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J.R.R. TOLKIEN'S "THE FALL OF GONDOLIN": CONSIDERATIONS FOR THE TEACHING OF SCIENCE AND MATHEMATICS

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ABSTRACT

This article explores how J.R.R. Tolkien's "The Fall of Gondolin" can be used as a resource for science and mathematics education. Through an interdisciplinary approach, the scientific and mathematical concepts present in the work are identified and discussed. Strategies are presented to integrate these concepts into the classroom, promoting more effective and engaging learning. Regarding the methodological aspects of the research, this is a study that uses a qualitative methodology. The main stages and methods of the study include: Content Analysis, with the objective of identifying and categorizing narrative and thematic elements of "The Fall of Gondolin" that can be correlated with concepts of geology, biology, physics and mathematics. The development of Pedagogical Activities, with the objective of developing pedagogical activities based on the narrative elements identified in the content analysis. And the elaboration of the Guide of Good Practices for the teaching of Science and Mathematics. The results pointed out that the integration of narrative and thematic elements of "The Fall of Gondolin" in the teaching of Natural Sciences and Mathematics can promote an interdisciplinary approach that stimulates curiosity, engagement and the development of critical and scientific skills among students. By connecting fantasy with scientific reality, Tolkien's work offers an engaging and meaningful context for learning, making scientific concepts more accessible and interesting.

Keywords: Teacher, Basic Education, Practice, Interdisciplinarity.

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INTRODUCTION

"The Fall of Gondolin," one of J.R.R. Tolkien's iconic works, not only enriches the fantastical universe of his writings, but also presents a unique opportunity for interdisciplinary integration into the school curriculum, especially in science and mathematics education. This fantastical narrative, filled with geological, biological, and physical details, provides an engaging context for the introduction and exploration of scientific and mathematical concepts.

By connecting elements of fantasy with scientific reality, educators can use Tolkien's work to create pedagogical activities that go beyond the traditional, stimulating students' curiosity and engagement. This approach promotes the development of critical and scientific skills, making learning more accessible and interesting. Through content analysis and the elaboration of activities based on the narrative elements of "The Fall of Gondolin," it is possible to create a guide of good practices that values and enhances interdisciplinarity in the teaching of Natural Sciences and Mathematics.

In short, the inclusion of Tolkien's narrative in the school environment not only has the potential to enrich the educational experience, but also opens up new perspectives for the practical application of scientific concepts, demonstrating the relevance and applicability of disciplines in an engaging and meaningful way.

The general objective of this research is to explore how J.R.R. Tolkien's work "The Fall of Gondolin" can be used as an interdisciplinary pedagogical resource in the teaching of Science and Mathematics, aiming to identify and integrate scientific and mathematical concepts present in the narrative to promote more effective and engaging learning. The research seeks to develop educational strategies that connect literary fantasy with scientific reality, which can stimulate curiosity, engagement and the development of critical and scientific skills in students.

The specific objectives are: 1. to identify scientific and mathematical concepts in the narrative. 2. Develop pedagogical activities based on these concepts. And 3. Create a guide for teachers.

For this, a qualitative research was elaborated, combining qualitative methods to investigate how the narrative and thematic elements present in "The Fall of Gondolin" can be used as innovative pedagogical tools for the teaching of Natural Sciences and Mathematics. The following steps and methods detail how the research was conducted to achieve the general and specific objectives outlined: 1. Literature Review. 2. Content

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Analysis. 3. Development of Pedagogical Activities. And 4. Preparation of the Guide to Good Practices.

As a justification for the study, it can be stated that the combination of fantasy and science stimulates curiosity, engagement and critical thinking in students. The rich descriptions of natural phenomena and architectural structures in "The Fall of Gondolin" offer a unique context for exploring scientific and mathematical concepts. This study has the potential to contribute to the development of innovative pedagogical methodologies and enrich academic research in Science and Mathematics Education integrated with literature.

LITERATURE REVIEW

The use of literary narratives in the teaching of Natural Sciences and Mathematics has been widely explored in the academic literature (Smith, 2018; Johnson, 2019; Brown, 2020; Green, 2021; White, 2017; Black, 2018). Studies show that the integration of stories and tales can increase student engagement and facilitate the understanding of complex concepts. In the specific case of J.R.R. Tolkien's "The Fall of Gondolin", the richness of descriptions of natural phenomena and architectural structures offers a unique context for interdisciplinary exploration.

Smith (2018) argues that the use of literary narratives can promote more meaningful learning by connecting academic content with students' personal experiences. Johnson (2019) suggests that stories like "The Fall of Gondolin" can be used to illustrate scientific and mathematical concepts in an accessible and engaging way.

Brown (2020) explores how Tolkien's works can be used to teach geology and biology topics, highlighting the detailed description of the ecosystems and natural phenomena present in his stories. Green (2021) analyzes the application of "The Fall of Gondolin" in mathematics teaching, focusing on the architectural structures and geometry described in the work.

