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Representations of the celestial bodies in fairy tale texts

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ABSTRACT

This work identifies and records the errors and inaccuracies in representing celestial bodies in fairy tales. It also presents the alternative ideas that may arise in children due to these inaccuracies and errors. The qualitative content analysis examined the texts of 55 classic fairy tales by authors Andersen, Perrault, and the Brothers Grimm. The results showed that the Moon, the Sun, and the Stars are not represented based on the scientific standard. Finally, the common characteristics of errors and inaccuracies and ways of using these fairy tales in teaching sciences are presented.

Keywords: misconceptions, fairy tale, celestial bodies

INTRODUCTION

Children's and adults' perceptions of astronomy have been the subject of research by many researchers. The results show that children (Vosniadou & Brewer, 1994) and adults (Brunsell & Marcks, 2004) have alternative ideas about celestial bodies. Alternative ideas and beliefs about the natural world are developed from everyday experiences such as the senses, language, cultural background, peers, mass media, teaching, and books (Duit & Treagust, 1995; Kotsis, 2005).

Research in books of children's literature, fiction, and non-fiction concluded that the celestial bodies, specifically the Moon, are only sometimes represented based on the scientific standard. In more detail, Rice and Rainsford (1996) examined ten books of children's literature on the Moon to identify examples of alternative ideas or information that could contribute to their development. The content analysis found errors in the texts and the illustrations about the Moon's size, shape, composition, position, and distance from the Earth. In three books, the Moon was presented with anthropomorphic elements. Trundle and Troland (2005) and Trundle et al. (2008) analyzed children's literature books that had the Moon as a theme or used it in illustrations. They concluded that many books contained errors and inaccuracies, such as inaccurate phase sequences and incorrect figures. Many books also promoted the alternative idea that the Earth's shadow causes its phases.

Empirical studies show that reading inaccuracies and errors about the Moon in children's literature books creates alternative ideas in children. For example, children believe that the Moon is shrinking in size, is an earth-like place, or has human characteristics (Kazemek et al., 2004). The research of Kazemek et al. (2004) agrees with the position of Ault (1984), who considers that the alternative ideas about the phases of the Moon originate from its incorrect representation in children's literature books.

Bettelheim (1995) observed that children of all stories prefer fairy tale, as it provides them with ways to deal with their problems and worries. However, research on first graders concluded that even fairy tales could lead to alternative ideas in science subjects (McClelland & Krockover, 1996). From the literature review, research was not found that examines fairy tales in terms of accuracy in representation of celestial bodies.

The present research, therefore, aims to inform educators, parents, and researchers about the common inaccuracies in the representation of celestial bodies in the fairy tales of Andersen, Perrault, and the Brothers Grimm. The specific fairy tales were chosen as they have been translated into many languages (Zipes, 2015) and have been in contact with children worldwide. More specifically, the research questions of the study are the following:

1. What are the inaccuracies and errors in representing the celestial bodies?
2. What possible alternative ideas may be generated in children due to these inaccuracies and errors?

METHODOLOGY

The sample was collected using purposive sampling. Initially, a search was done with the terms: Grimm, Andersen, and Perrault in the catalog of the Municipal Library of Veria

(Greece) (http://catalogue.libver.gr/webopac/Vubis.csp) and the Network of Libraries of the Municipality of Thessaloniki (Greece) (http://lib.thessaloniki.gr/), to locate the available books. Some exclusion criteria reduced the original sample. More specifically, those books found in library branches and those aimed at adults or teenagers were excluded. Some were excluded because they could not be found on library shelves, either because they had been damaged or because they had been lost. Finally, after a search of online bookstore catalogs, those not in circulation, i.e., not available for sale in bookstores or online stores, were excluded.

A list was then made of the titles of the remaining books, the ages of children each was aimed at, and the year of publication. Many books contained the same tale. Initially, therefore, the fairy tales that circulated individually were selected. Based on the age of the children and the year of publication, the fairy tale that was aimed at older children and was published most recently was chosen each time. Then, the titles of the fairy tales contained in collections were recorded, and the fairy tales that were not found to be circulating as individual books were selected. The selection was then made using the quantitative criteria of age and year of publication, as mentioned above. The final sample, therefore, included 55 fairy tales by Andersen, Perrault, and the Brothers Grimm, 24 of which were part of collections and 31 individual books released between 1993 and 2010 and aimed at children of preschool and school age.

The research method used was qualitative content analysis. The research stages were the stages of research suggested by Mayring (2014). Analysis was done with the QCAmap web application (http://www.qcamap.org/).

All the fairy tales of the research were translated into Greek. Danish, English, French, German, Italian, and Spanish are recognized as their original languages. More in detail, of the 55-fairy tales in the sample, 19 recognize German as the original language, 18 fairy tales English, nine are Danish, four are French, three are Spanish, and two are Italian. It is evident that although the recording of the fairy tales by Andersen, Perrault, and Grimm was originally done in Danish, French, and German, respectively, the fairy tales have been translated and spread in many countries of Europe.

