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Chapter 3

Mixed Messages for Our Next Generation of Scientists

Donna Farland-Smith

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Abstract

Scientists have been in the media ever since Frankenstein in 1931. Today's youth may not have seen the original movie or read the book, but they have seen cartoon reiterations of the famous classic as the work has inspired numerous films, television programs, video games, characters in books and movies. The concept of the "mad scientist" creating a creature, monster, or weapon that eventually falls out of his control, leading to the scientist's eventual defeat or ruin, is a common theme in science-fiction and comic books. Draw-A-Scientist protocols have been utilized by science education researchers to investigate learners' perceptions of scientists. This chapter discusses historical perspectives of scientists in the media, the methods for analyzing students' perceptions of scientists and how aspects of their illustrations relate students' perceptions of scientists. The discussion presented here is framed in the context in which young children hold a range of perceptions that are based on cultural influences, and sometimes these images are limited, and sometimes they compete within the individual. The position of this author is that each of these three are interconnected with the others, support each other, and must be considered along with students' cultural background and science identity if these illustrations are to fulfill any promise of its utility for research or instructional purposes.

Keywords: illustrations, perception, representations, science, scientists

1. Introduction

Over the last hundred years, "media" has grown to be a broad term to include television, movies, internet and books [1–6]. In this chapter, the term "media" is limited to include both print and graphic forms of communication. As media becomes increasingly accessible, these forms of communication have become increasingly pervasive.

The public perception of scientists can be traced back to alchemists in mid evil times [7]. Another wide-spread popular culture influence was Mary Shelley's novel *Frankenstein* in terms of the "mad scientist because the myth dealt with new scientific knowledge and fears of how this knowledge might be used" [7]. This stereotypic image of the scientist gained worldwide status from a number of international studies [8–15]. For example, Chambers [8] collected children's pictures of scientists in the US and Australia and Canada [11]; in Ireland [12, 13]; in the UK [14]; in Korea [9]; in Taiwan [15]; and in Hong Kong [10].

1.1. Scientists in trade books

In terms of how scientists are represented in print media, Farland [4] concluded that some third graders' perceptions of scientists can be broadened based on their weekly exposure to non-fiction historical-based trade books depicting the work of scientists. Other DAST research [2] has suggested texts can send messages to females that the math or science contributions of their gender are not as worthy as that of their male counterparts. In an extensive review of five widely used seventh grade life science texts, Potter and Rosser [16] reported textbooks were gender biased with regard to pictures, text, language and accomplishments of individuals. Accomplishments of females were either missing, trivialized or criticized. Also noted was a lack of topics of particular interest to women, consistent use of occupational stereotypes, a predominance of pictures with males, and males displayed in active roles while females were presented in passive roles. Gender portrayals in books have been hypothesized to help children develop a sense of their own gender role and gender appropriate behaviors [17].

A recent study [18] examined the visual representations of scientists in NSTA's Outstanding Trade Books Awardees from 2014 to 2016. Results revealed that many of the books, more than half did not include any visual representations of scientists, and those that did significantly reinforced the misconception that scientists are males who are Caucasian. Teachers who rely on the yearly list of recommended trade books from NSTA's to supplement their instruction may unwittingly reinforce or promote the idea that only Caucasian males can be scientists through the selection of these books for their classrooms. Thus, teachers, parents, and library, media specialists should be aware of common stereotypes and misconceptions about scientists appearing in children's literature. Such misconceptions may cause students' to develop a narrow, erroneous view of the appearance of scientists.

Frankenstein includes an example of a stereotypic scientist in the movies, today's efforts have changed dramatically with a television show for preschoolers called *Sid the Science Kid. Sid the Science Kid* revolves around Sid and a specific question he asks to launch each episode. Sid wakes up each day with a question on his mind. He takes this question to his family first at breakfast. Then, as he prepares for school, he brings this question to the playground at pre-school where he begins formalizing his research into the actual exploration phase by creating a survey with his friends' responses. His teacher, Susie, is ready, willing and prepared to investigate whatever particular question he has on his mind for that day at school. At pre-school, the students investigate the question in the classroom or on the playground. After pre-school, his grandmother picks him up, reinforces what he has learned that day during the drive home—usually an answer to the question he began the day with.

An extensisive variety of topics in the categories of earth, life and physical science have all been recorded over the 69 episodes using this framework. For example, topics relevant and developmentally appropriate to young scientists include: tools and measurement, changes and transformation, senses, health, simple machines, backyard science, weather, the body, force and motion, environmental systems, light and shadow, technology and engineering, and living things. Each episode's conceptual content connects to the National Science Standards [19], Cognitive Learning Theory, and on the preschool science curriculum, Preschool Pathways to Science [20].

Within each episode, show writers seem intentional not only in exploring science concepts but also Sid's questioning strategies. Sid embraces the idea of scientific process within the realm of scientific methods and spends his entire day zealously consumed with investigating a particular question. The producers in constructing his experiences conceptually and exploring them over time (a day- which is developmentally appropriate for a 4-year-old) increase opportunities for developing and discovering some "big ideas". For example, Sid may discover that some changes are reversible while others are not (i.e., "The Perfect Pancake" Episode) in which understanding of that irreversible transformation/heat is explored. According to the *Next Generation of Science Standards* (NGSS) [21], the call for scientifically literate students and their understanding of the science processes such as the benefits of considering irreversible change can motivate young children who experience such pleasure and fulfillment of discovery with the hopes that they will want to savor it again and again. Early investment and exposure to science can inspire many years of discovery. In this way, the content in Sid is both meaningful and relevant to the everyday lives of young children. For example, a question about decay, "Why is my banana yucky?" was the basis for the "My Mushy Banana" Episode. In this way, the science content is framed in relatable ways to its characters yet investigated through the nature of science, through posing questions, investigating objects and events that can be directly observed and explored.