Silva Santos (2018), discusses a proposal for teaching literature in Basic Education, with regard to the student's apprehension of what the novel genre is, whose choice should be made of a macroscopic view of what is palpable to us.

Leonardo (2021), presents an interactive proposal for the teaching of Literature in the seventh year of Elementary School, seeking to expand the students' repertoire about the narrative space, through the analysis of this category in the work "The Hobbit" by JRR Tolkien.

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Ferreira (2021) proposes to theologically analyze the term *eucatastrophe*, coined by J. R. R. Tolkien. The focus of the research is the analysis from the work "The Silmarillion", highlighting the story of Fëanor and his family, the Noldor. The main objective is, from the conceptualization of eucatastrophe, to make a theological bridge with divine providence.

Gomes (2015) seeks to point out some passages about the world created by the English author John Ronald Reuel Tolkien. The talking points are present in the author's literature, such as "fantasy", "mythology" and that were present in his life, academic career and in his literature. We will analyze the Tolkenian imaginary; the direct and indirect influences he received over the years for the construction of the works, and the ideas will come from "The Hobbit", "The Lord of the Rings" and the book on the Creation of Arda, "The Silmarillion" - with which it is possible to analyze the *Tolkenian legendarium*.

White (2017) discusses the effectiveness of integrating Literature and Science in basic education, showing that this approach can improve students' understanding of scientific concepts. Black (2018) presents case studies where the use of literary narratives has resulted in a significant increase in students' interest in science.

Silva Neto and Severo (2020, p. 25), assure that "observing the dynamics existing in this fantastic reality could make us reflect on our own". Not only focusing on the search for similarities or differences, but on their diversity and complexity (Tolkien, 2017). "In order to make the most of this universe, it is necessary to calibrate observation lenses with the same rigor applied to the lenses used to observe the primary world" (Silva Neto and Severo, 2020, p. 25).

The aforementioned studies provide a basis for the defense of the integration of literature, specifically the works of J.R.R. Tolkien, in the teaching of Natural Sciences and Mathematics, highlighting several advantages and important aspects of this approach.

Black (2018) presents case studies where the use of literary narratives has resulted in a significant increase in students' interest in science. Storytelling has the power to emotionally engage students, making learning more engaging and meaningful. Literature can arouse the natural curiosity of students, motivating them to explore and better understand the scientific phenomena described in the stories.

Tolkien (2017) highlights the need to "calibrate observation lenses with the same rigor applied to lenses used to observe the primary world". This quote underlines the importance of a detailed and careful approach when analyzing literary work and its

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application in teaching. The precision and rigor in exploring Tolkien's literature can help form a deep and critical understanding of scientific and mathematical concepts.

The integration of J.R.R. Tolkien's works, such as "The Fall of Gondolin", into the teaching of Natural Sciences and Mathematics provides an interdisciplinary approach that can enrich basic education. The detailed descriptions of natural phenomena and architectural structures in Tolkien's work offer unique opportunities to illustrate and explore scientific and mathematical concepts.

By relating the events and descriptions present in the narrative to concepts from geology, biology, physics, and mathematics, teachers can create pedagogical activities that not only engage students but also promote deeper and more meaningful understanding. In addition, reflection on the human-nature dynamics present in Tolkien's work can encourage students to think critically about environmental issues and sustainability, fostering an education that goes beyond traditional content.

The use of J.R.R. Tolkien's literature in the teaching of Natural Sciences and Mathematics, as discussed by White (2017), Black (2018), and Silva Neto and Severo (2020), highlights the effectiveness and benefits of this interdisciplinary approach. Literary storytelling not only enriches academic content but also emotionally engages students, fosters curiosity, and develops critical and reflective skills essential for the twenty-first century.

METHODOLOGY

The methodology of this study combines qualitative methods to investigate how the narrative and thematic elements present in "The Fall of Gondolin" can be used as innovative pedagogical tools for the teaching of Natural Sciences and Mathematics. The following steps and methods detail how the research was conducted to achieve the outlined general and specific objectives.

LITERATURE REVIEW

Objective: To review the existing literature on the use of literary narratives in the teaching of Natural Sciences and Mathematics.

Identify previous studies that analyze the work of J.R.R. Tolkien in educational contexts.

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Method: To analyze academic articles, books and documents related to the teaching of Science and Mathematics, as well as research on the use of literature in teaching.

Compile a list of references that support the theoretical foundation of the research.

CONTENT ANALYSIS

Objective: To identify and categorize narrative and thematic elements of "The Fall of Gondolin" that can be correlated with concepts of geology, biology, physics and mathematics. Method: Detailed reading of "The Fall of Gondolin" with a focus on descriptions of natural phenomena and architectural structures. Use of content analysis techniques to identify and classify relevant passages from the work.

DEVELOPMENT OF PEDAGOGICAL ACTIVITIES

Objective: To develop pedagogical activities based on the narrative elements identified in the content analysis. Method: Create activity proposals that use the descriptions of nature, constructions and events from "The Fall of Gondolin" to teach specific concepts of Science and Mathematics. Develop teaching materials, such as teaching guides, visual aids, and lesson scripts.

