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Content Analysis of Science Teacher Representations in Google Images

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Teacher images can impact numerous perceptions in educational settings, as well as through popular media. The portrayal of effective science teaching is especially challenging to specify, given the complex nature of science inquiry and other standards-based practices. The present study examined the litany of representations of science teachers available via a Google Images search. Initial data collected included image type (photograph, cartoon/clip art, text/graphic) and demographic information of the depicted science teachers. Common themes were detected and documented, including science teachers' attire, actions, materials and equipment, and interactions with students. The potential impact of these images is discussed, including comparisons with science education literature. Implications include ways science teacher educators can use these images to foster reflection and dialogue among preservice and in-service teachers. Furthermore, an examination of stereotypes may need to be addressed and overcome in order to recruit, prepare, and support science teachers successfully.

Influence of Teacher Image

Despite notions of skin-deep beauty, a teacher's appearance can actually influence student attitudes and learning. One study with undergraduate college students found that "well-dressed, good-looking, and approachable teachers had students who said they learned more, had higher grades, and liked the class better" (Gurung & Vespia, 2007, p. 5). At one university, the attire of graduate teaching assistants had a significant relationship with student cognitive learning, affective learning, and ratings of instruction. Teaching assistants with "high professional dress" also had fewer instances of student misbehaviors (Roach, 1997). While these studies examined a postsecondary setting, research in K-12 schools finds additional insight on the impact of teacher appearance.

When middle school students examined pictures of teachers, they revealed an expectation of more respect for formally dressed teachers than for teachers dressed more casually (Davis et al., 1992). Peterson (1980) surveyed two groups of students from two ends of the spectrum—elementary aged and university level—and found a preference for younger teachers (under age 35). Participants chose their "favorite teacher" from a group of photographs, with perceived personality and competence as primary reasons for their preference.

Teacher appearance also weighs heavily on the minds of fellow educators. Many school districts now require dress codes for teachers and staff (Abutaleb, 2012; Sternberg, 2003). Professional appearance is a common criterion identified among important student teacher characteristics, ranking among preparedness, responsibility, commitment, and organization (Chiang, 2001).

In a study comparing "above average" student teachers to those rated "average" and below, appearance was one aspect separating the groups (Eldar & Talmor, 2006). A teacher's appearance—namely one similar to other staff members—has also been found to be a deciding factor in principals' selections of new hires for their building (Mertz & McNeely, 2001).

Media Depictions of Teachers

Teachers are visible not only in schools but also among the litany of images surrounding society. Although many adults do not regularly set foot in a school building, they still see images of classroom teachers on a frequent basis. Television, film, print, and electronic media present teachers in a myriad of ways, with varying effects. Research into movies has found certain teacher archetypes, including roles such as culture guardian, change agent, compassionate mentor, student advocate, maverick, and incompetent (Raimo, Devlin-Scherer, & Zinicola, 2002).

Teacher characters may be fictional or real, but even the latter roles may not accurately reflect reality. For example, the 1960 film *Inherit the Wind* portrayed the role of science teacher John Scopes as a powerless victim dependent on stronger characters like lawyers Clarence Darrow and William Jennings Bryan; whereas John Scopes—the person—was actually more proactive in his work and relationships (Riley, Brown, & Braswell, 2007).

With an abundance of movies featuring teachers and school settings, opportunities exist to engage educators in critically examining and reflecting on practice (Nugent & Shaunessy, 2003; Paul, 2001; Shaw & Nederhouser, 2005; Trier, 2000). These film portrayals, however, also have the potential to create stereotypes in the public eye, fostering unfounded perceptions of how to improve education (Breault, 2009).

Although motion pictures have existed for over a century, a more recent multimedia upwelling has provided another collection of teacher portrayals—the Internet. More specifically, the Google search engine enables users to access thousands of images in a matter of seconds. In addition to use by the general public, academic studies are now citing Google search results to illustrate the massive array of information about a topic. This includes attention to issues like teacher performance pay (Burns & Gardner, 2010) and best practices teaching (Smagorinsky, 2009).

