Domain identification and stereotypes: representations of scientists among Romanian elementary school students

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The goal of the current study is to investigateelementaryschool students' domain identification andtheir representations of scientists compared to other professions (e.g., teacher, veterinarian).Research shows that students' stereotypes about scientists may affect their science self-efficacy and interest in science (Losh et al., 2008). Studies investigating children's representations of scientists using the Draw a Scientist methods (DAST) indicates that most students hold stereotypes about the role of the scientist and about the identity of a scientist. Findings from such research show that there is a bias regarding the demographics and gender variations in children's representations of scientists (Finson, 2002). A large number of scientists are depicted as white males; Hispanics and Asian scientists are underrepresented and women are depicted mostly as "superwomen". The sources of these misconceptions are various, including media, children's literature, and lack of students' experiences with the work of a scientist.

This proposal is a work in progress; data collection will be completed in October 2015 and data analysis will follow up shortly after all data will be cleaned and organized. Participants (approximate N=200) will be elementary students from Romania enrolled in public and private schools, in both rural and urban areas ranging in age and grade level (i.e., grades 1 to 5). Study findings will be discussed in relationship with research related to gender and cultural stereotypes, as well as research about conceptual change. Additionally, implications for teacher practices, teacher education, and student career preparation will be discussed.

1. Introduction

Recent reform initiatives in various countries around the world aim at preparing a scientifically literate work force that is capable of competing in an increasingly scientifically and technologically oriented global economy. In line with education reform suggestion initiated by the national education agencies, effective teacher practices are described as instructional approaches geared toward students' conceptual understanding (i.e., the use of inquiry-based learning, authentic activities), communication of scientific ideas, assessment-based instruction and the integration of technology in science teaching.

In addition to studying student academic achievements, or their attraction to a science or technology career, educators and national agencies monitor the composition of science and technology students and workers. For example, although US female participation in life and health sciences rose significantly in recent decades, women still lag as physical science or engineering students or professionals; African-Americans and Hispanics are underrepresented

in most science and technology fields. Research comparing science and technology occupational distributions over time suggests some changes in these proportions for women but comparatively few for African- or Hispanic Americans since the 1980s (National Science Board, 2006). Because of common beliefs that youth become psychologically involved with—or disengaged from—science long before they enter college or choose careers, the onus often falls upon early school experiences to stimulate the acquisition and nurturance of science interests among children.

Research (i.e., Losh et al., 2008; Finson, 2002) shows that children and public at large (among them teachers as well) have misconceptions and hold stereotypes about the nature and role of science, about the work of scientists, and about the image of scientists (who are the scientists and what do they do). Among these misconceptions, in the US studies, scientists were depicted as individuals serving greedy corporations, playing God, tempering with nature and misusing technology (Funk, 2003). Other misconceptions were related to scientists' gender and ethnicity; scientists were by large depicted by children as white males; Hispanic and Asian scientists are underrepresented, and female scientists were occasionally depicted, most of the time as "superwoman" (Flicker, 2003). The sources of such misconceptions are often media, children's literature, or students' lack of experience in interacting with scientists. Most teachers rely on limited resources for teaching science oftentimes because of lack of science resources, or use traditional teaching methods versus using authentic activities (i.e., working with a scientist in a lab) and inquiry-based teaching methods. Recent reform calls in the US and UK encourage teachers to think differently about science and mathematics teaching by adopting inquiry-based methods, promoting student critical thinking skills such as "think like a scientist" approaches, and use authentic activities. Because of the difficulties encountered by teachers in "translating" the reform suggestions into their daily classroom practices, teachers tend to adopt traditional ways of teaching (i.e., lecturing, teacher-directed instruction), despite the reform calls for student-centered and inquiry based instruction (Sharp et al., 2011; Smith & Southerland, 2007).

Research show that relatively few elementary teachers are adequately prepared to teach science effectively, and very often, they hold negative attitudes toward teaching science (Bryan, 2003; Lumpe et al., 2012). Additionally, many studies report feelings of low science teaching efficacy among elementary teachers (i.e.,Hayes, 2002; Smith & Southerland, 2007; Sharp et al., 2011). Low science teaching efficacy are related to the lack of preparation in science and mathematics of elementary teachers during their teacher education program, and a weak preparation in using inquiry based teaching strategies (emphasized in the educational reform reports). Also, lack of opportunities to participate in science professional development programs among elementary teachers add to their low confidence in science teaching (Smith &Southerland, 2007; Whitcomb, 2008; Lee, Hart, Cuevas, & Enders, 2004). Research conducted in the US and the UK investigating teachers' personal beliefs find that elementary teachers report a lack of confidence in teaching science due to their lack of science content knowledge, or effective science teaching models. Studies from the UK show the importance of teachers' gaining self-efficacy in science teaching by engaging teachers in collaborative work (i.e., team teaching, school professional teams) and learning from more experienced teachers that can serve as models for them (Sharp et al., 2009, 2011). Oftentimes, increasing teaching confidence is a result

of increasing the pedagogical and content knowledge in a particular area (Dixon &Wilke, 2007), and therefore increasing student science academic achievement.

2. Purpose

The current study aims at investigating Romanian elementary school students' representations of scientists compared to other professions (e.g., teacher, veterinarian). Participants (approximate *N*=200) will be elementary students from Romania ranging in age and grade level (i.e., grades 1 to 5). Additionally, participants will be recruited from different schools for maximum variation (i.e., variations in grade level, rural and urban settings). For instance schools located in both urban and rural settings are targeted, as well as private and public elementary schools. Studies on this topic have been conducted in western countries (i.e., US, UK, Australia), however there is a lack of research in this area in Eastern Europe, especially in Romania.

