Nurturing Culturally-Responsive STEM Talent in Gifted Girls

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Hope spent the majority of her most memorable childhood moments sitting at the kitchen table in a small 2-bedroom home with her mom and step-dad playing board games, solving logic puzzles, adapting recipes, navigating through "how to" manuals, dissecting auto-mechanic diagrams, and discussing current 'state of the home' affairs. At least once a month, she and her mom proudly glued notebook paper to the back of a 1000-piece puzzle that they had completed that month to hang as art throughout the house.

By age three, Hope had mastered the game of chess. And by age ten, she could take a technical manual of any kind, make sense of its complicated diagrams, and effectively communicate those instructions to anyone wanting to build a physical model of the design. She had done this many times, assisting her step-dad (a self-taught auto-mechanic and race car enthusiasts) in the yard as he built and/or rebuilt cars from frame to functional. Spending time on the road with him, she also collected a huge atlas and maps that kept her attention for hours. Hope recognized, early on, the patterns for numbering for all major highways and mile markers that systematically ran north to south and east to west. If there was something around the house that needed to be fixed, she often engineered tools in an attempt solve the problem.

At first thought, the idea of a young girl and her parents[1] sitting around the kitchen table playing games presents itself as nothing more than typical family time for any American household. However, for Hope—an unidentified gifted girl of color growing up in poverty - the kitchen table served as a playground where many hours of family-based, culturally relevant STEM-learning took place with critical thinking as the central theme of every activity.

This vignette provides an example of day-to-day practices of parent STEM engagement (Collins, 2015) experienced within the home that fosters STEM identity and positive self-concept (Collins, 2018). It was these contextual and gender-neutral STEM experiences—tied to feelings of belonging and family values—that later influenced and fostered intrinsic motivation for Hope's STEM interest, STEM academic success, and STEM talent development in school. As such, there are clear implications for educators to engage students, especially underrepresented students, in contextual STEM talent development. This is particularly important for educators at the elementary school level where cultural discontinuity between the home and the school and/or gender socialization can negatively influence a young girl's interest and persistence in STEM.

Gifted Girls in STEM

Gifted education is important in this discussion of STEM talent development because it offers a "socialized" culture that encourages students to explore STEM activities and take advanced STEM courses. It is commonly expected that gifted students show interest and excel in STEM areas of study. However, gifted girls are still pushed toward careers related to language arts (Collins, Joseph, and Ford, in-press).

In their article "Missing in Action: Black Gifted Girls in Science, Technology, Engineering, and Mathematics (STEM)", Collins, Joseph, and Ford (in-press), synthesized critical issues that contribute to the notable absence of girls in STEM. They found that empirical research generally suggested lack of motivation and ability as issues for underrepresentation, with disproportionate amounts of the research on lower achievement in comparison to majority groups. Little research focused on factors that encouraged motivation and persistence. They reported that "gaps in positive STEM experiences and practices begin as early as elementary school"

which skews perceptions of abilities in STEM by girls by the time they reach high school.

Contextual STEM Talent Development

The Expectancy-Value Theory suggests that students are motivated toward academic tasks and disciplines in which they expect to succeed and find personal value. Therefore, it is important that teachers nurture gifted girls' confidence and interest through successful STEM experience early on to support talent development and persistence throughout the STEM pipeline. STEM talent is commonly associated with the technical skillset (e.g., logical thinking, scientific literacy, domain-specific cognitive ability) developed as a result of persistence and achievement in specific STEM tasks. A student's positive self-concept in STEM, then, has to do with to what extent a student sees herself based on a belief in her ability to utilize her STEM talents to become a STEM innovator. And, for underrepresented students in STEM (i.e., Blacks, Hispanics, and female students) this identity—and motivation to succeed—is centered around social constructs of race and gender.

Collins' (2018) developmental model for STEM identity (Figure 1) offers a framework for understanding internal and external factors that may influence the persistence of gifted girls such as Hope who already showed a high interest in STEM.

