

## Gender Equitable Literature Review - Hughes

### Appendix A. Summary of Literature Reviewed

Citation	Domain	Setting	Method	N	Participants	Age	Time	Strategy	Findings Aligned with the Strategy
Adams et al., 2014	Science: Astrophysics	Informal - Out-of-school program	Qualitative	6	3 AA, 1 L, 1 SA, & 1 W	Grade 6 - high school	Multi-year	5 & 6	<ul style="list-style-type: none"> <li>Programs that are collaborative and community focused benefit girls' sense of belonging to break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> </ul>
Archer et al., 2013	Science: Physical	Formal	Mixed	9,319	49% F & 51% M; 75% W, 9% A, 7% B, 1% FE, 8% O	Ages 10 & 11 years old	1 time point	1 & 4	<ul style="list-style-type: none"> <li>STEM disciplines are viewed as inherently white and middle class and some are viewed as more masculine</li> </ul>
Archer et al., 2015	Science	Formal	Mixed	3,431	All F; 74% W, 6% A, 6% O, 1% B, 1% C/EA, & 1% ME	Grades 7- 10; Ages 11 - 15	1 time point	4	<ul style="list-style-type: none"> <li>Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> <li>STEM identity development is complex for girls of color who must negotiate multiple power dynamics and stereotypes</li> </ul>
Archer et al., 2017	Science	NA	Mixed	13,421	53% F & 47% M	Grade 11; Ages 15 - 16	1 Year	1 & 4	<ul style="list-style-type: none"> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> <li>Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> <li>STEM disciplines are viewed as inherently white and middle class and some are viewed as more masculine</li> </ul>
Authors, XXXX	STEM	Informal - Summer camp	Mixed	11	11 F; 10 W & 1 H	Middle - college	6 years	6	<ul style="list-style-type: none"> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> <li>Role model interactions need to progress beyond one time point to maintain girls' STEM interests</li> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Authors, XXXX	Science & Engineering	Informal - Summer camp	Mixed	3	2 F & 1 M; 1 A, 1 AA, 1 W	Ages 13 - 14	2 weeks	4 & 6	<ul style="list-style-type: none"> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> </ul>
Bricker & Bell, 2014	Science	Formal/informal - School/home & community	Mixed	1	HA Female	Grades 4 - 6	3 years	4	<ul style="list-style-type: none"> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Bruning et al., 2015	Engineering	Informal - After-school program	Qualitative	3	All F; 1 W, 1 AA, & 1 L	High school	3 Years	4	<ul style="list-style-type: none"> <li>STEM identity development is complex for girls of color who must negotiate multiple power dynamics and stereotypes</li> </ul>
Buchholz et al., 2014	STEM/ Maker Space: e-textile	Informal - Summer workshop	Mixed	80	49% F & 51% M; 47% B/AA, 15% W, 9% H, 9% Mix, & 19% O	Grade 7, Grade 10, & college	2 weeks	1, 2 & 4	<ul style="list-style-type: none"> <li>Programs that allow girls to drive the design around personally relevant topics improve their science and technology interests and attitudes</li> <li>Girls' perceptions of STEM fields and their identities are positively influenced when they take ownership of their own STEM learning and engage in meaningful STEM work</li> <li>Masculine stereotypes associated with STEM fields, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> </ul>

