Earth: the egg and the shell" presents the highest frequency of STS approach indicators (75.0%). This is justified by this section addressing issues related to the solar system and the mechanisms within the Earth, particularly geodynamics and their surface effects, such as earthquakes. Following are the units "Rocks and minerals: the bricks of the Earth" and "East Timor: living and coexisting", with 13.6% and 11.4% of the frequency of STS approach indicators, respectively. No narratives or activities with this approach were identified in the "Rock deformation: the force of the Earth" unit.

The analysis by indicator clearly shows the absence of discourse/information regarding the revelation that the work of scientists is often influenced by social, political, religious, and economic pressures, being residual throughout the text. Similarly, there is a lack of identification of different technological realities, highlighting how they change people's way of life and how these changes originate other social realities (1.5%), as well as the development of a critical and scientifically informed attitude towards social and environmental issues (2.3%).

The authors' investment seems to have been greater in promoting autonomous and voluntary idea generation by students, changing opinions, generating analogies, and providing explanations, as this gathered the highest number of occurrences in the book's narrative (14.4%). This indicator is accompanied by the exploration of topics in Geosciences based on social utility (13.6%), presenting information from various fields of knowledge, scientific and technological, that require/promote understanding of the STS interaction (12.9%).

Regarding the elements of teaching and learning process implementation, there is a greater focus on presenting proposals that lead to student engagement in projects promoting critical thinking skills on issues where the STS interaction is evident (12.1%). This is followed, equally, by the presentation of proposals for conducting practical activities with the aim of exploring, understanding, and evaluating STS interrelationships, notably those that may interfere with students' personal lives and futures, as well as situations that have daily application of new knowledge (9.1%).

In summary, it is considered that the 10th grade Geology student textbook incorporates the STS approach in a significant and meaningful way. Among the core indicators, the authors have solely omitted from the narrative the revelation that the work of scientists is often influenced by social, political, religious, and economic pressures. All other indicators are

present, with maximum expression in the study of topics with social applicability but minimal expression in the identification of technological realities, where it is explicit how they change people's way of life and are the origin of other social realities.

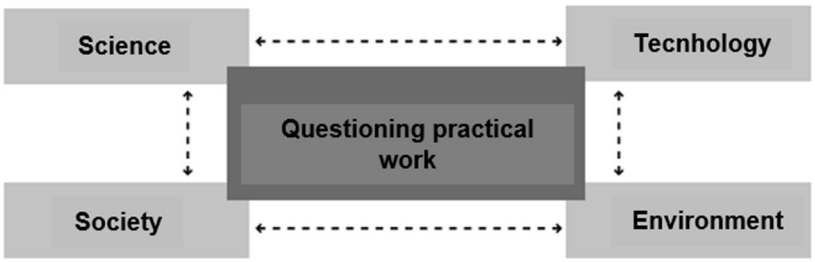
Studies of this nature regarding Physics/Chemistry textbooks in East Timor are unknown. However, research by Oliveira et al. (2018) indicates that in four 10th grade Chemistry textbooks in Portugal, the incorporation of the STS approach is not significant, and the relationships between STS are not explicitly addressed. The authors argue that there seems to be a certain scepticism and reluctance to incorporate the STS approach as an essential element for students' scientific literacy.

Teacher's guide

The teacher's guide (Rebelo et al., 2012b) was written with the aim of helping teachers, preferably working in cooperation with other colleagues, to think and develop teaching strategies suitable for the current needs of Timorese students. For this purpose, two parts were defined. The first incorporates methodological guidelines and didactic suggestions. The second includes concept maps, planning proposals, various suggestions, resources, and assessment recommendations. All of this, according to the authors, should equip teachers with a set of elements that allows them, in a sustained manner, to prepare teaching episodes so that learning leads to active citizenship.

The STS approach appears autonomously integrated into education for sustainable development, spanning about one page. The objectives of the STS approach are reinforced as integrating and globalizing the organization and acquisition of scientific knowledge, aiming to prioritize the education of scientifically literate citizens capable of actively and responsibly participating in open and democratic societies. It is emphasized that practical work and problem solving, from an STS perspective, should be questioning in nature (Figure 1).

Figure 1 – Practical work from an STS perspective



Source: Rebelo et al. (2012b, p. 15).

The authors of the teacher's guide suggest that, according to the STS perspective, teaching and learning processes should be centered on issues that are meaningful to students, with a problem-solving approach, where practical work is involved. For example:

> In the teaching and learning process, practical work should not emerge as an end in itself but rather as a means of collecting information and data that help understand current, local, regional, or global issues and develop diverse skills. In STS-oriented teaching, the context thus emerges as the starting point and endpoint of the development of practical activities, where theory and practice are integrated and contextualized.
>
> Teaching and learning processes should be centered on issues that are meaningful to students, that is, organized from a problem-solving perspective.
>
> Understanding a comprehensive problem and selecting pathways for its resolution should involve the formulation of questions, articulated and progressively simpler, that guide the definition of intentional learning paths.
>
> Problem-solving should include the development of planning activities, information research, execution of practical activities, assessment of results, and, ideally, the confrontation and evaluation of arguments, as well as the synthesis of information (Rebelo et al., 2012b, p. 15).