Figure 1. Underrepresented Students STEM Identity Model

According to Collins' (2018) model, teachers and mentors can expect gifted girls to continually evaluate and internalize four basic questions that influence their motivation to learn and persist in STEM:

1. Do I belong in a STEM field? (Reflective Identity)
2. Can I succeed in a STEM field? (Competence/Ability)
3. Do I want to succeed in a STEM field? (Value/Interest)
4. What must I do to succeed in a STEM field? (Assimilation)

The answers to these questions influence how gifted girls come to understand themselves, especially within their own culture (internal/ home environment) and in relation to the institution of STEM training (external/ STEM environment). It is important to note that three of the four questions are a reference to psycho-social, or relating to the interrelation of social factors, individual thought, and behavior issues. This affirms that persistence issues in STEM talent development are often related to issues around belonging, cultural values, and who the student is as socialized beings.

Nurturing STEM Talent in Gifted Girls

Cultural discontinuity and/or lack of awareness for the diverse way in which STEM talents are manifested in underrepresented STEM students can negatively affect the creative thinking, and academic success of underrepresented students as early as 4th grade. This is especially true when family-based or culturally-valued STEM talents are not valued or seen as transferrable to the academic setting. Frasier's (1992) Traits, Aptitudes, and Behaviors (TABS) evaluation tool, commonly used as a culturally responsive tool for identifying gifted students, serves as a great resource and basis for identifying and nurturing STEM talent in underrepresented students in STEM, including gifted girls. Frasier's TAB's offers a description of gifted characteristics that are not traditionally "tested" or measured. Extending Frasier's' TABS for advanced STEM development, Table 1 describes TAB's within the context of higher-order thinking skills (2nd and 3rd column) for the purpose of integrating depth and challenge within a gifted curriculum. Additional insight as to how these traits may be nurtured for STEM skill development within the home or community (4th column) are also offered. The last column may be used by educators at different educational levels to evaluate how these traits might look within the STEM discipline specifically. Once that has been identified, they should align their efforts of gifted and STEM talent development to that which complements the development that is present in the home. This ensures STEM identity development that does not pose a conflict between what is valued at home and what is valued at school.

For example, Hope exhibited advanced interests in maps. She used them as a navigational tool when traveling with her family. Beyond that, she also studies them to recognize directional and numbering patterns of the roads represented on the map. Her step-dad makes sure she has access to maps of all of the states. Relatively, in school, Hope is very good at recognizing ways in which constituent parts are interrelated or arranged. As such, the math teacher could complement her interest and family's developmental strategy by allowing Hope to study topology as part of a geometry lesson as one option. Of course, many problem-based lessons can be developed for several topics in algebra as well. Through these interventions, gifted girls like Hope can see their STEM talents grow and develop. **THP**

References

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[1]The term parent or parental is inclusive of biological and non-biological guardians of children such as adoptive parents, foster parents, and grandparents, and/or other relatives serving within a parental role.

Table 1. Nurturing STEM Talent Development Using Frasier's Traits, Attitudes and Behaviors