Science Teacher Self-Imagery

Classroom teachers receive intense attention in education circles (and beyond) due to their direct influence on student learning (Good & Brophy, 1994; Goodlad, 1990; Penick, Yager, & Bonnstetter, 1986; Sanders & Rivers, 1996). Purposeful, productive interactions with students are especially necessary for science teachers, who must provide "students with opportunities for a range of scientific activities and scientific thinking, including, but not limited to: inquiry and investigation, collection and analysis of evidence, logical reasoning, and communication and application of information" (National Research Council, 2010, p. 137). Such student-centered instruction is necessary not only in promoting an inquiry-based approach (Blosser, 2000; Bybee, 2002; Clark, Clough, & Berg, 2000), but also for facilitating project-based science lessons (Alozie, Moje, & Krajcik, 2010).

Effective science teachers go beyond demonstrations and experiences, challenging students to actively review and discuss ideas as they investigate phenomena and concepts. "Effective teaching is a highly interactive activity, and curricula alone cannot create this interaction" (Clark et al., 2000, p. 43). The role of teachers' interactive behaviors is even more critical because of the modeling effect on students' own behaviors. For example, inquiry and science standards documents advocate asking questions not only by the teachers, but also by the students (National Research Council [NRC], 1996, 2000, 2012).

Despite research on the science teacher's critical classroom role, many educators still find difficulty articulating these essential behaviors. In fact, the creators framing the *Next Generation Science Standards*' formation readily admitted, "The framework does not specify a particular pedagogy" (NRC, 2012, p. 250).

Historically, science teachers have often struggled identifying their roles in inquiry-based lessons, which emphasize student-centered instruction and more intangible strategies on the part of the teacher (Colburn, 2000; Oliver-Hoyo, Allen, & Anderson, 1994; Welch, Klopfer, Aikenhead, & Robinson, 1981). With regard to laboratory activities, Clark et al. (2000) noted that science teachers often view a "false dichotomy," in that they think they either must give students a directed step-by-step procedure to follow with high control or allow students to determine their own questions and procedures with little or no teacher intervention.

While the former teacher-dominated approach echoes a century of traditional lecture-based classrooms, the latter student-focused classroom—often associated with constructivist-based practices—can easily undermine or completely dismiss the critical role of the teacher (Baines & Stanley, 2000). Inquiry-based science instruction also evokes concerns by teachers regarding appropriate classroom management strategies when students have more freedom in their interactions and decisions in the classroom (Poon, Tan, & Tan, 2009; Wolfgang, 2009).

The image of an effective science teacher can be a blurry one, even in the eyes of many science teachers. This imagery includes not only a science teacher's appearance, but also what they are doing and how they are interacting with students. The seemingly limitless library of images available in media and online may add to this complexity. Nevertheless, a closer look could also inform science teachers' reflection and development, as well as the decisions made by science teacher educators and institutions.

Research Focus and Methodology

The present study seeks to examine the depiction of science teachers in one of the most widely used and accessible visual libraries in the world—Google Images. Google created the online search tool Google Images in 2001 (Zipern, 2001), and it has become a commonly used, efficient source of visual data. By 2010, the service had indexed over 10 billion images (Smith, 2010). In the same year, Google Images regularly received over 1 billion views a day (Shiels, 2010).

The keyword "science teacher" was entered into Google Images on April 23, 2012, and, according to the search engine, yielded "About 4,200,000 results" in "0.40 seconds." In actuality, only 968 images were available for direct viewing—approximately 24-27 images per page on 38 subsequent webpages via the "Gooooooooooogle" feature. The phrase "science teacher" included quotation marks to search for that exact phrase, as opposed to images with just "science" or "teacher" or both terms but not directly connected.

Examination of the assorted images relied on a content analysis approach (Esterberg, 2002) that was inductive in nature (Krippendorf, 2003). Initial data collected include image type (photograph, cartoon/clip art, text/graphic) and demographic information of the depicted science teachers (gender, race). For the purposes of this study, the images included in the subsequent analyses were either photographs or illustrations/clip art of teachers.

After removing text images (bumper stickers, T-shirts, PowerPoint slides), unrelated items (popular culture and images with no visible teacher), and duplicate images of teachers, the final number analyzed was 495 images. Photographs comprised 88% of studied images, with the remaining 12% consisting of illustrations—clip art, cartoons, sketches, and so forth.