In the development of the program, thematic units are explored. For each one, concept maps, teaching planning proposals, suggestions for operationalizing learning activities and assessment, other suggestions, and resources, as well as examples of assessment items, are presented. The operationalization suggestions correspond to didactic additions for carrying out the activities proposed in the student textbook.

The STS approach appears implicitly in additional teaching and learning activities presented under “Other suggestions”. For example, in sub-theme 2.1 (“The solar Earth”) of Thematic Unit 2, an activity associated with political contexts is proposed (Figure 2).

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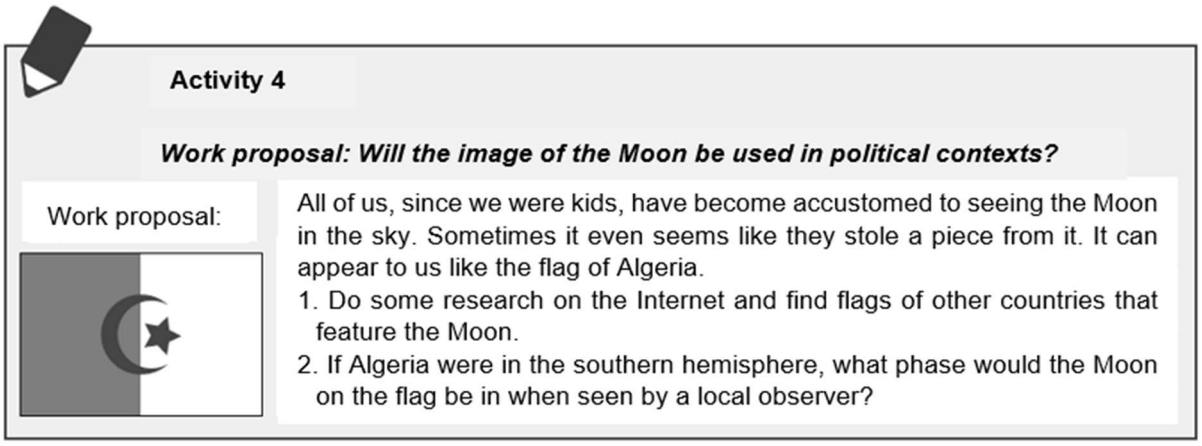
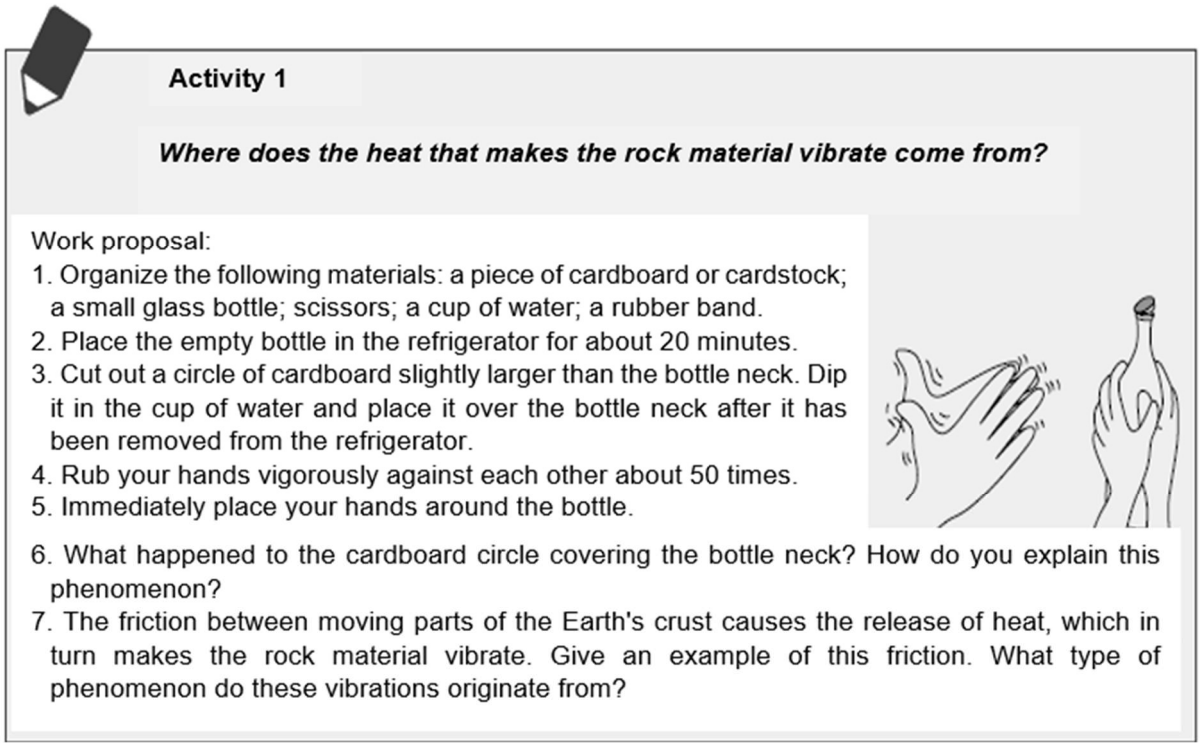
Figure 2 – Activity 4 of the sub-theme "The Solar Earth" from Thematic Unit 2