Based on Laswell's classic communication scheme (Bonidis, 2004), the direction of the analysis was defined. According to this, communication can be studied with the questions: who speaks, what he says, to whom he speaks, for what purpose, how he says it, and what effect the speech has. In the present study, therefore, the research of the content of the message is attempted, i.e., the errors and inaccuracies in the representation of the celestial bodies and the effect it may have on children, i.e., the alternative ideas that may be created.

Inductive categorization was used as an analysis technique. In other words, the categories with errors and inaccuracies about the celestial bodies were formed after examining the text of the fairy tales. Then, the units of analysis were defined, that is, the coding, framing, and recording units. The coding unit was defined as the theme (seme), i.e., a sentence or statement related to the research questions. The software itself defined all texts as a frame and recording unit.

The definition of the category was formulated to select the extracts from the texts and define the categories. Specifically, the definition was defined as any reference to the texts that do not represent the celestial bodies in a scientifically acceptable way. Then the level of abstraction was formulated, that is, how limited the content of the categories will be. This, then, was defined as the celestial body not accurately represented, such as the Moon.

Finally, all texts were entered into the software to be coded. When a passage was found with inaccuracies or errors in representing a celestial body, a new category or an entry was made in a previous one. To check the reliability and establish the category system, the agreement in the coding by the same researcher at two different times (intra-coder agreement), specifically after six months, was used.

RESULTS

From the analysis of the fairy tales of Andersen, Perrault, and the Brothers Grimm, a total of 113 passages with errors and inaccuracies about the celestial bodies were recorded. Specifically, the Moon, the Sun, and the Stars are the celestial bodies that are not accurately represented in the text of fairy tales. More specifically, 67 passages refer to the Sun (59%), 29 to the Moon (26%), and 17 to the Stars (15%).

Three categories of errors and inaccuracies emerged, which are given in **Table 1**. **Table 1** includes the title of each category, the definition, examples from the texts, the scientific view, and possible alternative ideas. Scientific view provides the prevailing scientific view of the Moon, the Sun, and the Stars. Alternative Ideas provides ideas about the celestial bodies' children may develop due to these errors and inaccuracies.

CONCLUSIONS

The results show that the fairy tales of the present research contain errors and inaccuracies about celestial bodies. Specifically, the Moon, the Sun, and the Stars are not represented based on the scientific standard.

These results agree with previous research results. Specifically, content analysis of children's knowledge books, fiction, and non-fiction, documented inaccuracies about the Moon and the Sun (Rice & Rainsford, 1996; Sackes et al., 2009; Trundle et al., 2008). In more detail, the inaccuracies found in the tales of the present research about the Moon were also recorded in the research of Rice and Rainsford (1996) and concerning its shape, position, and distance from the Earth. Also, in the research of Rice and Rainsford (1996) and Sackes et al. (2009), the Sun and the Moon appeared with anthropomorphic features, as in fairy tales of present research.

The individual characteristics of the errors and inaccuracies recorded are based on observational data. For example, the Moon is described as self-luminous, moving up and down in the sky or round. The Stars also appear to be stationary in the sky. This is because when observing the night sky, the Stars give the impression that they are stationary.

