Colors Of Nature: Connecting Science and Arts Education to Promote STEM-Related Identity Work in Middle School Girls

Carrie Tzou, University of Washington Bothell, tzouct@uw.edu
Laura Conner, University of Alaska Fairbanks, ldconner@alaska.edu
Stephen Pompea, National Optical Astronomy Observatory, spompea@noao.edu
Mareca Guthrie, University of Alaska Fairbanks, mrguthrie@alaska.edu

Abstract: Art and science share many overlaps in terms of both common practices and habits of mind. In this study, we focus on middle school girls who strongly identify with art and ask the following questions: (1) how does an art-focused approach to science instruction (STEAM) support engagement in scientific practices such as experimentation, observation, and communication of scientific information? and (2) how does a STEAM approach support STEM-related identity shifts in middle school girls?

Introduction

Art and science share many overlaps in terms of common practices and habits of mind. Visual-spatial thinking is key to understanding the structure of molecules, the actions of enzymes, and the 3-D structure of galaxies (Ramadas, 2009). Visual-spatial thinking is heavily used to model abstract scientific concepts (Walker et al, 2011) and is also widely recognized as a central aspect of creating art (Wai et al, 2009). However, much is yet to be learned about how teaching science through art, or connecting art and science teaching, affects science learning. In particular, more empirical work needs to be done on how youth with art-related identities connect to science learning and form science-related identities.

Research suggests that girls who gravitate towards art may have strong visual-spatial abilities that would also serve them well in science careers. However, in contrast to boys, most girls with such ability do not go on to enter STEM careers (Wai, et al, 2009). In formal education settings, little room is often made for explicit instruction on how visual-spatial reasoning and other artistic practices can overlap with science in significant ways. Furthermore, research has found time and again how girls lose interest in science starting in middle school, (Baram-Tsabari & Yarden, 2010). Therefore, the connection between art, science learning and engagement, and identity formation is an important area of research to document empirically. In this study, we focus on middle school girls who strongly identify with art and ask the following questions: (1) how does an art-focused approach to teaching science support (STEAM) engagement in scientific practices such as experimentation, observation, and communication of scientific information? and (2) how does a STEAM approach support STEM-related identity shifts in middle school girls?

Methodology

Theoretical Framing

The building of a science identity, or the sense of oneself becoming a person that does science and is comfortable with science, has been identified by the National Research Council (Bell, at al, 2009) as a central component to successful lifelong science learning and participation. We are particularly interested in the ways in which art-based science learning can lead to shifts in participation in communities of practice. Therefore, we see learning and identity formation as closely interrelated--as youth participate in practices and gain a measure of competence or mastery, those skills may become core parts of a youth's identity at the same time that they get publicly recognized for those skills (Lave & Wenger, 1991). Arts-based science education, in particular that which culminates in public display of some learning product—can lead to such public recognition and identity formation.

However, we also recognize that studying and identifying identity as a construct is empirically difficult as identities are constantly shifting, being formed and re-formed as individuals encounter new practices and resources in communities of practice they engage in (Calabrese Barton et al, 2013). Therefore, in this poster we will focus on and document *shifts* in identity work (Calabrese Barton, et al, 2013), or the ways in which youth engage in science- and art-related practices or the same practices more deeply as a result of a STEAM-based approach to science instruction.

Study Context

The context for this study was a two-week summer academy for middle school girls (N = 64) that ran in the summer of 2013. The academy ran for two sessions for two weeks each, once in a large urban city in the Southwestern United States and once in a small city in the far Northwestern United States. The focus of the academy was "the colors of nature", focusing on the functions of color in biology and art, how color is produced

(optical science and art), and how the practices of science overlap with the practices of artists (observation, experimentation, recording procedures, taking notes, publicly presenting scientific/artistic results).

Researchers assumed the role of participant-observers, sometimes teaching parts of the academy, conducting interviews with participants, videotaping sessions, and taking field notes. Data sources for this study include pre/post interviews, daily videotaped observations of each day of the academy, pre/post STEM and art attitude surveys and content assessments, and analysis of the girls' science and art notebooks that they kept throughout the academy. This project follows a design-based research (DBR) research paradigm (diSessa & Cobb 2004), with cyclical iterations of design, enactment, analysis, and re-design. Therefore, researchers were involved in all aspects of the design process before the academy as well as daily discussions after each day of the academy to talk about learning and refining the design of learning activities.

Findings and Analysis

Preliminary analysis of data from both summer academies suggest the following findings:

(1) When a STEAM approach to science instruction is taken with girls who are already strongly identified with art, many opportunities open up for connection to emerging identities and everyday practices. For example, art opens up space for mistakes and multiples possibilities in a way that is often challenging for traditional science teaching. Girls, in post-interviews, mentioned that they saw new areas of overlap between science and art, especially in the realm of experimentation, making mistakes, and persisting through science and art projects. One girl said, "Scientists and artists both experiment and make mistakes. The important thing is to keep trying."

(2) We also found that the STEAM approach opened up strong connections to scientific practices emphasized in the Next Generation Science Standards (NRC, 2012), such as observation and experimentation. In post-interviews, girls talked about how having accurate artistic drawings of their observations helps to convey accurate scientific information to other scientists who are not able to observe the same thing as them. They mentioned that both artists and scientists needed to look at problems from multiple perspectives, and that observation through drawing was one way to do that. This also represented a strong connection to everyday practices, as for almost all of these girls, drawing was something that was an important part of their everyday lives and, in fact, helped them think and learn in school. Finally, an unexpected finding was that the STEAM approach to instruction offered another way to look at and appreciate art.

Significance

Studies have suggested that the formation of STEM-related identities is a significant factor in whether or not youth pursue STEM-related undergraduate degrees (Tai, et al, 2006). This study suggests one way to support STEM-related identity formation in middle school girls by connecting to their already emerging art identities. In this way, this study fits squarely into exploring the conference theme, as we explore who the middle school girls see themselves becoming as they engage in learning science through art-focused practices.

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