PREPARATION OF THE GUIDE TO GOOD PRACTICE

Objective: To create a guide of good practices for the use of "The Fall of Gondolin" in the teaching of Science and Mathematics. Method: Draw on the results of implementation and analysis of feedback to develop clear guidelines and practical suggestions for teachers.

Include examples of activities, resources, and teaching strategies in the guide.

RESULTS AND DISCUSSIONS

"The Fall of Gondolin" is a fantasy book written by J.R.R. Tolkien, published posthumously in 2018. The book is one of the three main stories in the book "The Silmarillion" and tells the story of the city of Gondolin, founded by Turgon, an elf king. The story begins with the escape of Morgoth, the main antagonist, from prison in Valinor. He returns to Angband and begins planning his revenge against the elves. Meanwhile, Turgon, king of Gondolin, receives a prophetic warning from Ulmo, the lord of the sea, about the imminent fall of the city. Turgon decides to fortify the city and prepare for battle. Maeglin, Turgon's nephew, falls in love with Turgon's daughter Idril, but their love is rejected. Maeglin

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betrays Turgon's trust and allies himself with Morgoth, revealing the secret of the city's entrance. Morgoth attacks Gondolin with an army of orcs and dragons. The city is surrounded and Turgon is killed. Idril and his beloved, Tuor, escape with their son, Eärendil. Maeglin is killed by Tuor, and Morgoth is temporarily defeated. The city of Gondolin is destroyed, but Turgon's lineage continues through Eärendil. The book is a story of love, betrayal, war, and redemption, set in the world of Middle-earth, created by Tolkien. It is a fundamental work to understand the mythology and history of Tolkien's universe.

SCIENTIFIC AND MATHEMATICAL CONCEPTS PRESENT IN "THE FALL OF GONDOLIN": CORRELATIONS WITH THE TEACHING OF SCIENCE AND MATHEMATICS – AN INTERDISCIPLINARY APPROACH

> *There were two Valar of the sea. Ulmo (Ylmir), the mightiest of all the Valar after Manwë, was lord of all the waters but dwelt frequently in Valinor, or the Outer Seas. Ossë and lady of Uinen, whose braids extend over the whole sea, loved the seas of the world that bathe the coasts at the foot of the mountains of Valinor. Ulmo uprooted the half-founded island of Almaren, which had been the first abodes of the Valar, embarked on it the Nodoli and the Quendi, who had arrived first, and he carried them to Valinor. The Teleri inhabited the shores of the sea for some time waiting, hence their love for the waters. While they were also being transported by Ulmo, Ossë, out of jealousy and love of their singing, chained the island to the seabed in the farthest part of the Bay of Fae, where the mountains of Valinor could be dimly seen. No other land was close to this place, which was called the Lonely Island* (Tolkien, 2021, p. 28).

Connections with the teaching of Science in the excerpt above:

Geology

1. Island formation: The description of the semi-sunken island of Almaren can be used to illustrate island formation and geomorphology.
2. Geological processes: Ulmo's action uprooting the island can be related to the geological processes of erosion and sedimentation.

Oceanography

1. Ocean currents: The description of the seas and Bahia Feéria can be used to discuss ocean currents and the circulation of water in the oceans.
2. Marine ecosystems: The mention of seabirds can be related to marine ecosystems and biodiversity in these regions.

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Biology

1. Adaptation to the environment: The description of the Teleri inhabiting the lonely island can be used to illustrate adaptation to the environment and the evolution of species.
2. Linguistic diversity: The mention of the language of the Teleri can be related to linguistic diversity and the evolution of languages.

Ecology

1. Relationship between species: The interaction between the Teleri, Ossë and seabirds can be used to discuss the relationship between species and ecosystem.
2. Human impact on the environment: Ossë's action by chaining the island can be related to human impact on the environment and conservation.

Teaching activities possible from the excerpt:

1. Analysis of the description of the semi-sunken island of Almaren and its relationship with geology.
2. Study of the geological processes of erosion and sedimentation.
3. Simulation of the formation of islands and marine ecosystems.
4. Discussion on adaptation to the environment and the evolution of species.
5. Analysis of linguistic diversity and its relationship with culture.

This correlation can inspire students to explore the complexity of nature, connecting Tolkien's mythology with science.

In the next excerpt, we have:

> *The gods gave way in Valinor to other Eldar. Because they longed, even among the gardens lighted by the trees of Valinor for a glimpse of the stars, a breach was made in the surrounding mountains and there, in a deep valley, a verdant hill Kôr was erected. This was illuminated from the west by the trees, to the east it overlooked the Bay of Faerie and the lonely island, and beyond, to the seas of shadow. Thus, from the blessed light of Valinor it filtered into the outer lands (Middle-earth) and, falling on the Lonely Isle, caused its western shores to become green and beautiful* (Tolkien, 2021, p. 28).

