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SPECIAL ISSUE ON SCIENTIFIC LITERACY
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Perspectives of German and US Students as They Make Meaning of Science in Their Everyday Lives

Paul J. Preczewski, Alexandra Mittler and John W. Tillotson
Syracuse University, USA

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Scientific literacy is a major educational and political goal worldwide, yet the development and enhancement of scientific literacy is not well understood. In order to better understand scientific literacy at the level of everyday science meaning making and a person's ability to address scientific questions and issues, this study reports on findings from semi-structured interviews of seven German and five American secondary students. This paper reports on these students' conceptions of their science interactions in everyday life. By conducting the same interviews in the native languages of students representing two countries known for their emphasis on improving secondary science education's scientific literacy enhancement, this research aims to learn from a cultural and contextual spectrum of science experiences. Our findings include two distinct themes independent of the educational setting. In addition, the research finds the recurrent and prevalent theme of German students' practicing science in nature not mentioned by American students.

Key Words: scientific literacy, science education

Introduction

The Committee on Prospering in the Global Economy of the 21st Century in 2007 offers an in-depth articulation of a changing globalized educational climate, and the need for greater knowledge by all individuals in the area of science and technology in its report, *Rising against the gathering storm: Energizing and employing America for a brighter economic future* (RAGS). This report emphasized the need for America to fervently enhance scientific understanding and preparedness of all adults, but summarizes concern about the uncertainty of how to enact the widely accepted educational policy and standards to meet this goal. While this report is a summation of work intended to address America's concern for the level of scientific literacy among its citizenry, in a global economy each nation faces a similar task.

Known to vary widely between and among cultures, scientific literacy is the ability of a citizen to make rational and well-educated choices about scientific encounters as adults. These encounters can happen at any time: while interacting with media, making simple repairs, or voting about important issues. Scientific literacy as such has become a buzzword for science educators—it is often stated as a goal for science teaching and a public necessity for all contributing members of a community. However, seldom is the actual process of scientific

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literacy enhancement addressed. The means by which a person becomes scientifically literate is thought to range from rigorous science instruction and learning, all the way through the ability to solve never-before-seen science problems. So with varied perspectives about how to enhance scientific literacy in light of its stated importance, this research seeks empathize with and learn from secondary students' descriptions of making meaning of science in their everyday lives—the very act of practicing and building their scientific literacy.

Development of Scientific Literacy as a Concept

Scientific literacy is often cited as a curricular goal throughout secondary and post-secondary education, and the National Science Education Standards lists scientific literacy as one of two overarching goals for the outcome of primary and secondary science education in the United States (National Committee on Science Education Standards and Assessment, National Research Council, 1996). Accordingly, a movement to enhance scientific literacy has become a topic of many peer-reviewed articles and research projects (see, e.g., Shamos, 1996; Roberts, 2007), and the study and advancement of scientific literacy, itself, is the outcome goal of numerous formal and informal science education movements.

But scientific literacy remains a concept that is not well defined. In fact, the definitions vary enough to present a significant problem when striving to both measure and enhance scientific literacy (Laugksch & Spargo, 1996). In order to better understand scientific literacy definitions for the purposes of this research, two appreciably differently, but commonly used definitions are reported. Often cited, Miller (1998) defines scientific literacy as "a level of understanding of scientific terms and constructs sufficient to … understand the essence of competing arguments on a given [scientific] dispute or controversy" (p. 205) Miller thereby describes scientific literacy as means for comprehension, based on learners having enough science and technology knowledge to reason through important scientific issues. Somewhat contrary and more commonly cited, the National Science Education Standards (1996) define scientific literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity." This definition focuses on scientific literacy being understanding based, with content knowledge following for later science decision-making ability.