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Citation	Domain	Setting	Method	N	Participants	Age	Time	Strategy	Findings Aligned with the Strategy
Buck et al., 2014	Science	Formal - Classrooms & science fair	Mixed	89/30	Surveys for all 89 students, 30 AA F interviewed	Grades 3 - 6	1.5 years	1 & 5	<ul style="list-style-type: none"> <li>•Attending to personal relevance brings African American girls' interests and knowledge to the forefront of discussions</li> <li>• Programs that are collaborative and community focused benefit girls' sense of belonging</li> <li>• An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Cakir et al., 2017	Technology: Game design	Informal - Workshop	Mixed	21	All F	Grades 5 - 8	1 Day	1	<ul style="list-style-type: none"> <li>• Programs that allow girls to drive the design around personally relevant topics improve their science and technology interests and attitudes</li> </ul>
Calabrese Barton et al., 2013	Science	Formal/ informal - Class & clubs/ Out-of-school	Qualitative	36	F; 5 W, 1 AA, & 6 O	Grades 6 - 8	3 Years	4	<ul style="list-style-type: none"> <li>•Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> <li>• Traditional school science that privileges facts and results, leave minimal room for curiosity and mistakes</li> </ul>
Cantley et al., 2017	Math	Formal – Math classes	Quantitative	253	151 F & 102 M	Ages 11 - 13	6-weeks	5	<ul style="list-style-type: none"> <li>• Programs that are collaborative and community focused benefit girls' sense of belonging</li> </ul>
Carli, et al., 2016	Science	Formal – Higher education	Quantitative	949	772 F & 177 M; 43% W, 34% A, 7.5% Mix, 7.5% L/H, 5% B, & 3% O	Undergrad; Ages 17 - 64	1 time point	5	<ul style="list-style-type: none"> <li>• Youth view STEM fields as lonely and do not allow practitioners to help others</li> </ul>
Carlone et al., 2014	Science	Formal - Science class	Qualitative	3	2 F & 1 M; 1 AA, 1 W, & 1 H	Grades 4 - 6	3 Years	4	<ul style="list-style-type: none"> <li>• Stereotypes associated with the concept of being a good science student, particularly for girls of color, are present in school science</li> <li>• Girls are often penalized or punished for not exhibiting STEM skills even though the behaviors that they are expected to conform to prevent them access to such skills</li> <li>• An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> <li>• School science that privileges facts and results leave minimal room for curiosity and mistakes</li> </ul>
Carlone et al., 2015	Science	Formal - Science classes	Qualitative	13	All F	Grade 4 – 7; Ages 9 - 13	3 Years	4	<ul style="list-style-type: none"> <li>• Stereotypes associated with the concept of being a good science student, particularly for girls of color, are present in school science</li> <li>• Girls are often penalized or punished for not exhibiting STEM skills even though the behaviors that they are expected to conform to prevent them access to such skills</li> <li>• Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> </ul>
Degol et al., 2018	STEM	Formal - Mathematics classrooms	Quantitative	1,449	49% F & 51% M; 75% W, 18% AA, & 2% A	Grades 9 - 12	Academic School year	3	<ul style="list-style-type: none"> <li>• Girls' confidence and performance improves when they are given specific, positive feedback on things that challenge them but are within their control to overcome</li> </ul>
Erete et al., 2016	Science	Informal - Science camp	Qualitative	9	Parents of middle school girls	Ages 32 - 45	1 week	4	<ul style="list-style-type: none"> <li>• Programs that allow girls to drive the design around personally relevant topics improve their science and technology interest and attitudes</li> <li>• STEM identity development is complex for girls of color who must negotiate multiple power dynamics and stereotypes</li> </ul>
Gonsalves, 2013	Science	Informal - Afterschool club	Qualitative	6	6 F; 1 B, 4 W, & 1 Mix	Ages 14 - 18	Academic year	1	<ul style="list-style-type: none"> <li>• STEM disciplines are viewed as inherently white and middle class and some are viewed as more masculine</li> </ul>
Hazari et al., 2015	Science: Physics	Formal - Physics classes	Mixed	4	4 M HS teachers	Middle aged	1 week	4	<ul style="list-style-type: none"> <li>• As youth grow older, stereotypes increase and are reinforced by parents, peers and educators</li> </ul>