Category	Research-based, Reading, & Rigor		Characteristics and Talent Development
Motivation Evidence of desire to learn	Thinks "outside the box" with thorough and complex designs	Manages time and activities for task completion	Fosters an environment to sustain student interest and desire to obtain STEM goal
Interests Intense, advanced interest	Work/product is an extension of individual passion	Explores topics beyond scope of learning (self-efficacy)	Consistently creates situational, unique opportunities for students to engage in STEM activities and development
Communication Skills Highly expressive and elaborative	Work/product is a reflection of experiences	Demonstrates appropriate use of resources and research material	Use culturally expressive and valued symbols to promote STEM exploration (i.e. illustrations, art, song, etc.)
Problem Solving Ability Effective and inventive recognition and problem solving skills	Embraces the process of product development	Develops multiple and alternative methods of solution	Seek opportunities to promote alternate and novel use of STEM skills
Memory Large storehouse of information	Work/product is comprehensive in nature	Possesses a working and appropriate usage of vocabulary	Activates and elicits as many senses as possible to aid in memory and STEM comprehension
Inquiry Questions, experiments, explores	Work/product is a result of knowledge gained	Constructs explanations and generates more questions as a result of research	Asks well-structured questions or demonstrate behavior to elicit STEM inquiry about situation
Insight Quickly grasps new concepts and connections, senses deeper meaning	Creates additional content that enhances required work	Understands the "bigger picture" of conceptual knowledge	Promotes use of "gut feelings" or use of inference as observation tools (street sense); promote divergent and sometimes "confrontational/debatable" STEM thinking
Reasoning Logical approaches to problem solving	Elements of work have a strong correlation and interrelated theme	Provides a clear methodology in problem solving	Intentional use of metaphors and analogies to make STEM connections
Imagination/ Creativity Produces many ideas, highly original, exceptional ingenuity	Represents achievement in diverse formats	Interprets situations/ideas in a unique manner	Use of everyday/ simple material to explain complex STEM concepts; promote characteristics of creativity, especially non-traditional patterns of STEM thinking
Humor Conveys and synthesizes complex ideas in a humorous way	Understands perspective of personal growth in areas of needed improvement	Connects abstract meaning and origin of ideas/content	Uses entertaining approach (story-telling, movies, dramatic etc.) to teach STEM skills

Program Models and Resources for STEM Talent Development

Organization/Program	Description	Find Out More
The American Association of University Women (AAUW): Hands-on STEM packs	Community-based program coordinated by local AAUW chapters designed to teach practical applications of STEM and STEM skills	www.aauw.org/what-we-do/stem-education/stem-programs-for-girls/
Girl Develop It	Non-profit organization that offers opportunities for women to learn coding and software development	www.girldevelopit.com
Girl Start: Girls in STEM Conference, Grades 4-8	Unique annual conference just for girls, including hands-on workshops led by women in STEM	https://girlstart.org/our-programs/girls-in-stem-conference/
Girls Who Code	Offers various programs such as summer immersion programs, summer courses, clubs. etc. all related to coding	https://girlswhocode.com
Girls Who STEM	A free parent resource providing information that includes but not limited to in-depth STEM product reviews, expert STEM advice for girls, etc.	https://girlswhostem.com/best-stem-organizations-for-girls-and-women/
hErVOLUTION	Creates opportunities for women—particularly those from underserved communities—to connect with practical STEM educational opportunities and support like intensive workshops and instructional seminars	www.hervolution.org
National Girls Collaborative Project: Engaging Girls in STEM	Summarizes research focused on what works to engage and support girls in STEM	https://ngcproject.org/engaging-girls-in-stem
Pink STEM	Guided by a vision of breaking the status quo in STEM, coordinates mentoring, tutoring, and field experiences to empower girls and equip them to navigate beyond any under-representation, disadvantage, and/or disability.	https://pinkstem.org
Society of Women Engineers	National organizations with collegiate chapters that offer training and development, networking opportunities, scholarships, and outreach and advocacy activities; its purpose is to encourage more women to consider a career in engineering	https://pinkstem.org
STEM for Her	Provides funding for programs that foster STEM interest through fieldtrips, programs, curriculum development, etc.	www.stemforher.org
Texas State University: STEM GIRLS (Girls Integrating Research in Learning and Service) & PEACE (Pre-engineering, Academic, and Career Exploration) GEMS CAMP	A vertical mentoring program that includes women STEM faculty and girls majoring or interested in STEM at different educational levels. Currently offered as a 10-week program for college level girls and a residential summer camp for high school girls pre-engineering academic and career exploration residential camp for high school girls	http://creativelygifted.wp.txstate.edu/resources/ci5383-mentoring/mentoring matters