Results and Analysis

Following the initial analysis of image type, several aspects were identified during data collection for further study. These specific data included (a) male or female science teachers, (b) race/ethnicity of science teachers, (c) science teachers' attire, (d) science teachers' actions, (e) science teachers' materials and equipment, (f) inclusion of students and their attributes, and (g) types of interactions between students and science teachers. In addition to demographic content, the teacher actions, materials, and interactions were studied based on their key role in science education literature (NRC, 1996, 2000, 2010, 2012). Given the nature of these data, basic statistics (frequencies and percentages) were determined and reported.

Demographics

The portrayal of both sexes in the Google Images search of "science teacher" was almost equal, with 51.5% of the images featuring female science teachers and 48.5% focusing on male science teachers (see Table 1, Figure 1).

Race and ethnicity, however, were largely unbalanced. Caucasian, or white teachers made up 90.5% of the images. The remaining images featured teachers of African descent (4.4%), Hispanics or Latinos (1.6%), and 3.5% other minorities or unclear ethnic backgrounds (Table 1, Figure 2).

Table 1
Comparison of Science Teacher Demographic Information

Google Images Data: "science teacher"		**Profile of Teachers in the U.S. (Feistritzer, 2011) [a]**	
Sex			
Female: 51.5%	Male: 48.5%	Female: 68.8%	Male: 31.2%
Race/Ethnicity			
Caucasian/White	90.5%	"White"	80.2%
African Descent	4.4%	"Black"	7.3%
Hispanic/Latino	1.6%	"Hispanic"	5.6%
Other/Unclear	3.5%	"Other"	6.9%
[a] Includes only those identified as "science teacher."			

