

Short report

Common misconceptions regarding physics concepts in the fairy tales written by the Grimm Brothers

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Abstract: The Grimm Brothers' fairy tales, compiled during the early 19th century, are renowned literary works celebrated for their captivating storytelling and didactic messages. Nevertheless, these narratives frequently incorporate components that defy our current comprehension of physical principles. This paper examines the erroneous beliefs regarding physics that are included in the fairy tales written by the Grimm Brothers. Through the analysis of these myths, our objective is to elucidate how these narratives might lead to a misinterpretation of essential principles in physics and the possible ramifications of perpetuating such misunderstandings.

Keywords: misconceptions; physics concepts; Grimm Brothers' fairy tales

1. Introduction

There is a consensus that pupils acquire ideas and comprehend the concepts and principles of physics. Children develop diverse conceptions of the functioning of the world through their engagement with the environment (including cultural, social, and technological aspects), social interactions, and language acquisition. They utilize these perceptions to elucidate the occurrences they observe in their surroundings. The concept of examining children's views of science is very old. Starting very early, Piaget (1951, 1960) employed the interview technique to examine how children understand concepts. He generated numerous insights on various subjects within the field of science. The word "misconceptions about students" is referenced in the 1967 worldwide bibliography, specifically in physics, as described by Burge (1967). Approximately 45 years ago, researchers Driver and Easley (1978) initiated a systematic investigation into children's understanding of scientific concepts and phenomena by connecting their learning of scientific objects to their cognitive development. These perceptions are given different names depending on when and how they were formed in childhood. Therefore, these perceptions are recognized as the understanding of different phenomena that children have independently developed at an early age, typically without any involvement from the teacher.

The thoughts of these pupils are subjective interpretations influenced by their observations, perceptions, and reasoning rather than being a result of inaccurate knowledge (Kotsis, 2023a). The students develop as they strive to comprehend the world in which they reside. Based on their experiences, individuals seek similarities and differences to notice and analyze phenomena and occurrences, ultimately constructing relationship structures.

The prevailing consensus in the global body of literature, derived from extensive research on science education, is that educators must consider students' perspectives. Considering students' perceptions is an approach that empowers teachers to customize instruction to suit their students. The outcome of the extensive study endeavour is classifying the students' alternative ideas and perceptions (Driver et al., 1985) into numerous concepts and phenomena in the sciences field.

On the other hand, many times educators use fairy tales in their teaching (Carramillo et al., 2018). Especially for the young students in primary school fairy tales are a very useful tool. Even for adult students at the University level, some studies show educators are using fairy tales, for example, to enrich the vocabulary of foreign languages (Kuzmanovska et al., 2022). Another study (Logofatu & Lämmlein, 2016) reports that fairy tales are used to improve the communication skills of engineering students by employing texts such as fairy tales. The idea

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of connecting fairy tales with science is very old (Jackson, 1973). Recently it has been reported (Kucheriavyi, 2022) that the key to proactive training in Physics and Mathematics at primary schools is to design a didactic fairy tale. The stories of fairy tales usually are in mythic words and educators have to take care of how will connect concepts of science with these stories. Otherwise, they will transfer misconceptions about physics concepts to the young students (Kotsis, 2023b). Such misconceptions about concepts in sciences have been reported in Charles Perrault's fairy tales (Kazantzidou & Kotsis, 2023). The same authors have reported before, errors and inaccuracies about the environment in fairy tales (Kazantzidou & Kotsis, 2017).

Classic fairy tales, such as the ones written by the Brothers Grimm (Grimm & Grimm, 2015), have captivated readers for generations. These narratives frequently incorporate enchanting aspects, legendary beings, and ethical teachings that deeply resonate with individuals of all ages. Yet, underlying the allure, there exists a wealth of misunderstandings regarding the natural world, namely in physics.

This study aims to identify and analyze the misunderstandings included in famous fairy tales, intending to illuminate how these stories influence our comprehension of the physical realm. By analyzing various instances, we aim to illustrate the significance of advocating for scientific literacy and cultivating a more precise comprehension of the physical universe in classic fairy tales.

The Grimm Brothers, Jacob and Wilhelm Grimm, are renowned for their anthology of folklore, encompassing renowned narratives like "Cinderella", "Snow White", and "Hansel and Gretel". Although these fairy tales have withstood the test of time and captivate readers of all ages, they frequently incorporate elements that defy conventional physics principles we got used to. While originating from the fanciful and enchanting essence of the stories, these fallacies might unintentionally cultivate misunderstandings regarding fundamental principles of physics. This research explores prevalent misconceptions regarding physics ideas depicted in the Grimm Brothers' fairy tales and analyses their potential impact on our comprehension of science.

2. Misconceptions

2.1 *Misconception 1: Gravity-Defying Actions*

The Grimm Brothers' fairy tales have left an indelible mark on literature and popular culture, but beneath the enchanting narratives lie recurring themes that challenge our understanding of physics concepts. One such recurring theme is the portrayal of characters defying the laws of gravity, engaging in actions that would have dire consequences in the real world. Examples can be found in characters like Rapunzel, who lowers her hair for the prince to climb, or characters who perform high leaps or descents without harm. These depictions challenge our comprehension of the fundamental force of gravity, which pulls objects toward the center of the Earth. In reality, falling from great heights can lead to severe injuries or worse.