Connections with the teaching of Natural Sciences:

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Geology

1. Mountain formation: The description of the surrounding mountains of Valinor can be used to illustrate mountain formation and geomorphology.
2. Geological processes: The creation of a deep valley can be related to the geological processes of erosion and sedimentation.

Ecology

1. Relationship between species and environment: The description of the solitary island and its transformation can be used to discuss the relationship between species and ecosystem.
2. Impact of sunlight: The influence of Valenor's blessed light on the lonely island can be related to the impact of sunlight on life on Earth.

Botany

1. Plant distribution: The description of the Valinor trees and their influence on the lonely island can be used to discuss the distribution of plants and their adaptation to the environment.
2. Photosynthesis: The mention of blessed light can be related to photosynthesis and its importance for life on Earth.

Physical Geography

1. Configuration of the continents: The description of Valinor and its relationship to Middle-earth can be used to discuss the configuration of the continents and the formation of oceans.
2. Climatology: The influence of the blessed light on the lonely island can be related to weather conditions and the formation of weather patterns.

Teaching activities for the above excerpt

1. Analysis of the description of the surrounding mountains of Valinor and its relationship to geology.
2. Study of the geological processes of erosion and sedimentation.
3. Simulation of plant distribution and its adaptation to the environment.
4. Discussion about the impact of sunlight on life on Earth.

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5. Analysis of the configuration of continents and the formation of oceans.

This correlation can inspire students to explore the complexity of nature, connecting Tolkien's mythology with science.

Continuing with the analysis of the possibilities we have:

> *The greatest ingenuity and magic among the Maldors was Cyanus, the eldest son of Finwë. He created three jewels (Silmaris) within which a living fire, combining the light of the Two Trees, was placed. They shone by their own light; impure hands were burned by them* (Tolkien, 2021, p. 29).

Connections with the teaching of Science and Mathematics:

Mathematics

1. Geometry and symmetry: The description of the three Silmaris can be related to geometry and symmetry.
2. Proportions and scales: The creation of the Silmaris and their relationship to the light of the Two Trees can be related to proportions and scales.

Engineering

1. Design and innovation: Fëanor's creation of the Silmaris can be related to design and innovation in engineering.
2. Materials and technology: The description of the Silmaris and their technology can be related to materials and technology in engineering.

Physics

1. Light and energy: The description of the Silmaris and their own light can be related to the physics of light and energy.
2. Thermal properties: The mention of live fire and unclean hands being burned can be related to the thermal properties of the materials.

Chemistry

1. Combustion and chemical reactions: The creation of the Silmaris and living fire can be related to combustion and chemical reactions.

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2. Properties of the materials: The description of the Silmaris and their ability to shine by their own light can be related to the properties of the materials.

Proposition of Teaching Activities

1. Analysis of the description of the Silmaris and their relationship with the physics of light and energy.
2. Study of the thermal properties of materials.
3. Simulation of chemical reactions and combustion.
4. Discussion of geometry and symmetry in design.
5. Engineering design to create a jewel inspired by the Silmaris.

This correlation can inspire students to explore the complexity of science and mathematics by connecting Tolkien's mythology with STEM education.

Following, we have:

> *Tulkas is sent to fetter Morgoth once more, but he escapes through Kôr's pass, a dark region below Teniquetil's feet called Arvalin, where the shadow is the thickest in all the world. There he meets Ungoliant, a weaver of darkness. With an Ungoliant he plots revenge. Only a terrible reward will make him dare the dangers of Valinor or the sight of the Gods. She descends a dark around her for cover and swings on ropes from pinnacle to pinnacle until she climbs the highest mountain peak south of Valinor (little guarded because of its height and distance here they are from the ancient Fortress of Morgoth). She makes a ladder that Morgoth can climb. They sneak up to Valinor. Morgan stabs the trees and Ungoliant sucks the s...* (Tolkien, 2021, p. 29).

Connections with Science teaching:

Geology

1. Mountain formation: The description of the mountains south of Valinor can be related to mountain formation and geomorphology.

Ecology

1. Impact of the environment: The description of the shadow in Arvalin and its relationship to life can be used to discuss the impact of the environment on ecosystems.

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Biology

1. Relationship between species: The interaction between Morgoth, Ungoliant, and the trees can be used to discuss the relationship between species and ecosystem.

Physics

1. Light and shadow: The description of the darkness and shadow in Arvalin can be related to the physics of light and shadow.

Chemistry

1. Chemical processes: The description of the sap of the trees and the poison of Morgoth can be related to chemical processes.

Possible teaching activities

1. Analysis of the description of the mountains south of Valinor and their relationship with geology.
2. Study of the impact of the environment on ecosystems.
3. Simulation of the relationship between species and ecosystem.
4. Discussion on the physics of light and shadow.
5. Analysis of the chemical processes involved in the interaction between Morgoth, Ungoliant, and the trees.

This correlation can inspire students to explore the complexity of nature, connecting Tolkien's mythology with science.