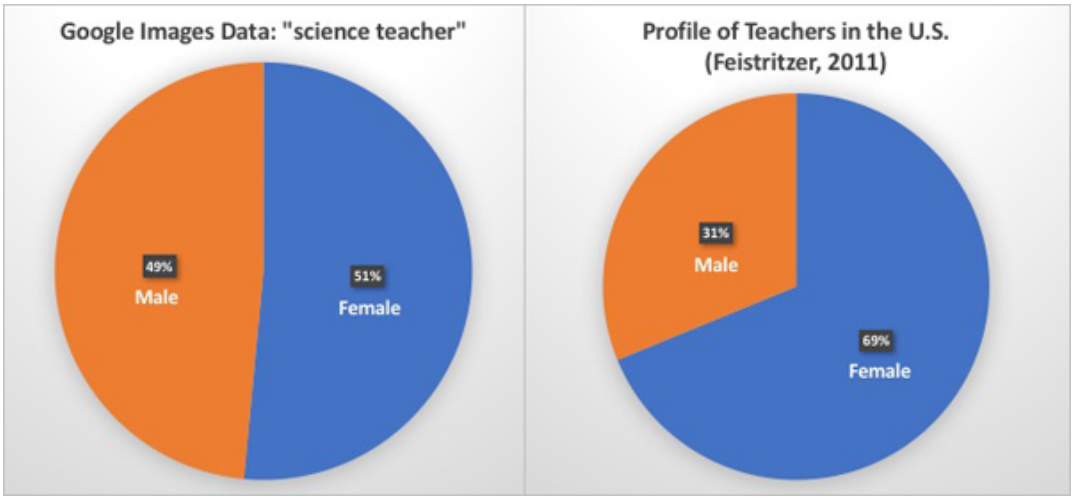

Figure 1. *Comparison of science teacher demographic information—sex.*

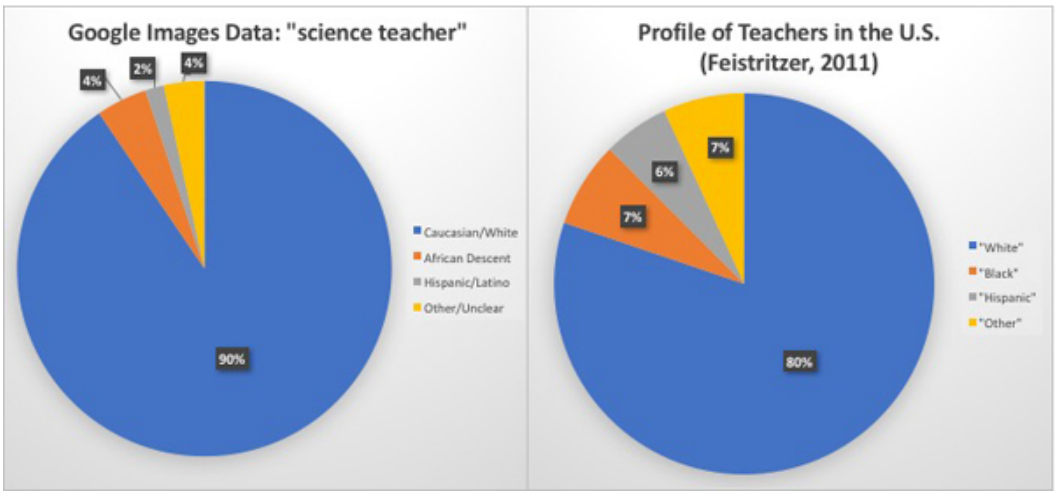

Figure 2. *Comparison of science teacher demographic information—race/enthicity.*

Science Teachers' Attire, Actions, and Materials

Figure 3 displays the percentages of images including various elements or items with the featured science teacher. The presence of some of these items will be discussed later with respect to stereotypical scientist imagery. In terms of attire, science teachers were wearing lab coats in 14% of all the Google Images. Safety glasses or goggles were visible in only 6% of all images of teachers. Teachers were presenting some sort of scientific demonstration at the front of the classroom in 18% of the images. Example materials used in the demonstrations were glassware with chemicals, explosions, or models. A blackboard or whiteboard was present in 23% of the images. Any visible writing on the board was typically a chemical formula, mathematical equation, or diagram. Science teachers were outdoors (e.g. nature walk) with their students in 6% of the images.

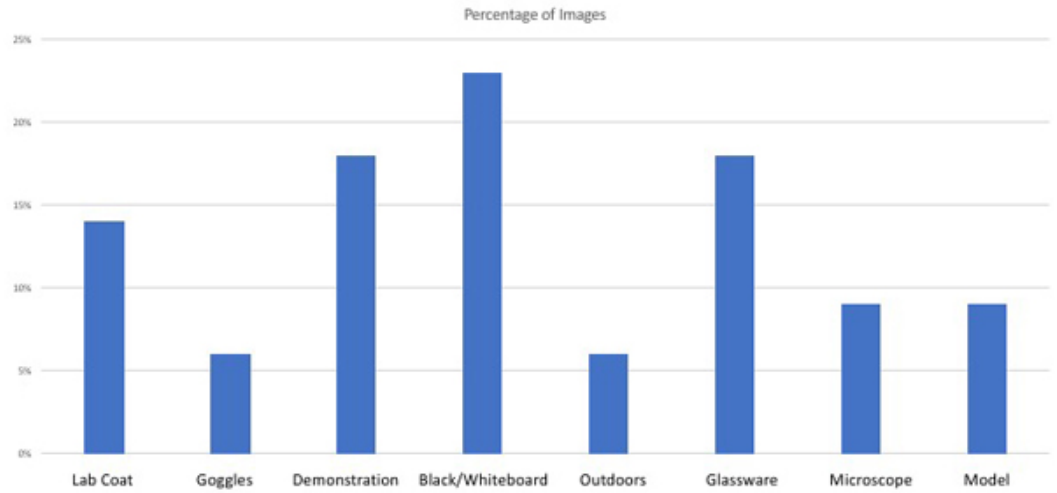

Figure 3. *Summary of common items or elements in "science teacher" Google images.*

The presence of equipment or materials was noticeable in several images, some with more than one kind of apparatus. The most common item either held by the teachers or sitting beside them was glassware, including test tubes, flasks, and beakers. These were found in 18% of all images. Microscopes (9%) and models (9%) of some sort (e.g., atoms, molecules, and DNA) were also common in many images. Other items were computers (3%), magnets (2%) and the presence of fire or explosions from a demonstration (4%).

Students and Science Teachers' Interactions

Additional analysis examined the inclusion of students in the "science teacher" images. Students were included in 144 of the 495 studied images (29%). Students ranged in age levels from preschool to adult education. While the number of students visible with the science teacher varied from one individual to entire classrooms, the most common depictions featured a teacher with just one or two students, accounting for 31% and 28% of all images including students, respectively. In images of science teachers with students, at least one student was the same race as the teacher 83% of the time.