Source: Rebelo et al. (2012b, p. 34).

In activity 1 of sub-theme 2.2 ("The Deep Earth"), a simulation activity is proposed, leading the student to problem solving, with an explicit appeal to critical thinking skills (Figure 3).

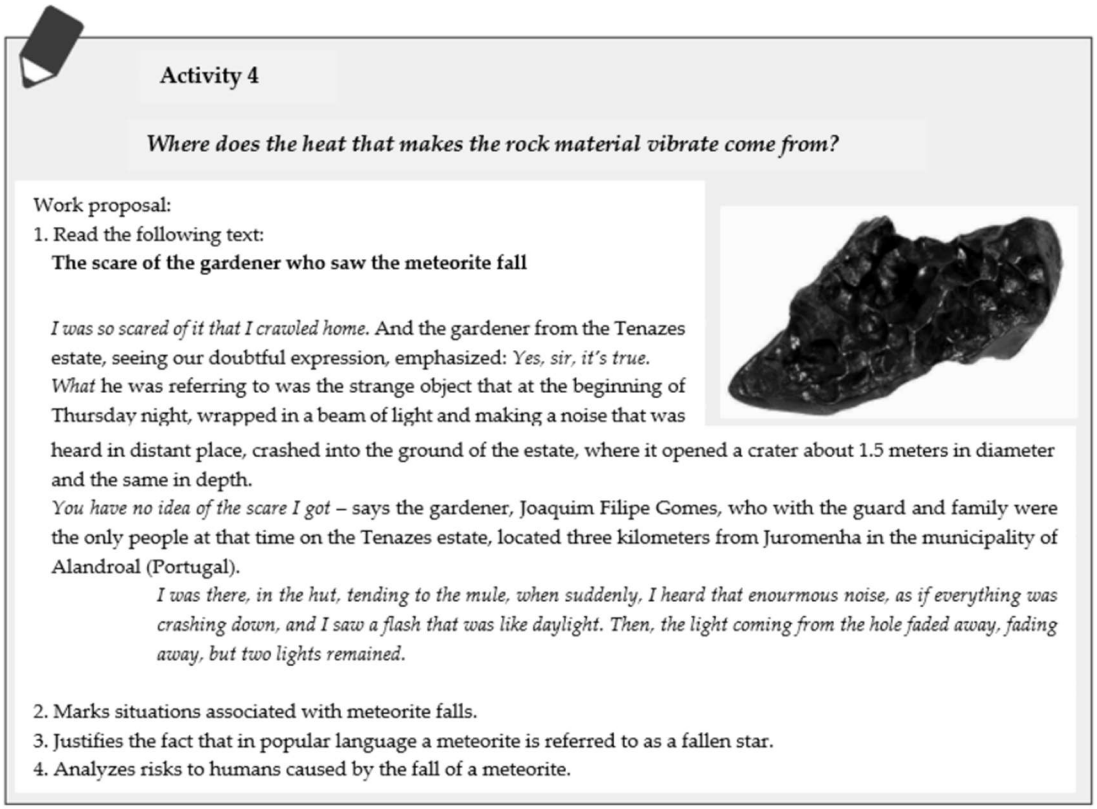
Figure 3 – Activity 1 of the sub-theme "The Deep Earth" from Thematic Unit 2



Source: Rebelo et al. (2012b, p. 34).

Another example, without aiming to be exhaustive, is the proposal of activities to explore situations that may interfere with the student's personal life and future. In activity 4 of sub-theme 2.2 ("The Deep Earth"), a situation associated with the risks inherent in meteorite falls is presented (Figure 4).

Figure 4 – Activity 4 of the sub-theme "The Deep Earth" from Thematic Unit 2



Activity 4

Where does the heat that makes the rock material vibrate come from?