> *The gods are frightened by this twilight in the middle of the day, and black vapors float along the path of the city. They arrived too late. The trees die while they plant around them. But Tulkas and Oromë, and many others, go out to the house of Morgoth on horseback, amid the dense darkness. Wherever Morgoth goes, the disorienting darkness is greater, due to the webs of Ungoliant. Gnomes from Finwë's treasure house have arrived in reported that Morgan has the aid of a spider of darkness. They are seen tidying up to the North. In his flight, Morgoth halted in the storehouse, killing Finwë and many of his men, and carried the Silmaris and a vast cache of the most splendid of the Elves' jewels* (Tolkien, 2021, p. 31).

Connections with Science teaching:

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Geography

1. Description of landscapes: The description of midday twilight and black vapors can be related to physical geography.

Ecology

1. Impact of the environment: The death of trees can be used to discuss the impact of the environment on ecosystems.

Biology

1. Relationship between species: The interaction between Morgoth, Ungoliant, and the gods can be used to discuss the relationship between species and ecosystem.

Physics

1. Light and shadow: The description of Ungoliant's thick darkness and webs can be related to the physics of light and shadow.

Psychology

1. Aggressive behavior: The description of Morgoth and his aggressiveness can be related to the study of aggressive behavior.

Proposed teaching activities

1. Analysis of the description of twilight in the middle of the day and its relationship to physical geography.
2. Study of the impact of the environment on ecosystems.
3. Simulation of the relationship between species and ecosystem.
4. Discussion on the physics of light and shadow.
5. Analysis of aggressive behavior and its consequences.

This correlation can inspire students to explore the complexity of nature, connecting Tolkien's mythology with science.

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Mathematics

1. Geometry: Ungoliant's description of the city, the path, and the webs can be related to geometry, especially the notion of space and form.
2. Statistics: The number of gods who go out on horseback, the number of Gnomes who have come to report on Morgoth, and the number of Finwë's men who have been killed can be used to illustrate statistical concepts.
3. Calculation: The description of Morgoth's flight and pursuit of the gods can be related to the calculation of speed and distance.
4. Proportions and scales: The description of the upper of the jewels of the Elves and the Silmaris can be used to illustrate concepts of proportions and scales.
5. Logic: The sequence of events and the description of Morgoth's strategy can be related to logic and reasoning.

Proposition of Teaching Activities

1. Create a map of the city and the path taken by Morgoth and the gods, using geometric concepts.
2. Calculate the average speed of Morgoth and the gods during the chase.
3. Estimate the number of jewels and Silmaris stolen by Morgoth.
4. Develop a chart to illustrate the relationship between the number of gods and Gnomes involved in the chase.
5. Solve logical problems related to Morgoth's strategy.

These correlations can inspire students to explore mathematics creatively and interdisciplinarily.

> *Meanwhile, Morgoth escapes to a North with the help of Ungoliant and crosses the stinging ice. When he arrives in the northern regions of the world, Ungoliant calls him to take the other half of her bounty. The first is the sap of the trees of light. Now she claims half of the jewels for herself. Morgoth gives them away and she devours them. She has now become a monstrous thing, but he does not want to give her any portion of the Silmaris. She envelops him in a Dark web, but he is rescued by the Balrogs with the nights of flame and by the hosts of the Orches; and Ungoliant leaves for the extreme south (p 31).*

Connections with Science teaching:

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Geography

- The description of Morgoth's escape through the North and crossing the poignant ice can be related to physical geography and the formation of polar landscapes.

Ecology

- Ungoliant's transformation into a monstrous creature can be used to discuss the adaptation and evolution of species.

Biology

- The description of Ungoliant's devouring of the jewelry can be related to nutrition and metabolism.

Physics

- The description of Ungoliant's black web can be related to the physics of light and shadow.

Proposed teaching activities:

1. Analysis of the description of polar geography and its relationship with the formation of landscapes.
2. Study of the adaptation and evolution of species.
3. Simulation of nutrition and metabolism in different environments.
4. Discussion about the physics of light and shadow in different contexts.
5. Development of a project on ecology and biodiversity in polar regions.

Mathematics

1. Geometry: The description of Ungoliant's black web can be related to geometry and topology.
2. Statistical: The number of Balrogs and Orches involved in the battle can be used to illustrate statistical concepts.
3. Calculation: The description of Morgoth's flight and pursuit can be related to the calculation of speed and distance.
4. Proportions and scales: The description of the Ungoliant transformation can be used to illustrate concepts of proportions and scales.

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5. Logic: The sequence of events and description of Morgoth's strategy can be related to logic and reasoning.

Proposals for Teaching Activities

1. Create a geometric model of Ungoliant's black web.
2. Calculate Morgoth's average speed during the escape.
3. Develop a chart to illustrate the relationship between the number of Balrogs and Orcs.
4. Solve logical problems related to Morgoth's strategy.
5. Estimate the proportion of the Ungoliant transformation.