In addition to the speculation that media influence students' perceptions of scientists, some researchers have also suggested that schools, and the activities that occur in them [22] have significant effects upon student s' perceptions of scientists. Numerous studies have been conducted that consider what teachers do in their classrooms can be affected by teachers' attitudes and dispositions toward science, including confidence levels in doing science [23–25]. In particular, teacher attitudes matter because they manifest themselves in actions that are fully recognizable to students and consequently influence student behavior [23, 25–27].

2. Methods for analyzing students' perceptions of scientists

Asking students to "draw a picture of a scientist" has been a popular method for those wishing to engage in Draw-A-Scientist Test research [8–10, 12, 14, 15]. While the majority of DAST research concentrated on students' stereotypical images and their perceptions of scientists, the manner in which data derived from these studies has been analyzed has often been limited to such things as the reporting of frequencies and the computation of simple t-tests. This level of analysis has provided a starting point for the investigation of students' perceptions of scientists and interesting discussion regarding potential interventions that might be utilized to help students modify

their perceptions. This may be why science education researchers have speculated about where these images derive without having further investigated this issue much beyond basic general observations for the better part of the last sixty years.

Analyzing images of scientists and labeling them stereotypical, rather than investigating where these images originate in students' schema, has left a gap in the existing DAST research. This may be due to the multifaceted complexity involved with such investigations. Even so, some notable questions regarding conceptions of scientists have arisen through DAST research: "When are concepts initiated?" [8], "When are concepts most likely to impact conceptual formation?", "Which concepts are central to students' personal science identities?", and "What are the influences that impact formation of such concepts?"

3. How aspects of illustrations relate to students' perceptions of scientists

For many children, what is included in media messages is often interpreted by students in ways that helps them define what they perceive to be culturally acceptable thinking and behavior [28] and have some effect of children's idea of the word "scientist." This researcher contends that students undergo a specific process when developing perceptions of scientists and that process is intimately related to one's culture. It is a process that begins with children viewing scientists with positive or negative associations from within their culture. Students typically look to culture and people within their immediate environment to help reinforce or redefine their perceptions while synthesizing their own ideas [29]. As children mature, they begin constructing personal perceptions of scientists, which are unlikely to change until they have personal contact with a scientist or experience a situation that causes a change in perceptions.

While educational researchers often discuss the significance of one's culture in relation to children and education, culture is not typically linked in terms of how children perceive scientists. Such an approach allows educators to understand the influence of culture on students' perceptions of scientists and ultimately may help shape future scientists.

In 50 years of looking at drawings and analyzing the images children draw when asked to draw a scientist, one common figure that has emerged has consistently been that of the "mad scientist" [30]. Therefore, it is not surprising then that science educators have long since suspected a connection between the relationship of media and its influence upon students' perceptions (or conceptions) of scientists [31–33]. Numerous authors have argued that media significantly contribute to students' schema development [1, 6, 28, 31–39].

4. Conclusion

For many children, what is included in media messages is often interpreted by students in ways that helps them define what they perceive to be culturally acceptable thinking and behavior [28]. Making students aware of real scientists can be a huge benefit in exciting

students about science and the possibility of pursuing careers in science-careers that are experiencing a dramatic loss of interest today. These messages must be incorporated with traditional science content in the classroom and must be systematically and deliberately taught to young children [40]. If aware that children come to school with a variety of scientist perceptions, teachers can use this knowledge to help young children to accurately understand what scientists look like, where they work and what they do. On the other hand, children need opportunities to voice the perceptions they have about the world in which they live. Allowing children in all cultures an opportunity to voice those perceptions provides educators with an opportunity to correct misunderstanding and hopefully influence children to consider scientists and science differently.

Illustrations of scientists provide insight into an individual's personal science identity. Some critics are dismissive of the significance of draw a scientist tests because they believe they yield meaningless representations of the concept of scientist [41]. Add the intriguing consideration that even the act of asking students to draw a scientist may inadvertently indicate to students that a typical scientist exists. Doubts such as these regarding the reliability and validity of the DAST have caused some to disregard it as useful in spite of the desire by many to investigate students' perceptions of the nature of scientists. However, Farland-Smith et al. [42] concur there is something to be gained by considering children's illustrations since they have long been accepted as *representations* of how they view the world. Such pictures or illustrations can convey information about a child's personal science identity. Formerly, children's science identities, as well as teacher responses to these identities, have been considered as being shaped by gender, race, and class relations [34, 43]. Teachers should be aware and pay close attention to the significance of DAST illustrations because the contemporary approach offers much more than a label of stereotypical or non-stereotypical. Rather, students' pictures of scientists expose cultural clues within a community of practice, and insight into students' personal science identity.

Understanding the similarities and differences in educational systems, not to mention cultures, and its impact on children also may help in developing positive perceptions that motivate students to consider careers in science. For the purposes of this chapter science careers are defined as those occupations which utilize knowledge of engineering and the natural and physical sciences, which include: engineer, research scientist, statistician, conservationist/forester, and all persons with majors in biological sciences, physical science, or engineering. Science-practitioner occupations (i.e., physician, dentist, veterinarian, pharmacist, optometrist) are included as "science fields" in this study.

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