The evolution of the concept of scientific literacy (while also being called "science literacy" and "civic scientific literacy") began in the 1950s (Roberts, 2007) and gained more US prominence in 1990 with the American Association for the Advancement of Science's, *Science for all Americans: Project 2061*. In this policy-determining document, the authors created "a set of recommendations on what understandings and ways of thinking are essential for all citizens in a world shaped by science and technology" (p. xiii). The science recommendations covered three main categories: 1) "the scientific endeavor" to be known as the nature of science, 2) "basic knowledge" in science, and 3) "what people should understand about…episodes [in science]" to be known as the public understanding of science in society (p. xvii). This three-dimensionality of scientific literacy became the foundation for attempting to assess scientific literacy categorically (Laugksch & Spargo, 1996).

As a follow-up to AAAS's *Science for All Americans: Project 2061*, in 1993 AAAS released *Benchmarks for Science Literacy*. This document further detailed AAAS's consensus views of scientific literacy tenants by describing them as specific performance indicators by grade-level in education, a very readable and easy fit to actual science curricula as a direct, quantitative measure.

Accordingly in 1996, Laugksch and Spargo set out to determine a test of scientific literacy by describing scientific literacy in terms of a set of testable statements based on the aforementioned AAAS publications. He established topics of scientific literacy in a series of learning statements, similar to the way curriculum is presented: conceptual point by conceptual point. By doing this, Laugksch and Spargo articulated "paper and pencil" (p. 1) testable items for scientific literacy, a step towards specific items instead of concept areas when Laugksch and Spargo (1996) is compared to the categories of literacy expressed by the *Benchmarks for Scientific Literacy*. For example, rather than just stating that scientifically literate adults would exhibit an ability to understand probability, Laugksch and Spargo (1996) proposed that scientifically literate adults would show the ability to explain the meaning of probability of one in four. This example shows an advance for the purposes of those interested in measuring scientific literacy directly, for Laugksch and Spargo's work converted civically necessary concepts into testable items. AAAS (1997) makes a point of achieving these and other items by the time students finish secondary education, producing scientifically literate adults.

However, these advances in scientific literacy rely on expected outcomes. That is, they are founded on ideas of what students ought to know by the time they are adults. But thinking of scientific literacy as a phenomenon that is individually developed rather than a set of benchmarks, we hold that science literacy development can be characterized by engaging young adults (secondary education students near graduation—the finishing age covered by NSES) regarding their descriptions of making meaning of science in their everyday lives—the very act of practicing and building their scientific literacy.

A review of the literature related to these definitional and dimensional advancements to the understanding of scientific literacy, has yielded no qualitative research studies in science education aimed at better defining scientific literacy from the point of view of young adults. Thus, the means by which to enhance scientific literacy not are well understood other than the one key dimension of scientific literacy, the understanding of the nature of science (NOS). In fact, NOS has been addressed extensively in this field. For instance, NOS informing work is exemplified by two qualitative studies by Akerson. In the first study Akerson and Abd-El-Khalick (2003) sought to determine how a fourth grade teacher demonstrated knowledge of the nature of science. They assessed this through a prolific NOS interview tool, the Views of Nature of Science (VNOS), a qualitative measure asking participants to comment of NOS issues and report their understanding of NOS topics. Regarding the nature of science perception by the participant teacher, they concluded that nature of science beliefs by the teacher were not in alignment with scientifically accepted nature of science concepts, indicating a need for better teacher preparation in NOS. Akerson, Morrison and McDuffie (2006) furthered this research by conducting VNOS interviews with pre-service teachers in order to see if their nature of science views were able to change over time. This study illuminated aspects of nature of science enhancement (a component of scientific literacy) but concluded that enhanced NOS views reverted back to naive views over time. This method of qualitatively analyzing specific NOS development and understanding served as a model for us as we analyzed science literacy data from our interviews. Illustrating this again with NOS definition, Lederman et al. (2002) gives an example of seeking to move beyond a paper-and-pencil assessment NOS views and into participant-defined NOS views through semi-structured interviewing. The success of their subsequent qualitative instrument, the VNOS, has helped redefine NOS from a more emic perspective. The same is needed for scientific literacy.

To do this, we sought a two-country sample of secondary students where research shows that some external factors affect scientific literacy reporting. Miller's quantitative work shows international disparity in participants' performance on a scientific literacy measure when administering his quantitative survey to more than 12,000 participants (Miller, 1998, p. 205).