2.1.1 *The Whimsy of Gravity-Defying Acts*

In many Grimm Brothers' fairy tales, characters perform extraordinary feats that involve defying gravity. Rapunzel's ability to lower her hair for the prince to ascend the tower without injury is one of the most iconic examples. Similarly, characters like Jack from "Jack and the Beanstalk" or Hansel and Gretel escape from perilous situations by leaping from great heights. These actions are presented as commonplace in the world of fairy tales, driven by the narrative's whimsical and fantastical nature.

2.1.2 *The Reality of Gravity*

In reality, gravity is a fundamental force of nature that exerts a constant pull on all objects with mass. This force keeps us anchored to the Earth's surface and governs the motion of celestial bodies in the universe. Falling from significant heights, even a few stories high, can result in serious injuries or fatalities due to the gravitational acceleration that causes a rapid increase in velocity.

The portrayal of characters in Grimm Brothers' fairy tales performing gravity-defying actions can foster misconceptions, particularly among young readers or viewers who may develop unrealistic beliefs about the consequences of such actions. This can have unintended and potentially harmful consequences when individuals attempt to replicate these feats, believing that real-world physics will be as forgiving as the enchanted world of fairy tales.

2.1.3 *Promoting Understanding and Safety*

To address the potential misunderstandings arising from these portrayals, educators, and storytellers can use these tales to discuss the scientific principles that govern our world. Encouraging critical thinking and curiosity about the physical world can help individuals differentiate between the imaginative narratives of fiction and the laws of nature.

Moreover, it is essential to emphasize the importance of safety and the real-world consequences of defying gravity. This can be particularly relevant when discussing rock climbing, bungee jumping, heights, and potential falls. Understanding the laws of physics, especially those related to gravity, can lead to safer decision-making and prevent accidents.

In conclusion, portraying characters defying gravity in the Grimm Brothers' fairy tales challenges our understanding of a fundamental physical force. While these depictions serve the narrative purposes of the tales, they can lead to misconceptions and potentially dangerous beliefs about the consequences of gravity-defying actions in the real world. By promoting scientific literacy and safety awareness, we can ensure that individuals appreciate both the magic of fairy tales and the importance of respecting the laws of nature in their everyday lives.

2.2 Misconception 2: Talking Animals and Inanimate Objects

The Grimm Brothers' fairy tales are replete with enchanting stories featuring talking animals and inanimate objects that exhibit human-like qualities. While these elements add whimsy and charm to the tales, they also challenge our understanding of biology, communication, and the nature of life. In "The Bremen Town Musicians", a group of animals forms a band and communicates as if they were humans, while in "The Twelve Dancing Princesses", the worn-out shoes of the princesses suggest magical elements at play. These depictions present a fantastical world where the boundaries between living and non-living and between humans and animals are blurred.

2.2.1 The Fantasy of Talking Animals and Objects

In many Grimm Brothers' fairy tales, animals and objects are portrayed as possessing human-like qualities, including the ability to speak and reason. For instance, in "The Bremen Town Musicians", a donkey, a dog, a cat, and a rooster form a band and engage in conversations, making collective decisions. Similarly, in "The Twelve Dancing Princesses", the princesses' shoes wear out every night, hinting at magical nighttime escapades.

These fantastical elements create a sense of wonder and amusement, contributing to the enduring appeal of these tales. However, they also challenge our understanding of biology and communication, implying that animals and objects can possess consciousness and language similar to humans.

2.2.2 The Reality of Animal Communication

In reality, animals communicate using a variety of signals, vocalizations, and behaviours specific to their species. While animals can convey information to one another, their modes of communication differ significantly from human language. Animal communication is adapted to meet the needs of their social structures, mating rituals, and survival strategies. It does not involve sophisticated language and abstract reasoning in human communication.

2.2.3 The Limits of Inanimate Objects

Inanimate objects, on the other hand, lack the capacity for consciousness or communication. While the Grimm Brothers' tales often imbue objects with human-like qualities, it is crucial to recognize that objects are devoid of awareness, intentions, and emotions. The portrayal of objects as having personalities or consciousness can blur the line between fantasy and reality, potentially leading to misunderstandings about the nature of life.

2.2.4 Nurturing Understanding and Critical Thinking

To address potential misunderstandings arising from these portrayals, educators, and storytellers can use the Grimm Brothers' fairy tales as opportunities for discussions about the boundaries between fantasy and reality. Encouraging critical thinking and curiosity about the natural world can help individuals differentiate between the imaginative narratives of fiction and the scientific realities of biology, communication, and the nature of life.

Moreover, these tales can serve as a springboard for exploring the fascinating world of animal behaviour, communication, and cognition. By providing context and accurate information about how animals communicate and the limitations of inanimate objects, individuals can develop a more nuanced understanding of the natural world.