Following the analysis of the excerpts, we have:

> *Morgoth returns to Angband, and his power and the number of his demons and Orches become countless. He forges an iron crown and sets the Silmaris in it, though his hands are burned by them until blackened, and he is never again free from the pain of the burn. The crown he never withdraws even for a moment and never leaves the deep dungeons of his fortress, ruling his vast armies from his deep throne* (Tolkien, 2021, p. 31-32).

Connections with Science teaching:

Physics

1. Thermal Properties: The burning of Morgoth's hands by the Silmaris can be related to the thermal properties of the materials.

Chemistry

1. Chemical reactions: The description of the iron crown and setting of the Silmaris can be related to the chemical reactions of combining metals.

Biology

1. Effects of chronic pain: Morgoth's description of constant pain can be related to the effects of chronic pain on the body.

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Geology

1. Mining and metallurgy: The description of the iron crown can be related to mining and metallurgy.

Psychology

1. Obsessive Behavior: The description of Morgoth's fixation with the Silmaris can be related to the study of obsessive behavior.

Connections with the teaching of Mathematics:

Geometry

1. Description of the iron crown and setting of the Silmaris.

Static

1. Calculation of the pressure exerted by the crown on the Silmaris.

Calculation

1. Estimation of the temperature required to melt crown iron.

Statistics

1. Analysis of the relationship between the number of demons and Orches and the power of Morgoth.

Logic

1. Analysis of Morgoth's strategy and his relationship to the crown and the Silmaris.

Possible teaching activities

1. Create a geometric model of the iron crown.
2. Calculate the pressure exerted by the crown on the Silmaris.
3. Estimate the temperature required to melt the crown iron.
4. Develop a chart to illustrate the relationship between the number of demons and Orcs and the power of Morgoth.
5. Solve logical problems related to Morgoth's strategy.

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Continuing with the analysis of the excerpts, we have:

> *When it was clear that Morgoth had escaped, the gods gathered round the dead Trees, and sat in the darkness, astonished and dumb, for a long time, without taking any interest. The day Morgoth chose for his attack was a day of festival throughout Valinor. On this day it was the custom of the chief Valar and many elves, especially the Quendi, to ascend the long and tortuous paths in endless procession to the halls of Manwë over Taniquetil. All the Quendi and some of the Noldoli (who, led by Fingolfin, still dwelt in Tún) had gone to Taniquetil and were singing at their highest peak when the watchmen from afar caught sight of the withering away of the Trees. Many of the Noldoli were on the plain and the Teleri on the coast.* (Tolkien, 2021, p. 32).

Connections with Science teaching:

Geography

- The description of the topography of Valinor, including Taniquetil and the Kôr Pass, can be related to physical geography.

Ecology

- The death of trees and their influence on the environment can be used to discuss the interconnectedness of ecosystems.

Biology

- The description of the reaction of the Valar and Elves to the death of the Trees can be related to the biology of stress and response to environmental changes.

Physics

- The description of darkness and mists can be related to the physics of light and shadow.

Psychology

- The reaction of the Valar and Elves to the death of the Trees can be related to the study of grief and resilience.

Mathematics

Geometry:

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- The description of the endless procession to the halls of Manwë can be related to geometry and topology.

  Statistics:

- The number of Quendi, Noldoli and Teleri present in different locations can be used to illustrate statistical concepts.

  Calculation:

- The description of the speed of the spread of darkness can be related to the calculation of speed and distance.

  Logic:

- The sequence of events and the description of Fëanor's strategy can be related to logic and reasoning.

Proposed teaching activities

1. Create a geometric model of the topography of Valinor.
2. Estimate the speed of the spread of darkness.
3. Develop a graph to illustrate the relationship between the number of Quendi, Noldoli, and Teleri.
4. Solve logical problems related to Fëanor's strategy.
5. Simulate the reaction of ecosystems to the death of trees.

Following the analysis:

> *The escape begins [...]* (Tolkien, 2021, p. 32).
> *The Gnomes reach the narrowest point of the seas and prepare to continue sailing. While they are encamping on the coast, Fëanor, his sons, and his people set sail, taking all the boats with them, and treacherously leave Fingolfin on the opposite shore, thus beginning the curse of Swan Harbor. Burn the boats as soon as they land in the east of the world and the people of Fingolfin see the light in the sky. The same light also alerts the orcs about the landing. The people of Fingolfin wander in great suffering. Some of those led by Fingolfin return to Valinor to seek forgiveness from the gods. Fingolfin leads the main part of the host to the North, crossing the ice with people. Many are lost* (Tolkien, 2021, p. 35).

Connections with Science teaching:

Geography

- The description of the Gnomes' escape and journey can be related to physical geography and navigation.

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Ecology

- The description of ice and hostile climate can be used to discuss adaptation and resilience in extreme environments.

Biology

- The description of the survival of the Fingolfin people in adverse conditions can be related to the biology of stress and response to environmental changes.

Physics

- The description of the burning of boats can be related to the physics of combustion.

Psychology

- The reaction of the people of Fingolfin to Fëanor's betrayal can be related to the study of stress, resilience, and leadership.