Accordingly, national difference should be accounted for when seeking to understand secondary student perspectives on scientific literacy. But, when Stigler and Hiebert (1999) used videotapes of classes to analyze similarities and differences between US, German, and Japanese classrooms, they found that between the US and Germany far more was similar than was different. That is, while differences did abound, German and US science and math classes shared very similar structure in terms of content and teaching methods. Their research shows that differences in standardized test scores between the countries can be accounted for by major cultural differences, not necessarily class content or structure. Notable differences in education between the US and German systems are as follow: Germany uses a tracking system by dividing students among three separate scholastic tracks after grade 4. These tracks are physically separated schools. The US, on the other hand slowly begins tracking around the fourth grade level but always within the same schools, using class variation to match student academic achievement rather than separating schools physically. Science education is similarly handled in both countries the US and Germany less-reform-based, more didactic tactics, but in the US science is taught using the 'layer cake' method from ninth grade and beyond, where subjects covered year by year, whereas Germany employs a 'spiraling' and concurrent system where different science subjects are taught at the same time and repeat after one or two years. At the junction of these cultural differences in becoming scientifically literate and similarities in schooling is a mandate to analyze science literacy qualitatively—to ask secondary students from their own cultural perspectives how they interact with science.

Study Purpose

The results of the aforementioned qualitative and quantitative studies suggest a need to resolve ways to go about identifying key aspects of scientific literacy by analyzing participants' descriptions of their interaction of science in everyday life—the process of their scientific literacy acquisition. This research seeks to accomplish this by using semi-structured interviews in two countries that differ in civic scientific literacy and in standardized secondary student outcomes (PISA, 2003). Themes discovered and their subsequent comparison across cultures can lead to a stronger understanding of scientific literacy. In order to resolve this articulated gap in understanding of what both entails and could possibly enhance scientific literacy, this research discusses with secondary learners the process they use as they make meaning of science in their every-day lives. By doing this, this research is capturing participants' descriptions of the moments when science is encountered and attempting to better define scientific literacy through analysis of its practice.

Accordingly, the study asks:

> How do late secondary education students describe their process of making meaning of science in everyday life?
>
> What do these processes tell us about defining scientific literacy?

Theoretical Framework

This research was undertaken with the phenomenological perspective. Scientific literacy is a term used to describe a myriad of ideas among our research community, yet scientific literacy in fact describes a skillful understanding unique to every individual. By pursuing a better definition of this individual understanding through interviews and analysis conducted by one scholar and overseen by scholars of both cultures, the researchers' perspective is held relatively constant. Bentz and Shapiro (1998) write about phenomenology: "One gains understanding of an experience through empathy" (p. 98), and this project is an attempt by the first author to come to know the participants' understanding of their own interaction with science in everyday life—the process of them practicing and developing scientific literacy—through singular empathetic engagement. Phenomenology is an ideal approach for this research task because the task directly asks about cultural and individual construction of the concept of scientific literacy.

Subjectivities Statement

In accordance with ideas proposed by Peshkin (1988) the first author of this study kept a subjectivities journal throughout the process of designing the semi-structured interviews, collecting the data, and analyzing the results. Key aspects of this journal included a purposeful attempt to mitigate language-based bias in the research: questions were purposely asked similarly in the native language of each participant, and the first author was the only interviewer, speaking both languages. Even with great attention given to conducting all interviews without language bias, the fact that two languages were used may have changed the perception of the researcher's and participants' discussions.

Additionally, while creating the semi-structured interview questions, administering the interviews, and analyzing the results, the author's preconceived notions of scientific literacy informed by both current literature and personal practice, undoubtedly influenced the direction and interpretation of the research. This is the case with all research of this type, and the use of a subjectivities journal and well-informed research questions are the means by which this subjectivity is mitigated to the largest degree possible.