Work proposal:

1. Read the following text:

The scare of the gardener who saw the meteorite fall

I was so scared of it that I crawled home. And the gardener from the Tenazes estate, seeing our doubtful expression, emphasized: *Yes, sir, it's true. What* he was referring to was the strange object that at the beginning of Thursday night, wrapped in a beam of light and making a noise that was heard in distant place, crashed into the ground of the estate, where it opened a crater about 1.5 meters in diameter and the same in depth.

You have no idea of the scare I got – says the gardener, Joaquim Filipe Gomes, who with the guard and family were the only people at that time on the Tenazes estate, located three kilometers from Juromenha in the municipality of Alandroal (Portugal).

> *I was there, in the hut, tending to the mule, when suddenly, I heard that enourmous noise, as if everything was crashing down, and I saw a flash that was like daylight. Then, the light coming from the hole faded away, fading away, but two lights remained.*

2. Marks situations associated with meteorite falls.
3. Justifies the fact that in popular language a meteorite is referred to as a fallen star.
4. Analyzes risks to humans caused by the fall of a meteorite.

Source: Rebelo et al. (2012b, p. 42).

The analysis of the Geology textbook and teacher's guide used in the East Timor educational system reveals significant insights into the effectiveness of the STS approach in fostering critical and engaged students. The research found that the educational material not only presents scientific content but also promotes activities that encourage reflection and discussion on relevant social and environmental issues.

One of the most notable findings was the emphasis on promoting the generation of independent and voluntary ideas by students. The textbook's narrative showed a high frequency of occurrences related to this practice, indicating that the authors prioritized creating a learning environment that stimulates students' curiosity and creativity. This approach is crucial as it

allows students to take ownership of their own learning, developing critical thinking and problem-solving skills.

Furthermore, the analysis revealed that exploring geoscience topics based on social utility was a central aspect of the material. The content was presented in a way that connects scientific theory with everyday situations, fostering an understanding of the interaction between science, technology, and society. This connection is essential for students to perceive the relevance of scientific knowledge in their lives and in addressing community problems.

Another important observation was the inclusion of activities that encourage student participation in debates on socio-environmental issues. This practice not only enriches the learning process but also prepares students to become informed and active citizens, capable of contributing to public and policy discussions affecting their communities.

In summary, the research results indicate that the Geology textbook and teacher's guide, by incorporating the STS approach, provide a valuable tool for developing an education that goes beyond mere knowledge transmission. They promote comprehensive education, equipping students to become critical, aware, and engaged citizens, ready to tackle contemporary challenges and contribute to a sustainable future. This analysis reinforces the importance of continuing to invest in educational methodologies that integrate science, technology, and social issues, particularly in developing educational contexts such as East Timor.

Conclusions

In the current context, science and technology education assumes a decisive relevance, particularly in light of the challenges posed by the COVID-19 pandemic and the transformations of the Fourth Industrial Revolution. Education must transcend the mere transmission of knowledge, aiming to cultivate critical and active citizens who are capable of understanding and interacting with the complex social and environmental realities that surround them.

The STS approach represents a crucial pedagogical strategy for fostering this education. By integrating science and technology with social issues, STS education aims to develop students' critical thinking skills, enabling them to analyze and reflect on the impact of technological innovations on their lives and society as a whole. Without a single and ideal method of learning or teaching, research has shown that science education guided by the STS

approach possesses a cultural strength capable of inducing practical citizenship for a more democratic society, using STS relationships themselves as the subject. This approach serves as a basis for discussing how its implementation in education, particularly in the context of teaching Geology in East Timor, can contribute to the development of informed and engaged citizenship, capable of addressing contemporary challenges and promoting a sustainable future. In this sense, over a decade ago, the development of the student textbook and the accompanying teacher's guide for the Geology discipline in the secondary education system of the Democratic Republic of East Timor began. The designed methodology allowed for the search for evidence regarding the subjects under analysis.

Regarding the student textbook, occurrences were identified for each indicator of the two selected dimensions, namely the discourse used in the presentation of content and the way teaching and learning activities are presented and developed, then for the thematic units of the textbook. The results indicate that, out of the 14 indicators, only one indicator lacked STS support. Also, three out of the four units fell within a matrix of similar nature. Therefore, it can be anticipated that Timorese students find in this Geology textbook, developed in line with educational research indicators, a tool capable of helping them develop a critical and interventionist citizenship.

From the analysis of the teacher's guide to support the teaching of the 10th grade Geology discipline, it is observed that only in the first part was there a section specifically designated as STS. In this section, the general ideas of this teaching approach are presented, emphasizing learning activities centered on real contexts. In the exploration of the thematic units, there are proposals for activities that implicitly use this type of approach. Alongside the student textbook, Timorese teachers find in this guide a tool to support the planning of the teaching and learning process that frequently relies on the STS approach, with concrete action proposals available.

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