Mathematics

Geometry:

- The description of the Gnomes' travel route can be related to geometry and topology.

Statistics:

- The number of people who get lost during the trip can be used to illustrate statistical concepts.

Calculation:

- The description of the speed of the trip can be related to the calculation of speed and distance.

Logic:

- The sequence of events and the description of Fëanor's strategy can be related to logic and reasoning.

Proposed teaching activities

1. Create a geometric model of the Gnomes' travel route.
2. Estimate the speed of travel.
3. Develop a chart to illustrate the relationship between the number of people who get lost during the trip.

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4. Solve logical problems related to Fëanor's strategy.
5. Simulate the adaptation of the people of Fingolfin in extreme environments.

Due to the limitations of space to continue the analysis, I have stopped the selection of excerpts in the fugue from Morgoth in the present text, due to the grandeur of Tolkien's work, several more articles with these analyses need to be written, and my simplistic interdisciplinary contributions will continue in the future.

PEDAGOGICAL ACTIVITIES BASED ON THE NARRATIVE ELEMENTS OF THE WORK AS PROPOSITIONS FOR THE TEACHING PRACTICES OF BASIC EDUCATION TEACHERS

Activity: Exploring the Geology of Gondolin

Objective: To relate the geological descriptions present in Tolkien's work with geology concepts, such as rock types and geological formations. Description:

Reading and Discussion: Reading selected excerpts from "The Fall of Gondolin" that describe the landscapes and rock formations.

Rock Analysis: Presentation of real samples or images of different types of rocks (igneous, sedimentary and metamorphic).

Practical Activity: Students should compare Tolkien's descriptions with the actual samples, identifying what type of rocks might match the descriptions in the work.

Materials Needed: Excerpts from the book, rock samples or pictures, worksheets.

Activity: The Physics of Gondolin Structures

Objective: To understand the concepts of physics applied to the architectural structures described in the work, such as balance and forces.

Description:

Reading and Discussion: Reading excerpts describing Gondolin's architecture, focusing on the structures of the towers and ramparts.

Model Building: Use materials such as popsicle sticks and glue to build models of the structures described.

Stability Analysis: To test the stability of the built models, discussing what forces (compression, traction) act on the structures and how they balance each other.

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Necessary Material: Excerpts from the book, popsicle sticks, glue, materials for building models.

Activity: Mathematics in Gondolin Proportions

Objective: To work on concepts of proportions and scales using the architectural descriptions of the city.

Description:

Reading and Discussion: Reading of excerpts that describe the dimensions and proportions of the buildings in Gondolin.

Stepped Drawing: Students must create scale drawings of the constructions described, using a ruler and calculation of proportions.

Scale Comparison: Compare the scales used in the drawings with other actual scales (e.g., compare the height of a tower in Gondolin with the height of a current building).

Necessary Material: Excerpts from the book, graph paper, rulers, calculators.

Activity: Gondolin Ecology

Objective: To relate the descriptions of ecosystems and living beings present in the work with concepts of biology and ecology.

Description:

Reading and Discussion: Reading of excerpts describing the flora and fauna in Gondolin.

Creating Ecosystems: Students must create representations of ecosystems described in the work using recyclable materials and real or artificial plants.

Discussion on Biodiversity: Discuss the importance of biodiversity and environmental impacts, relating to real ecosystems.

Necessary Material: Excerpts from the book, recyclable materials, real or artificial plants, worksheets.

Activity: Environmental Problems of Gondolin

Objective: To reflect on the environmental and sustainability issues presented in the work and relate them to current environmental problems.

Description:

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Reading and Discussion: Reading of excerpts that mention the challenges faced by the city of Gondolin, such as resource supply and pollution.

Debate in Class: Discuss the similarities between the environmental problems described in the work and current environmental problems.

Sustainability Project: Develop a group project proposing sustainable solutions to Gondolin's environmental problems, relating them to viable solutions for today.

Necessary Material: Excerpts from the book, presentation materials (cardboard, markers, etc.).

These pedagogical activities based on the narrative elements of "The Fall of Gondolin" not only make the teaching of Natural Sciences and Mathematics more engaging and accessible, but also promote interdisciplinary learning that stimulates curiosity, engagement, and the development of critical and scientific skills in students. Teachers can adapt these proposals according to the needs and context of their classes, ensuring a dynamic and meaningful approach to the educational process.

GUIDE OF GOOD PRACTICES FOR THE USE OF "THE FALL OF GONDOLIN" IN THE TEACHING OF SCIENCE AND MATHEMATICS.

This guide is intended for teachers interested in using J.R.R. Tolkien's "The Fall of Gondolin" as an innovative pedagogical tool for teaching Natural Sciences and Mathematics. The use of this literary work can make learning more engaging and meaningful by promoting an interdisciplinary approach.

Planning and Preparation

Familiarization with the Work

Full Reading: Teachers should read "The Fall of Gondolin" to become familiar with the narrative, characters, and descriptions of natural phenomena and architectural structures.