Methods

In and around one medium-sized city in the US and one major city in Germany, three schools were selected to represent urban and suburban areas. From these schools, research participants were volunteer secondary education students recruited by their science teachers at the request of the first author. Participants were assured anonymity, and no identifying information was ever asked, including age, but their ages are assumed to be between 18 and 19 among the seven participants and Germany and between 18 and 20 among the five participants in the US. Three participants in Germany were dropped from the study because the first author deemed these participants to be too young for the chosen secondary education group as defined by US standards, despite being identified as 18 or over by school administration and teachers. The fact that their age was below 18 was made clear by the participants' description of their educational program and progress. The addition of new subjects ceased at each location when the availability of interview opportunities and saturation of thematic occurrenced. By the end of five US and seven German interviews, the same major themes were repeating.

A semi-structured interview was developed by determining essential questions derived from the overarching research questions of the study in accordance with the procedures outlined by Marshall and Rossman (2006). Special attention was paid to addressing research questions about science literacy, meaning making, and practice without leading the participants in any direction other than those of their own volition and instincts as interviewees. The main interview questions are reported in Appendix A. Interviews were audio recorded and the author created transcripts of the interviews. All German interviews were translated by the author into English before analysis, and in order to ensure accuracy, the translation was overseen by a native German speaker and professor of German at an English-speaking university.

All data were then analyzed using thematic coding procedures outlined in Bogdan and Biklen (2007). The researchers divided each data source into sections based on small, conceptual stories. Within the sections, the researchers noted all incidents of major concepts relating to my research questions in the form of a code in the margins. Once complete, all codes were viewed searching for similarities. In doing so, similar codes were combined into themes and then recoded based on the data pertaining to these themes. Using coded frequency and depth of description, the three most prevalent themes were identified and reported in order to directly address this project's research questions.

Results by Theme and Conclusions

Upon analysis of the 12 semi-structured interviews using theme coding, two emergent themes were consistent among nearly all 12 interviews, and one theme was consistent among all German interviews but no US interviews. This research summarizes these themes as they relate to the research questions regarding scientific literacy.

Theme 1: Awareness of Science

For the first theme, this research found repeated examples of science meaning-making being modified by the participants' perception of responsibility for and the awareness of science. That is, the decision by the participants to assimilate the scientific concepts they encounter in everyday life was consistently modified by their appraisal of whether or not they were responsible for knowing the science and aware of the potentially science-related encounter. For example, one US participant spoke often of situations in which she identified a science concept being integral, but she stated that her perception of the science was not necessary for her to interact with the situation. In fact, she could often be ignorant of the science entirely until she had a reason to be responsible for knowing it. She said of daily activities, "I see something fall I don't think of, like, the physics behind it," and she stated that regarding electricity she need not "think about when I plug something in, like, what's going on." She explains that if she has a scientific problem with something, "I just ask somebody I know who would be able to help me." As the interview continued, she spoke often of situations where science was very likely involved in her actions, but her knowledge of it or even awareness of it was not required. Likewise in a German interview, one male student explained, "outside of school [I encounter science] not very much … but when I hear about something that I'm interested in, then I maybe look it up." This student, upon repeated probing regarding his interaction with science, continued to state that science was only involved when he made the decision to investigate it due to interest. All but two of the twelve participants were coded as mentioning determining the science behind a concept when only they felt a need to understand or express the science. The two other participants did not contradict this theme; rather, they simply did not introduce any data to support it.

Also of note, German participants consistently described what qualities are present in a scientist as one who is precise and exacting in his or her work. For instance, one male German participant explained of a scientist:

> Someone who looks intelligent, wears glasses, and talks informatively. The person must act very carefully … definitely. And, definitely likes to experiment. Um, well, they most likely write down their questions, or what they found out, and then speak clearly about it.

US participants answered the same question by defining the type of scientific work a scientist does. For instance when asked to describe a scientist, a male US participant listed five different types of jobs that included science (e.g., "engineers, botanists"…) and then describing how well that work must be accomplished ("they have to be very good at what they do and very highly-educated"). The reason these answers inform this theme of awareness, though, is that all 12 participants detailed how scientists were those whose job it is to engage in scientific practice by trade, not just anyone who asks scientific questions. Even with prompting, no participant regarded someone who casually asks and test questions of science in everyday life as a "scientist." As a follow up to this, the first author asked a male US participant in an interview, "Are you a scientist?" He answered, "No; [pause] well, only if I'm doing an experiment in school I guess."