Further study of these images with students analyzed the types of teacher-student interactions depicted. Three primary interaction types were identified. The most frequent interaction was the science teacher standing at the front of the room with students seated in chairs, at desks, or on the floor as a group. This depiction accounted for 39% of all images including students. The second most common interaction type (33%) was the science teacher positioned behind the student(s), standing or leaning over a student's shoulder and acting the role of supervisor, observer, or helper by assisting with equipment or pointing at an open text or computer monitor. The third type of interaction between science teachers and students was the teacher and student(s) working together on a task, such as operating a laboratory apparatus or manipulating a model. These cooperative interactions made up 29% of all images portraying science teachers with students.

However, this analysis of science teacher images including students did not take into account all of the other images without students (71% of all studied images). Many of these images with just the science teacher also portrayed interactive behaviors on the teacher's part. When a follow-up analysis included all science teacher images (with and without students), the frequencies of interaction types changed greatly. Images with the science teacher standing at the front of the classroom or in front of a board in a lecture stance increased to 59% of all interaction types. Images of science teachers looking over students' shoulders decreased to 22% and images of teachers and students working together diminished to 19%.

Discussion

The focus of this study was to examine representations of science teachers in the online visual library Google Images. The nearly 500 science teacher images analyzed provide insight into the depiction of science teachers, their interactions with students, as well as implications for recruiting, developing, and supporting science educators.

Demographic data portrayed in the Google Images science teachers may create misconceptions about the population and personalities of actual science teachers. Although females (51.5%) and males (48.5%) had a nearly even split in the Google Images, these numbers do not match data found in national reports on teacher populations. For example, a recent publication—*Profile of Teachers in the U.S.* (Feistritzer, 2011)—indicates that

American science teachers actually have a larger female population (68.8%) than male population (31.2%). The same report reveals a much larger discrepancy between reality and Google Images' depiction of science teachers' race/ethnicity, indicated in Table 1 and Figures 1 and 2. For example, although Caucasian/White teachers are a large majority according to the 2011 U.S. profile (80.2%), this imbalance is even more extreme (90.5%) as presented by the Google Images. Furthermore, no minority group has more than 5% representation in the online image catalog.

An important consideration is that Google Images is accessible worldwide and features images from global sources, not just one nation. Nevertheless, the underrepresentation of minority groups in Google Images may undermine the goal of "science for all" frequently stated in science education literature (American Association for the Advancement of Science, 1989; Calabrese Barton, 1998; Lee & Fradd, 1998; Malcom, 1994; NRC, 2012; Tan & Barton, 2008).

Another issue needing attention is the cultivation or perpetuation of science teacher stereotypes. More than the inclusion of lab coats or glassware, stereotypical images are potentially hazardous by limiting the perceptions of individuals seeing themselves engaging in science education endeavors.

Such stereotypes of scientists and related occupations are numerous and resistant to change (Finson, 2002, 2009). For example, the recruitment of female students in STEM-related courses and fields of study often requires concerted effort to first overcome stereotypical or biased notions about ability and interest (Hawkins, 2015; Shapiro & Williams, 2012). For the purposes of recruiting and celebrating science teachers, the use of images and the messages sent must be evaluated—both individual science educators in their public representations and institutions creating a brand through online and print media. In the latter case, the choice of visual images—whether homegrown or via stock footage—should include consideration of what message of inclusion is sent to a diverse audience.

Beyond demographics and wardrobe choices, the actions and interactions of science teachers in the classroom require careful consideration. For example, safety is always an essential component in the science classroom (Barrier, 2005; Kwan & Texley, 2002; Roy, 2010), and the science teachers found in Google Images provide both useful and detrimental examples. Science teachers were wearing safety goggles correctly in only 6% of all the images examined, considerably fewer than the instances of science teachers using laboratory or demonstration equipment in the images.

Moreover, students included in many images did not wear any goggles. Such discrepancies are problematic in light of the common protective eyewear practices found in most safety procedures and contracts: "Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!" (Flinn Scientific, 2011, p. 1); "Approved chemical splash goggles or safety glasses, as appropriate or directed by your instructor, shall be worn at all times in the laboratory or field, including pre-laboratory work and clean-up" (National Science Teachers Association, 2012, p. 2).

Where materials and equipment were included in the images, most fell under the category of "science stuff" (see Figure 3). Altogether, glassware, microscopes, and models were visible in more than one third of all the science teacher images. Hands-on materials and demonstration tools certainly are essential ingredients for meaningful learning experiences (National Science Teachers Association, 2004). Concrete encounters provide a foundation from which students can develop understandings of more abstract concepts. Moreover, use

of familiar household items can help remove the mystique of science research to make it more practical and immediate in the eyes of students.