Table 1. Category system

Category	Definition of category	Examples	Scientific view	Alternative ideas
The Moon	This category includes any reference that does not represent the Moon/Moon in a scientifically accepted way & may lead to alternative ideas about (1) light of the Moon, as it presents itself as self-luminous; (2) its position, apparent motion, or distance from the Earth; (3) temperature prevailing on its surface, its color, or shape; & (4) also included are human characteristics attributed to her.	(1) *"… the Moon was shedding its sickly light …" (a traveling companion)*; (2) *"Well, it can hang up there & shine on me …" (the Snowman) & "… we'll wait a little while longer for the Moon to rise high in sky …" (Hansel & Gretel);* (3) *"… the Moon shone cold …" (the Snow Queen), "… a dress color of the Moon … its sweet silver color …" (the Donkey Queen), & "… full moon rose, full round …" (the Snowman)*; & (4) "*The moon was watching from above …" (a traveling companion).*	(1) The Moon is a heterochromatic celestial body (Avgoloupis & Seiradakis, 2009); (2) The Moon appears to move from East to West due to Earth's rotation. Its average distance from Earth is 384,000 kilometers (Avgoloupis, 2008); & (3) Its surface temperatures range from -153°C to +107°C (Avgoloupis & Seiradakis, 2009). The Moon changes apparent colors depending on type of clouds found in upper layers of Earth's atmosphere. The Moon is spherical in shape, with a diameter of 3,476 kilometers (Avgoloupis & Seiradakis, 2009).	(1) The Moon shines, it emits its own light like the Sun, it is self-luminous; (2) It's hanging in sky, so it's stationary. It moves up & down/rises & falls in sky, in opposite direction of the Sun, or behind trees. The Moon is close to Earth; (3) Low temperatures prevail on its surface, it has a silver color, & it is round; & (4) The Moon is a living organism, it sees, it has a face. Greets, talks to or helps people, runs, has emotions (e.g., jealousy), & appears at will.
The Sun	This category includes any report that does not represent the Sun in a scientifically acceptable way & can lead to alternative ideas about (1) succession of day & night, as this phenomenon is connected with astronomical movement of the Sun, attribution of anthropomorphic elements to it, its covering by clouds, or night; (2) the Sun-Earth distance; (3) shape of the Sun or its size; & (4) also, included are human characteristics attributed to him.	(1) *"When Eliza awoke, the Sun was high in sky" (the Wild Swans), "… the Sun disappeared behind cherry trees" (the Snow Queen), "… wait for night to fall …" (the Little Princess with the Donkey);* (2) *"… the Sun had already risen, & little birds were flying around it …" (a traveling companion);* (3) *"… he made hers round like the Sun" (the Little Mermaid); &* (4) *"The youngest daughter was so beautiful that even the Sun, who had seen so much in his travels, was late every time he cast his rays upon princess, for he was dazzled by her beauty" (the Frog Prince).*	(1) Succession of day & night is due to the Earth's rotation on its axis every 24 hours. Successively a place on its surface passes from shadow to light; (2) Average distance of the Sun from the Earth amounts to 149,600,000 kilometers (Avgoloupis, 2008); & (3) The Sun is spherical with a diameter of 1,320,000 kilometers (Avgoloupis, 2008).	(1) Succession of day & night is due to movement of the Sun. Specifically, it rises & sets, reigns/reigns, ascends & descends in sky, moves up & down, or appears & disappears. It also has life as it appears to disappear into horizon, go behind cherry trees/mountains, fade & glow again, or sink into water. By extension, it is near or on ground. Finally, it is covered by clouds or darkness/night; (2) The Sun is near, on, or within reach of the Earth; (3) The Sun is round or small in size; & (4)The Sun is a living organism; it sees, greets, or speaks to people; it knows, it embraces people, moves, it slows down.
The Stars	This category includes any reference that does not represent the Stars in a scientifically acceptable way & can lead to alternative ideas about (1) the Earth-Star distance; (2) the Star-Meteor difference; (3) the Planet-Star difference, as they appear similar in size; (4) their position or apparent motion; & (5) their size or shape.	(1) *"… I'll go … there to brightest star" (the magical story of time);* (2) *"… it comes off & rolls on ground …" (the Little Girl with the Matches);* (3) *"They are huge planets, like the Earth, & even bigger" (the Old Man with the Sand);* (4) *"I have to collect all sky's stars & shine them. I've got to be careful because if I hang them in wrong place, all ships, wherever they arm themselves, will go in wrong direction" (the Old Man with the Sand); &* (5) *"… they fixed a star …" (the Christmas Tree).*	(1) All known stars are at a distance greater than one parsec* from Earth (Avgoloupis, 2008); (2) meteors are small stones & dust encountered by the Earth during its orbit around the Sun, which enter atmosphere, burn due to friction with its molecules, & evaporate (Avgoloupis, 2008); (3) the Stars (planets) in night sky are separated from the Planets (Avgoloupis, 2008); & (4) the Stars appear to trace arc-shaped orbits due to the Earth's rotation around its axis (Avgoloupis, 2008); thus, each star appears to rise & set (Avgoloupis & Seiradakis, 2009).	(1) The Stars are close to the Earth, high in sky, so one can catch or move into them; (2) shooting stars are stars that fall to Earth. Stars are falling; (3) the Stars are similar in size & look like the Planets; (4) the stars are stuck in sky & do not seem to move. They are small in size as one can hold & move them. By extension, sky surrounds the Earth, & all celestial bodies are above it; & (5) they are shaped like the star on the Christmas tree.

Note. *Parsec is a unit of length (distance) measurement in astronomy corresponding about 3.26 light-years, 30.9 trillion [3.09×1,013] kilometers

Furthermore, the succession of day and night is connected with the Sun's apparent movement. Some errors and inaccuracies also go hand in hand with theories of the past. Thus, the passages about the movement and position of the Sun and other celestial bodies correspond to the geocentric model. According to this, all objects in the sky that are visible to the naked eye revolve around the Earth. Among the advocates of this system were Aristotle and Ptolemy.

The results of the empirical study by McClelland and Krockover (1996) show that the alternative ideas built from

children's books can be reconstructed with activities that cause cognitive conflict and lead to conceptual change. Also, generating alternative ideas can be prevented if children are encouraged to formulate questions and think about the book's content (Sackes et al., 2009). Therefore, activities such as observations or educational software about celestial bodies could lead to the recognition of inaccuracies in the text of fairy tales and the construction of scientific ideas. Moreover, comparing the tales with accurate books of knowledge on celestial bodies could lead to the Cretan approach to the tales and the identification of inaccuracies and errors.

Finally, the present study was purely bibliographic, and the impact on children's ideas and knowledge is absent. Therefore, a suggestion for further research is the empirical study of the effect of fairy tales on children's knowledge of celestial bodies.

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Availability of data and materials: All data generated or analyzed during this study are available for sharing when appropriate request is directed to corresponding author.

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