The motivation for the understanding is where a major difference was coded between German and U.S. participants. The five US participants never described any responsibility for knowing science or making meaning of science unless prompted by a class or external situation (such as "parent," "museum," etc.). On the other hand, 6 of 7 German participants specifically and repeatedly noted a personal responsibility for the knowledge of science. For instance, on female participant stated, "It is better to understand than to go through life always wondering how things work." When considering scientific literacy, this theme is centrally important. Being civic minded from a scientific point of view by some might require knowledge of key scientific issues, but as the thematic coding of ten of twelve participants revealed, scientific knowledge is only pursued when one perceives some responsibility for knowing the material or engaging the science of the encounter. This theme is key to enhancement of scientific literacy, for it shows the need to portray knowledge as a responsibility in order to motivate students to learn. As noted earlier, few interventions have been proposed to enhance scientific literacy, but of those that have, Elliot (2006) targets increased scientific literacy by having pre-service science regularly read and report on science in the news, an act of engagement in accordance with theme one from this study's data.

This theme also ties to the dimensionality of scientific literacy developed by Miller et al (1998) and summarized previously here. Specifically, the dimension of awareness of science connections with societies can apply here. When considering how to enhance scientific literacy, one can argue that a fundamental concept would be to have learners aware that they are encountering science. Simply stated, participants explained situations in which they suddenly realized science was involved, and that was the cause of their increase in the pursuit of science meaning making. One female US participant explained when she said, "A lot of times [science can be in] something that you see every day so you're not going to think about it all that much. So like, a stapler is a type of lever but you don't really think about it. This happens all the time." This participant explained four other items she realized recently were science related, and she described in detail how she was making meaning of them in light of her new understanding.

Theme 2: Engagement

"For me, science classes are the easiest ones, because they are the most logical and the liveliest and because one gets confronted with many things, as in daily life." This statement by a male German participant summarized why he likes science classes, but in doing so, it illustrates the connectedness between science understanding and science practice.

To the science teaching community, learning by doing—engagement in science—is nothing new at all, but to see it illustrated as a strongly emergent theme in this research underscores the need to emphasize procedural learning in order to elucidate the details of scientific literacy. One female US participant described in detail working through labs in school using the same steps she uses when trying to solve a scientific problem on her own: "I put stuff together to make it work, just like in school." Later she said, "When I see something I don't understand [scientifically], I follow steps I learned in school to figure it out." One German participant spoke about this theme by describing, in depth, his interactions with his garden. He told a story of the plants he planted and how flower structure never made as much sense as when he finally looked at flower blossoms on his own, noting the structures that were in common. When asked, he said this experience meant he would now remember flower structure from this self-chosen experience far more than anything from school because he was "doing science" in the garden.

Notably, three of five US participants mentioned a "scientific method" and none of the German participants did. The interviewer never mentioned "scientific method" in the interviews, so any discussion of it was begun by the three US participants. Quite likely an artifact of the way science is taught by country, it is interesting to note in this context that the treatment of the scientific method is not mentioned enough by the US participants to be considered a theme.

These data regarding science meaning making as a matter of some procedure of interacting with the science make it clear: an avenue for increased scientific literacy could be the simple act of doing science, whatever individual form that takes. As one US student articulated, "an experiment can make science make sense." A body of literature accompanies this theme, regarding learning by doing as a major educational process (National Committee on Science Education Standards and Assessment, National Research Council, 1996, p. 23). However, returning to Miller's dimensions of scientific literacy for the purposes of assessment, engaging in science is not assessed, nor can it necessarily be assessed. However, our data show that the participants of this study construct their views of science meaning making around their ability to engage in science, and as we construct scientific literacy from the data, this theme emerges.

German-Only Theme: Natural Setting

To introduce this theme, it is important to point out that following the methods of this study, the theme first coded into the category of theme two: engagement. The reason for this is that every German interview participant described an active interaction with nature to be instrumental to their everyday lives. From stories of gardens and flowers, to excitement over the content of the air they were breathing in the park, all the participants discussed science in terms of interacting with a natural setting. As one male German participant explained about science in everyday life, he said, "I always notice this when I sit with my grandparents and see how they are astonished by flowers and how they look at them. In daily life, when one is out in nature."