To that extent, science teachers can strengthen the connections to students' lives by including objects and examples from students' everyday experiences. For example, if students need something to hold a liquid, a plastic cup (recycled and reusable) is often an appropriate alternative to a glass beaker. For examinations of chemical properties, vinegar (acetic acid) can replace hydrochloric acid, and baking soda (sodium bicarbonate) can replace calcium carbonate. In addition to being cheaper and safer options, common materials are also more recognizable. Students can learn how science is not confined to the laboratory, but rather is accessible to all.

With respect to pedagogy, 59% of Google Images science teachers in an instructional setting displayed teacher-centered, lecture-heavy behaviors. Even in the second most frequent type of interaction, teachers standing or bending over students' shoulders (22%) were often in a supervisory role, perpetuating a teacher-dominated classroom.

The least common interaction type (19%) was the most collaborative relationship, as science teachers worked at the same level with students. In these cases, the teachers truly exhibited the role of "guide on the side" advocated in teacher education literature (Bergman, 2010; King, 1993; Smith, 1993). Nevertheless, this student-focused approach was the minority of interaction types portrayed in the Google Images science teachers.

Teacher-student interactions are complex and context-sensitive, increasing the difficulty of communicating such relationships via a single image. Moreover, the unique nature of inquiry-based, standards-aligned classrooms makes the depiction of science teacher behaviors even more complicated. Even so, the combined pedagogical message to science teachers in Google Images seems to contradict science education research and literature more often than not.

Given the complexity of teaching, it is perhaps impossible to convey the complete message of science teaching through one image. By its nature, teaching is based on interpersonal relationships and two-way communication. Research has found that during live interactions (as opposed to viewing photographs), a teacher's attire has less effect on one's perception of that teacher (Gorham, Cohen, & Morris, 1997).

A picture may very well be worth a thousand words, but an isolated image might still be insufficient in communicating the range of aspects involved in the identity and actions of a science teacher. For example, researchers using the Draw-a-Scientist Test acknowledge that individuals can possess multiple ideas and images of scientists (Farland & McComas, 2008; Vosniadou & Kollias, 2003). In the same way that someone's single drawing of a scientist is insufficient to communicate the extent of his or her ideas, a single picture from Google Images is limited by its existence as a snapshot of a moment or setting that may or may not have a much more elaborate context. A possible future study could compare perceptions among various interactions, such as viewing images, watching videos, and interacting directly with a science teacher.

The type of image may also enhance or diminish one's viewing. For example, the vast majority of images analyzed in this study were photographs (88%), which often include additional visual data beyond the initial focus on the science teacher. Ancillary information has been found to distract or detract from the viewer's examination of the photograph (Clary & Wandersee, 2011; Coleman, 2012). Such data (materials, setting, and other individuals) may or may not appear in illustrations (drawings or clip art), in which the artist

selects the elements he or she wishes to portray. Even so, additional information may provide further indication about the context and setting surrounding the science teacher. Data to collect in future research are image source (educational, commercial, private, etc.), confirmation and clarifying criteria of ethnic backgrounds, examination of age demographics, and the impact of efforts to increase alignment among images and science education literature.

Implications for Practice

Despite these potential limitations, an analysis of Google Images provided fruitful data and insight. In a world of instant information, Google Images is a visual library with multiple connections to popular media, including images from television, movies, news events, and more. This link to popular culture can become an especially powerful asset. "Popular culture...is a way for adults, children, and teens to reposition themselves, from cogs in the machine to social actors intent on jamming, resisting, and/or rewriting the status quo" (Marshall & Sensoy, 2011, p. 11).

In our current image conscious society, future research can continue to examine ways science teacher images influence perceptions and decisions, as well as how these images can be used effectively in advocating the profession. This visual library is also a potential resource for enhancing the reflection and development of science teachers. In both preservice and in-service settings, teacher educators can use Google Images of science teachers to initiate discussion, review, and further learning.

Based on the results in this study and on previous literature in science teacher education, a collection of prompts and questions was developed (see Appendix) for facilitating conversation. A common purpose in these questions is enhancing reflection among preservice and in-service teachers. "Reflection can highlight the critical aspects of a performance and encourage [teachers] to think about what makes for a good performance and how they might improve in the future" (Collins, 2006, p. 57).

