

STEM Education and Science Identity Formation

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As the world struggles with the COVID pandemic, one question that keeps coming up in conversations among educators is how to teach students amid the uncertainty. Specifically, the difficulty is with teaching subjects that require hands-on learning in order to master the concepts and make them one's own. Today, however, I would like to pose a different, more global question: How can we help students identify with science in a deeper, more meaningful way? How can we help students develop what is known as science identity?

For students, developing a sense of science identity means studying the content, internalizing concepts and making the knowledge their own. It means mastering skills. Additionally, and equally importantly, it means viewing oneself as pursuing a career in science, a career in which they can see someone like them succeed (Sage 2YC, nd).

Identity develops when mentors, faculty, role models, and others involved in mentoring the young implement a set of strategies that promotes interest and motivation to engage in that profession (Hernandez et al., 2017). Hidi and Reninger (2006) present an interest development model that includes a four-phase trajectory: from fleeting interest induced by a situation, cue, or event (phase 1) to deep individual interest (phase 4). One might argue that reaching stage 4 results in a sustained sense of identity.

While teaching science in school is necessary to develop science identity, there is another angle to consider: the role of experience outside of school is

equally important. For science identity to flourish, science-related experiences need to begin when children are much younger than school age. When children play, they try on a persona and see if this persona feels comfortable, if it is something that they can enjoy for prolonged periods of time. For example, when playing house and being a "mom" or "a brother", children use a safe space to try out these roles and see whether they feel comfortable in those roles. Bodrova and Leong (2005) point out that dramatic play, where children take on specific roles, helps children negotiate meaning, practice social skills, and aids in cognitive development. We do not question when children create dramatic scenarios where they take on a role of a community helper (e.g., police, firefighter) or a teacher, doctor, parent. These are typical roles that children see repeatedly, which allows them to envision themselves engaging in these roles.

If we want our students to be comfortable with seeing themselves as scientists, we, therefore, need to create ample opportunities for children of all ages to engage with science, to see what the "role" of a scientist might be, and whether it might fit the child. This does not and should not limit the role to being a person in a white lab coat. Rather, children should see multiple and diverse ways that scientists are integrated and participate in our society. Exposing children to visualizing scientists who do not fit the well-accepted schema of a laboratory worker, helps create new schemas of what doing science means. For example, as students learn about healthy habits in eating and exercise, they can understand that doctors work together with

nutritionists and personal trainers. I think that the more specific and the more targeted the exposure of children to the scientific professions, the better the chance of them assuming this identity and sustaining interest in science. Bringing in science that is relevant to the life of a child (e.g., the importance of clean water to be healthy) and then introducing the child to the profession that “does that science” (e.g., chemists who test the water, ecologists who clean up local water sources) allows children to broaden their horizons and develop the necessary knowledge so that the role play becomes possible.

This is easier said than done.

I believe there are three fundamental ways we can foster interest (and subsequently identity) to help children and adolescents see science as an attractive professional option.

1. Affording students the opportunity to become scientific investigators from the early age requires revising the curriculum in all levels of education. Traditionally, the early childhood and early elementary curriculum is filled with math and literacy instruction with all other content being assigned a secondary role. While no one argues that literacy and computational skills are not important, adding scientific exploration can enhance these skills in ways that are meaningful for young children. Many teachers have difficulties visualizing the types of occupations that would be appropriate to introduce to the children. Thus, educators themselves should use opportunities to learn about various professional opportunities available to scientists if they are to bring that knowledge to the classroom.

2. Although not new, phenomenon-based teaching (Symeonidis & Schwarz, 2016) gains more traction with its introduction and emphasis in Finnish educational system in the last few years.

Phenomenon-based teaching allows learners to examine systematically real-world phenomena or situations from multiple perspectives. The phenomena should be multifaceted to allow holistic observations and contextual explorations.

Symeonidis and Schwartz argue that the results of investigations might range from simple explanations with limited evidence to explorations that use actual tools and methodology employed in real-world problem solving.

3. Broadening a view of STEM education outside of the classroom helps students underscore the idea that science happens not only in the lab but outside. Taking science outside of the traditional classroom or laboratory can be as insightful as it provides additional perspective on what it means to do science. Allowing opportunities to view what scientists do daily through field trips, conversations with science practitioners, as well as observing how innovations developed in the lab are applied in everyday life helps inform students what it really means to be a scientist. It allows them to try out this role in their mind’s eye. Using platforms like Skype (see <https://www.skypeascientist.com/>, for example), Zoom, and others can be used for offering such opportunities to children right in their classrooms. Inviting students to participate in learning outside of the classroom through other platforms that are becoming readily available to us can encourage students to look into explorations on their own.

Implementing these changes across the school systems is a daunting and time-consuming task. However, if we are to take seriously the need to

foster the love of science and the respect for the science-based professions, if we are serious about affording opportunities for all students, irrespective of gender, socio-economic status, or ethnicity, to

consider science as their identity and their future, we ought to begin changing our own attitudes on what we do in and outside of the classroom when teaching and discussing science.

References

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