In the final school in Germany where the first author conducted the interviews, three participants invited the researcher to join them in their garden in order to informally carry on our discussion of science in their everyday lives—following the semi-structured interviews. We walked outside the school (this was one is an urban setting) and into the alley of a city lot about 100 meters from the school. Upon turning the alley's corner to bring their garden into sight, I noticed 10 students and one teacher quietly at work after school hours, tending to a shaded and sparse garden no larger than a typical classroom. I spoke with 10 students about their garden and how they maintain it. These students were not part of the study nor did I know their eligibility, so their comments cannot be reported, but the science in nature theme continued in this corner lot of a major German city. Eager students raked leaves and tended to plants as their science teacher counted seeds. All three students from this school whom I interviewed mentioned the school garden as a location of their encounters with science, and the German participants at two other schools around this German city all reported gardens or nature as avenues for science encounters. It is very important to point out here that these other schools were not running a similar garden project—the students were mentioning gardens and nature beyond school grounds. The framework of this study was to attempt though interviews to understand how each individual was making meaning of science, to see scientific literacy through the perspectives of the young adults willing to discuss it. In Germany, three individuals literally lead me to the place where science has meaning for them—in a garden.

This theme was never mentioned (did not code) in US interviews. This study is not nearly large enough or well enough controlled to conclude a cultural difference in this aspect of science meaning making; however, the German participants were repeatedly expressing an avenue of scientific integration completely left out of US interviews. The German students included science in nature regardless of school location, and time of year is the only widespread, contextual difference between US and German interviews. An understanding of the reason behind this difference could be a powerful avenue for science literacy enhancement, and it potentially ties into the research movement regarding environmental education importance (Hart, 2007). Hart explains the need to increase dialogue between science and environmental educators for the sake of better contextual understanding in education, and data from this study obtained in Germany shows the value of this perspective to each participant's individual perspective of making meaning of science.

Discussion

Our data suggest three themes regarding the construction of scientific literacy from the point of view of our participants about how they make meaning of science. The data show two emergent themes in common with all participants and one theme in common among German students only. Awareness of science and engagement in science emerged as key aspects of the participants' meaning making of science. Meanwhile, all German students discussed observation and awareness of science in nature as also key. By engaging participants about their encounters with new scientific concepts, these thematic pathways to scientific literacy showed themselves as essential among these secondary students. This research study thereby documents the ways in which these participants are actually using and enhancing their scientific literacy. Taking the themes together, we define scientific literacy as an ability to recognize and engage in the practice of science. As a revision to our definition for scientific literacy, this would be the first study to suggest scientific literacy viewed without attention to basic science knowledge (Roberts, 2007). In fact, the participants in this study did not value their science knowledge in their attempts to make meaning of science to the point of recording it as a theme. While this could be a consequence of the design of the questions themselves, a nearly complete lack of mentioning of science content knowledge in terms of trying to make meaning of science in everyday life is noteworthy. Clearly, basic science knowledge is the goal of a scientifically literate population, for prior knowledge of science is both essential and cornerstone to scientific advance. But these data indicate a very plausible overemphasis of content, rather than process, in scientific literacy—as our participants described their science meaning-making, content knowledge did not register as important to the description.

Accordingly, movements to both measure and enhance scientific literacy (through the views expressed by these participants' making meaning of science) should focus on application of science and science as a process. Is his thorough review, Roberts (2007) divided scientific literacy definitions into two 'visions': 1) scientific literacy by a focus on science situations and 2) scientific literacy as a cultural product. By his development of these visions, our participants' data fits into the situational vision, but it lacks the science content knowledge component valued by other authors who have developed definitions within this vision. Notably, however, we are the first to develop our definition of scientific literacy from the point of view of those on the cusp of adulthood: those finishing their formal adolescent education. Our participants show us a process-valued idea of what it means interact with science. Further research is called for where our findings fall short: 1) when educators target the themes we derived from our study, is scientific literacy as defined by the literature in fact enhanced among individuals, and 2) how can the robust nature of science field of study better inform our findings that science meaning-making is process based?