The focus on science teacher depictions via Google Images provides an avenue for critical reflection, both regarding individual performance as well as widespread media representations. These two levels—personal and popular culture—can provide opportunities for robust examination, comparison, and application.

The prompts in the Appendix are applicable in multiple settings. For example, Questions 1 and 2 could be used at the beginning of a program or semester to gauge individuals' preconceptions about science teaching:

1. Select and share an image you judge to be a depiction of an effective science teacher. Provide at least five reasons why you chose this image.
2. Select and share an image you judge to be a depiction of an ineffective science teacher. Provide at least five reasons why you chose this image.

These and other prompts could also prove useful in online discussion board or blog settings, where individuals are welcome to share ideas and dialogue openly. In some cases, teacher educators can promote further research and application (e.g., Questions 5, 6, and 12). Specific aspects of science teaching—safety, classroom interactions, materials and equipment—can be addressed through other prompts. In all of these instances, the images can be used to assess individuals' ideas and attitudes toward science teaching. Furthermore, these prompts can engage science teachers in reflection on their practice and

ongoing development. In today's information age, such awareness is essential for all viewers.

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Appendix
Example Prompts Using Google Images Science Teachers to Promote Discussion and Reflection

Instructions: Access the online Google Images search tool (http://images.google.com) and type "science teacher" (with quotation marks) in the search bar.

1. Select and share an image you judge to be a depiction of an effective science teacher. Provide at least five reasons why you chose this image.
2. Select and share an image you judge to be a depiction of an ineffective science teacher. Provide at least five reasons why you chose this image.
3. Which image would you select to display openly with others (e.g. on your classroom door/wall as a poster, as your Twitter/Facebook profile picture, etc.) and why?
4. Based on your experiences, which image is the closest to the reality of science teaching? How so? Which image is the farthest from the reality of science teaching? Why?
5. Choose six SCIENCE TEACHER images found in your search and create a "meme" poster to share, using a different image to correspond with the following captions:

    - What my friends think I do
    - What my mom thinks I do
    - What society thinks I do
    - What kids think I do
    - What I think I do
    - What I really do

(Perception meme generator resources:
http://whatireally.memegenerator.net/, http://frabz.com/meme-generator/what-i-do/)

6. Select an image depicting a science teacher interacting (verbally and/or nonverbally) with a student or group of students. Evaluate the quality of instruction, engagement, and assessment exhibited by this teacher, citing evidence in the image to support your conclusions.

Additional prompts to guide evaluation:

- If any verbal communication (captions, talking bubbles) is included, evaluate the effectiveness.
- What facial expressions are used by the teacher(s) and student(s)?
- What do you notice about the body language of the teacher/students?
- Evaluate the relative position of each individual.
- What is the level of "hands-on" and/or "minds-on" engagement? How do you know?
- What elements in this image do you want to apply in your own teaching? Why? How would you implement this?
- What elements would you NOT want to apply in your teaching? Why?

7. Evaluate the extent of safety measures exhibited by a science teacher in three different images. For each image, also provide an action plan or recommendations to improve safety. [For added analysis, choose one image you judge as "A" level safety

(exceptional), one as "C" level safety (average but potential problems), and one as "F" level safety (major problems).]

8. Examine at least the first "page" or two (25-50 images) of science teacher images presented by your search and summarize what underlying or common messages these depictions might imply about what it means to be a science teacher. (E.g. characteristics, background, behaviors, dispositions, professionalism, demographics, etc.)
9. Examine images that contain just objects or text/graphics (no teacher). What trends or common elements do you notice and what implications might there be for science teaching?
10. Examine at least ten images that contain a student or group of students. What evidence do you see of authentic, engaged student learning? What are signs of unengaged or off-task students? What recommendations would you give to increase engaged student learning?
11. Which of these science teachers would you like to have had as a student and why? Which science teacher would like to have as a colleague? Which would you like your children to have as a teacher?
12. Research the sources of the images you selected for the prompts above. Use this additional information* to draw conclusions about possible influences and implications of these "science teacher" images.

*Additional information could include original purpose of image; date of creation/posting; country of origin; contextual factors; accompanying text, images, and links; and more.