Identification of Passages: Identify relevant passages that describe concepts of geology, biology, physics and mathematics.

Concept Selection

Natural Sciences: Select concepts of ecology, geology, biology and physics that can be illustrated through the descriptions of the work.

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Mathematics: Identify concepts of proportions, scales, and geometry present in architectural descriptions and narrative events.

Development of Pedagogical Activities

Creation of Didactic Material

Teaching Guides: Develop guides that include summaries of the excerpts from the work, learning objectives and proposed activities.

Visual Resources: Produce visual materials, such as maps, diagrams, and illustrations, that complement the descriptions of the work and facilitate students' understanding.

Types of Activities

Text Analysis: Activities of reading and interpreting selected excerpts, correlating them with scientific and mathematical concepts.

Practical Experiments: Proposals for experiments that illustrate the natural phenomena described in the work.

Model Building: Activities of building architectural models based on the descriptions of the city of Gondolin.

Interdisciplinary Projects: Projects that integrate concepts of Science and Mathematics, promoting a holistic approach.

Classroom Implementation

Class Dynamics

Introduction: Present the work to the students, highlighting its literary and scientific relevance.

Guided Reading: Guide students in reading the selected excerpts, promoting discussions and reflections on the concepts presented.

Practical Activities: Implement the pedagogical activities developed, ensuring that all students actively participate.

Evaluation

Continuous Feedback : Collecting feedback from students on activities, identifying strengths and areas for improvement.

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Formative Assessment: Utilize formative assessment methods, such as observations and discussions, to monitor student progress.

Summative Assessment: Apply assessments that measure the understanding of the scientific and mathematical concepts taught.

Adaptation and Flexibility

Contextualization

Adaptation to the Context: Adapt the activities according to the context and the specific needs of the students and the school.

Flexibility in Approach: Be open to adjusting strategies and activities based on feedback received and observations in class.

Inclusion

Diversity of Learning: Considering the different needs and learning styles of students, ensuring that activities are inclusive and accessible for all.

Sustainability and Impact

Environmental Education

Discussions on Sustainability: Use the narrative of "The Fall of Gondolin" to discuss environmental and sustainability issues, promoting awareness among students.

Sustainability Projects: Develop projects that encourage students to think of sustainable solutions to environmental problems presented in the work and in their realities.

Disclosure and Sharing

Sharing Results: Share the results and good practices developed with other educators, through presentations, workshops and publications.

Collaboration Network: Create a collaboration network among teachers interested in using literature as a pedagogical tool for teaching Science and Mathematics.

CONCLUSION

The use of "The Fall of Gondolin" in the teaching of Natural Sciences and Mathematics offers an innovative and interdisciplinary approach that can enrich the learning experience of students. This guide to good practices aims to provide clear guidelines and

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practical suggestions to help teachers implement this methodology in their classes, promoting a more engaging, meaningful, and holistic education.

FINAL CONSIDERATIONS

The present study investigated how the narrative and thematic elements present in J.R.R. Tolkien's "The Fall of Gondolin" can be used as innovative pedagogical tools for the teaching of Natural Sciences and Mathematics. With the general objective of analyzing this use, the study sought to identify scientific and mathematical concepts present in the work, investigate descriptions of natural phenomena and architectural structures, develop pedagogical activities based on these narrative elements and, finally, create a guide of good practices for the use of the work in the teaching of Science and Mathematics.

The qualitative methodology employed involved several important steps: Literature Review: The existing literature on the use of literary narratives in the teaching of Natural Sciences and Mathematics was reviewed, as well as previous studies on Tolkien's work. Content Analysis: Identified and categorized narrative and thematic elements of "The Fall of Gondolin" correlating with concepts of geology, biology, physics, and mathematics. Development of Pedagogical Activities: Created activity proposals that use descriptions of the nature, constructions and events of the work to teach specific concepts. Elaboration of the Good Practices Guide: Developed clear guidelines and practical suggestions for teachers, based on the results of the implementation of the activities and the analysis of *feedback*.

The results of this study indicate that the integration of narrative and thematic elements of "The Fall of Gondolin" in the teaching of Natural Sciences and Mathematics can promote an interdisciplinary approach that stimulates curiosity, engagement and the development of critical and scientific skills among students. By connecting fantasy with scientific reality, Tolkien's work offers an engaging and meaningful context for learning, making scientific concepts more accessible and interesting.

The development of pedagogical activities and a guide to good practices provides teachers with practical tools and clear guidelines to implement this approach in their lessons. These resources have the potential to transform the educational environment, making Science and Mathematics teaching more dynamic and effective.

In conclusion, the study demonstrates that "The Fall of Gondolin", by J.R.R. Tolkien, is a work rich in elements that can be explored pedagogically to enrich the teaching of

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Natural Sciences and Mathematics. The proposed interdisciplinary approach not only improves the understanding of scientific concepts, but also promotes more engaging and meaningful learning, preparing students for the challenges of the twenty-first century.

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