Teachers of science can take note of this study's new outlook on scientific literacy based on our participants' views. To see scientific literacy as an ability to recognize and engage in the practice of science, we encourage science teachers to outline in their teaching 1) the constant link between classroom studies and students' everyday experiences, and 2) the ways of going about science investigation through less formal inquiry. Specifically, our findings suggest to teachers that classic science content should be deemphasized when attempting to teach towards the enhancement of individuals' scientific literacy; instead, the process and interaction with science in natural-world and individualized methods should be the focus.

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Authors

Paul Preczewski is a PhD candidate in the Dept. of Science Teaching and instructor in the Dept. of Psychology at Syracuse University in Syracuse, NY, USA as well as a researcher in mental health epidemiology for the U.S. Department of Veterans Affairs' Center of Excellence in Canandaigua, NY, USA. Paul's research interest is scientific literacy, particularly as it is defined and affected by cultural influences and secondary science education curricula. In addition, Paul researched health and mental health literacy as it relates to scientific literacy, healthcare, and health outcomes. **Correspondence:** Depart of Science Teaching, Syracuse University, 101 Heroy Labs, Syracuse, NY, 13041, USA. E-mail: pjprecze@syr.edu.

Alexandra Mittler Alexandra Mittler has a Ph.D. in German Linguistics and currently teaches German language classes at UC Berkeley (Berkeley, CA, USA) and San Francisco State University (San Francisco, CA, USA). Alexandra's research interests span from linguistic aspects of literary texts to methods of teaching German, in particular German (popular) culture in the classroom.

John Tillotson is a dual associate professor of science education in the Department of Science Teaching and Teaching & Leadership Programs at Syracuse University. He serves as the Coordinator of the Adolescence Science Teacher Education Program at Syracuse and directs the graduate program in science education. John's research focuses on the influence of preservice teacher education programs on science teachers' beliefs and classroom practices across key stages of the teacher career continuum, and the impact of education reform on science education programs in high-needs rural school districts.

Appendix A: Semi-structured Interview Questions

English

- Please describe your favorite class.
- Please tell me about how you learn science. [Make sure clear steps are said. Redirect as needed.]
- Please describe your everyday encounters with science. Tell me about it. [Probe for understanding of science seen and understood in everyday life. Where is science encountered: TV, newspapers, etc.?]
- How do you feel about science? [Probe for approachability of science, fear of science, enjoyment of science.]
- If you were asked to describe a typical scientist, what characteristics come to mind? [Probe: Think as though you're describing a picture of a scientist.]
- Describe how you think a scientist goes about doing his or her work.
- To what extent does science play a role in your everyday life?
- How would you describe the ways in which you do science in your everyday life?
- What does it take for someone to be "good at science?"
- What do you see yourself doing 10 years from now?

German

- Was ist Ihre lieblings Klasse? Bitte beschreiben Sie das.
- Bitte sagen Sie, wie Sie Naturwissenschaft lernen? Beschreiben Sie bitte ausführlich.
- Bitte beschreiben Sie, wo und wie Sie im täglichen Leben mit Naturwissenschaft in Berührung kommen.
- Was denken Sie über Naturwissenschaft? Warum ist das so?
- Wenn Sie einen typischen Wissenschaftler (oder eine typische Wissenschaftlerin) beschreiben sollen, an welche besonderen Kennzeichen denken Sie?
- Bitte beschreiben Sie, wie Wissenschaftler ihre Arbeit machen.
- Welche Rolle spielt Wissenschaft in Ihrem Leben? Wie groß ist die Rolle von Wissenschaft in Ihrem Leben? Beschreiben Sie das bitte.
- Wie würden Sie beschreiben, wie Sie Naturwissenschaft im täglichen Leben (außerhalb der Schule) machen?
- Welche Kriterien sind wichtig, um gut in Naturwissenschaft zu sein? Was braucht man dafür?
- Was machen Sie seit zehn Jaren?