3. Research Questions

The main research questions addressed by the current study are:

a) How do Romanian elementary school students' pictorial depictions of scientists compare with their depictions of other professionals?

b) How do student demographic and cultural data (e.g., gender, ethnicity and grade level) influence their depictions of the occupational incumbents?

4. Data Sources

The primary data are children's depictions using DAST (Draw a Scientist). In addition to the representations of scientists, other professionals are added in the current proposal and are studied, such as portraits of teachers and veterinarians. The rationale is based on the hypothesis that students are able to distinguish among professionals, but will reveal stereotypes: drawing teachers as most attractive and largely female, and scientists as more often male and less attractive. Other quantitative data used in the current proposal are students' demographics, such as age, gender, ethnic membership, SES, rural or urban setting, private or public school.

5. Proposed Data Analysis

The current proposal is a work in progress. Data collection will be completed in October 2015 and data analysis will follow up shortly after all data will be cleaned and organized. The first step in data analysis consists in data coding. Students' depictions of scientists, teachers and veterinarians are the primary data for coding. A numerical code will be assigned to each drawing based on several categories (i.e., clarity of picture, gender, ethnicity etc). The coding is based on Barman's (1999) list as a base to score the children's drawings. Barman's coding categories included gender, figure color, and physical appearance features that could relate to gender, such as head or facial hair, body shape, cosmetics. Also part of coding will include characteristics related to whether the student's drawing appeared to be some kind of nonhuman rendering, such as a "fantasy" figure or a "monster". Additionally, coding will include the presence or absence of the same occupational details (e.g., animals, syringes, lab coats, head lamps, chalkboards, books) for each professional figure: teachers, veterinarians, or scientists.

After data coding, quantitative analysis will consist in comparative analysis (i.e., ANOVA, MANOVA) to explore variations among depictions with respect to student demographic variables. Findings might show stereotypes in depiction of certain occupations due to school setting (rural versus urban setting) or students' SES status; professional gender preferences/stereotypes among students (i.e., teachers being represented as females and scientists and veterinarians as males); and variations in grade level (i.e., less stereotypes at higher grade levels, such as 4th and 5th). Study findings will be discussed in relationship with teacher practices, implications for teacher education and research regarding conceptual change.

6. Discussions and Conclusions

Findings from prior studies using "Draw a Scientist Test" methods (DAST) suggest that students see scientists as largely white, often unattractive men; one consequence may be that girls and minority students feel a science career is "not like me". However, a major shortcoming in prior research is that scholars have asked children to draw only scientists, thus making interpretations of earlier research findings ambiguous. In the current study, students were asked to draw other professionals to compare how drawings of teachers, scientists, and veterinarians by elementary school children varied by student gender, ethnicity and grade. The current research study is a follow up of another study (Losh, Wilke, & Pop, 2008) in which K-5 students from different grade levels (*N*=206) in the US were assessed in their understanding of domain identification.

Several major contribution of the current study can be discussed. First, the comparison of different professions (i.e., scientist, veterinarian, teacher) allows us to better understand if children have stereotypes only for "scientists", or for other professions as well. Secondly, the current study involves elementary students from Romania. Thus, findings from the current study conducted in Romania could bring contributions to understanding cultural differences related to children's and public understanding of science, the role of science and of scientists, and how this information might be related to the approach used in science teaching. Western countries (i.e., UK, US, Canada) have implemented gradually for almost two decades reforms in STEM education encouraging teachers to use inquiry-based strategies in their teaching. This instructional approach emphasizes features like, promoting student critical thinking (e.g., "think like a scientist"), self-regulated learning and a student-centered instructional style. Some of the Eastern European countries recently started adopting a focus on STEM education, but this is not a nationwide effort.

Teachers' role is significantly important in addressing and correcting students' misconception about the role of science and scientists. Providing students with various instructional modes (i.e., active, inquiry based) and experiences would facilitate students' conceptual changes about the nature of science. Teacher professional development can provide valuable opportunities to teachers to work with a scientist in an authentic environment (e.g., in a lab) and learn knowledge and skills that are consequently transmitted to students. Such programs, like the Research Experience for Teachers (RET) in the US are beginning to gain more support and have been shown that teachers make significant gains when learning in a cognitive apprenticeship model with a scientist (Dixon & Wilke, 2007; Pop et al., 2010). Similar models to

RET can be adapted to Romania where the educational system provides very little support for teachers' professional development in the STEM area, and such models of professional development (based on cognitive apprenticeship with a scientist) are needed.

Additionally, research findings show that teacher' beliefs are at the core of teachers' behaviors, professional identities and classroom decisions (Richardson & Liang, 2008). Understanding the key factors that impact conceptual change and professional learning can help teacher education programs tailor their instruction and provide field experiences that would develop prospective teachers into highly qualified teachers. Additionally, examining cultural aspects related to teacher training variables is crucial for teachers' professional development and could help future research and educators to understand aspects possible related to student achievements.

6. Research Limitations and Future Directions

One limitation of the proposed study could be related to students' demographic data. Participants are all elementary school students and the majority of Romanian students are white (with ethnic membership to Romanian, Hungarian, or Roma). The study is restricted to an age range from 9-11 years old students, and there is very limited ethnic variety among the Romanian student population. Additionally, the type of data collected could impose some limitations on study findings. Students are asked to draw three professions in one sitting (i.e., scientists, veterinarians and teachers). Young children are limited in how many drawings they can produce in one sitting, and also limited with respect to the quality of drawings they produce.

Future studies could address these limitations and focus on including systematic extensions to other jobs to assess where scientists "fit" as occupational incumbents. It will also be helpful to consider other student characteristics and relationship with the type/quality of drawings produced. For example, do high academic achievers depict scientists differently from less achieving students? Or, do students with low SES depict professions, especially scientists differently than high SES students?

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