In conclusion, the Grimm Brothers' fairy tales, with their talking animals and animated objects, present a fantastical world that challenges our understanding of biology, communication, and the nature of life. While these elements contribute to the charm of the stories,

they can also lead to misunderstandings about the limits of animal behaviour and the capabilities of inanimate objects. By promoting scientific literacy and critical thinking, we can ensure that individuals appreciate both the magic of fairy tales and the scientific realities of the natural world.

2.3 Misconception 3: Time Manipulation

The Grimm Brothers' fairy tales are replete with fantastical elements, and one recurring theme that challenges our understanding of physics is the concept of time manipulation. Characters in these tales often experience time dilation or compression, where time passes differently depending on the circumstances. While time dilation is a legitimate concept rooted in Albert Einstein's theory of relativity, fairy tales present it without a scientific basis, leading to misconceptions about the nature of time.

2.3.1 The Enchantment of Time Manipulation

In many Grimm Brothers' fairy tales, characters encounter situations where time behaves in a non-linear or magical manner. For instance, in "Sleeping Beauty", the princess and the entire kingdom fall into a deep slumber for a century, only to awaken as if no time had passed. Similarly, in "Rumpelstiltskin", the spinning wheel's magic allows for time manipulation, enabling the heroine to accomplish an impossible task overnight.

These enchanting depictions of time manipulation serve the narrative purposes of the tales by creating dramatic tension and allowing for miraculous resolutions. However, they present a simplistic and unscientific view of time.

2.3.2 The Complexity of Time Dilation

In reality, time dilation is a well-established concept in the theory of relativity, proposed by Albert Einstein in the early 20th century. Time dilation occurs when an object's relative motion or gravitational field strength affects the passage of time. It is a consequence of the fact that time is not an absolute and uniform concept but is instead influenced by the conditions of the observer.

While time dilation is a fascinating phenomenon supported by empirical evidence, it is not as simplistic as depicted in the Grimm Brothers' fairy tales. It arises in situations involving extremely high speeds, such as near the speed of light, or in the presence of strong gravitational fields, such as near massive celestial bodies like black holes.

2.3.3 Addressing Misconceptions and Promoting Understanding

The portrayal of time manipulation in fairy tales can foster misconceptions about the complexities of time and relativity. It may lead individuals to believe that time can be manipulated effortlessly without scientific explanation. To address these potential misunderstandings, educators and storytellers can use these tales as opportunities to introduce discussions about the real-world physics of time dilation and the theory of relativity.

By explaining that time dilation is a phenomenon governed by specific conditions, educators can help individuals appreciate the richness of scientific concepts while enjoying the magic of fairy tales. This approach can foster curiosity about the universe's complexities and promote a more informed understanding of the nature of time.

In conclusion, the Grimm Brothers' fairy tales, with their depictions of time manipulation, challenge our understanding of physics concepts, particularly the nature of time and time dilation. While these portrayals serve the narrative purposes of the tales, they present a simplistic view of a complex scientific concept. By promoting scientific literacy and using these tales as springboards for discussions about physics, educators can ensure that individuals appreciate both the enchantment of fairy tales and the fascinating realities of the physical world.

3. Implications

The Grimm Brothers' fairy tales, with their timeless and enchanting narratives, have left an indelible mark on our cultural heritage. However, as explored in this paper, these tales often contain misconceptions about fundamental physics concepts. These misconceptions challenge our understanding of gravity, communication, and time. While these stories are not intended to be scientifically accurate, they can inadvertently foster misunderstandings about essential physics principles.

It is essential to recognize the potential consequences of perpetuating these misconceptions. They have the potential to influence decision-making and understanding in various aspects of life. The portrayal of gravity-defying actions may lead individuals to underestimate

the dangers of falls from heights, potentially leading to accidents and injuries. Misunderstandings about communication with animals and sentient objects may hinder effective wildlife conservation efforts and contribute to unrealistic technological expectations. Similarly, the portrayal of time manipulation can lead to misconceptions about the complexities of time and relativity.

To strike a balance between the magic of fairy tales and the need to promote accurate scientific understanding, educators and storytellers can use these tales as opportunities for discussions about the natural world and the scientific principles that govern it. By encouraging critical thinking and curiosity about the physical world, we can ensure that future generations appreciate both the wonder of fairy tales and the beauty of scientific discovery.

Promoting scientific literacy is key to addressing the potential harm of these misconceptions. Educators can use fairy tales as springboards for discussions about the real-world scientific concepts that relate to the tales. These discussions can help individuals differentiate between the imaginative narratives of fiction and the scientific realities of the physical world.

4. Conclusions

In conclusion, the Grimm Brothers' fairy tales, while cherished for their enchanting narratives, contain several misconceptions about physics concepts. These misconceptions challenge our understanding of gravity, communication, and time. Recognizing the potential consequences of perpetuating these misconceptions is crucial, as they may influence decision-making and understanding in various aspects of life.

By using these tales to promote scientific literacy and critical thinking, we can ensure that individuals appreciate both the magic of fairy tales and the beauty of scientific discovery. Striking a balance between the two allows us to enjoy the richness of both worlds while fostering a more informed and curious society that appreciates the wonders of fiction and reality.

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