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Citation	Domain	Setting	Method	N	Participants	Age	Time	Strategy	Findings Aligned with the Strategy
Hillman et al., 2014	STEM	Formal - Classroom settings	Qualitative	485	62 elementary, 208 middle, & 215 high school	Grades 3 - 11	1 year	4 & 6	<ul style="list-style-type: none"> <li>When girls can relate to role models as multidimensional people with diverse lived experiences, they develop broad visions of STEM people and they expand their vision of what is professionally and personally possible</li> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Hubert, 2014	Mathematics	Formal - Mathematics class	Mixed	5	4 F & 1 M; 2 AA, 1 H, 1 W, & 1 Mix	High School	10 days	1	<ul style="list-style-type: none"> <li>Culturally relevant teaching can add to youth's sense of STEM belonging by empowering girls, especially girls of color, to incorporate their interests, identities, cultures, backgrounds, and experiences as central to the learning process</li> </ul>
Jethwani et al., 2016	Cybersecurity	Informal - Summer program	Qualitative	38	38 F; 38% W, 14% B or H, & 48% A	Ages 15 - 19	2 weeks	3 & 6	<ul style="list-style-type: none"> <li>ISE settings are uniquely situated to support girls to engage in and reflect on ill-defined problems or activities</li> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> </ul>
Kim, 2016	Science & Technology	Informal - Enrichment program	Quantitative	123	All F; 44% H, 22% W, 13% AA, 11% A, 10% O	Grade 8	1 week	2	<ul style="list-style-type: none"> <li>Programs that are collaborative and community-focused benefit girls' sense of belonging</li> </ul>
Koch et al., 2015	STEM	Informal - Afterschool	Qualitative	6	All F; 1 H, 1 L, & 1 AA, & 3 O	Grade 10	4 years	6	<ul style="list-style-type: none"> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> </ul>
Levine et al., 2015	Science: Chemistry	Informal - Chemistry camp	Quantitative	36	All F; 25% Non-W,	Middle school	1 week	6	<ul style="list-style-type: none"> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> </ul>
Lock & Hazari, 2016	Science: Physics	Formal - Physics classrooms	Mixed	38	16 F & 20 M (1 teacher)	High school & 1 adult	2 years	4 & 6	<ul style="list-style-type: none"> <li>Youth need agency in choosing and reflecting on role model interventions for success</li> <li>Role model interventions that address discrimination and sexism prepare women to face future issues with resilience</li> <li>Challenging stereotypes helps girls develop stronger and more resilient STEM identities</li> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> <li>Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> </ul>
Master et al., 2016	Computer Science	Formal - K-12 education	Qualitative	269	125 F, 138 M, & 6 O; 44% W, 19% L, 17% A/PI, 11% Mix, 5% B, & 2% O	Ages 14 - 21	1 time point	4	<ul style="list-style-type: none"> <li>Sense of belonging can be influenced by the perception of STEM as lonely, white, masculine, and unfriendly to women and people of color</li> <li>Masculine STEM stereotypes s, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> </ul>
McCreedy & Dierking, 2013	STEM	Informal - Informal STEM Experiences	Mixed	174	All F; 39% W, 36% B/AA, 14% H/L, 3% O, 2% AI/AN, & 1% H/PI	Ages 18 - 40+	1 time point	1 & 4	<ul style="list-style-type: none"> <li>Attending to personal relevance brings girls' interests and knowledge to the forefront of discussions</li> <li>Fields that are historically dominated by women are labeled as less scientific</li> </ul>
O'Brien et al., 2016	Science	Informal - Science outreach event	Mixed	175	All F	Grades 5 - 8	1 day	4 & 6	<ul style="list-style-type: none"> <li>To break down stereotypes and develop STEM identities, girls need to meet role models with diverse backgrounds from multiple STEM fields</li> <li>Masculine STEM stereotypes, which can be reinforced by teachers and parents, prevent girls from seeing opportunities for success in STEM and seeing themselves as belonging in STEM</li> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Polman & Hope, 2014	Science	Formal/informal - Science classrooms/ program	Qualitative	5	4 F & 1 M; 2 W, 2 AA, & 1 A	High school	3 years	1	<ul style="list-style-type: none"> <li>Attending to personal relevance brings girls' interests and knowledge to the forefront of discussions</li> </ul>

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Richard, 2016	Computer Science	Informal - Gaming sites	Mixed	203	48 F, 93 M, 1 Genderqueer & 60 O	Ages 18 - 57	NA	4	<ul style="list-style-type: none"> <li>STEM identity development is complex for girls of color who must negotiate multiple power dynamics and stereotypes</li> </ul>
Riedinger & Taylor, 2016	Science	Informal - Summer camp	Qualitative	12	12 F; 5 W, 1 AA, & 6 O	Grade 7 & 8	4 days	1, 2, & 5	<ul style="list-style-type: none"> <li>Attending to personal relevance brings African American girls' interests and knowledge to the forefront of discussions</li> <li>Programs that are collaborative and community-focused benefit girls' sense of belonging</li> </ul>
Riegle -Crumb & Morton, 2017	Science	Formal - Science classrooms	Qualitative	1273	647 F & 626 M; 78% H, 12% B, 7% W, & 3% O	Grade 8 & high school	Multiple time points	4	<ul style="list-style-type: none"> <li>Inclusive and collegially nurturing spaces where girls can work together increase their confidence about their ability</li> <li>As youth grow older stereotypes increase and are reinforced by parents, peers and educators</li> </ul>
Robinson et al., 2016	Computer Science	Informal - Workshops	Mixed	37	All F; 81% AA, 3% NA, 3% A, & 13% Mix	Ages 11 - 13	5 days	1	<ul style="list-style-type: none"> <li>Programs that allow girls to drive the design around personally relevant topics improve their science and technology interests and attitudes</li> </ul>
Ryoo & Kekelis, 2018	STEM+C	Informal - After-school maker program	Qualitative	25	25 F; 40% W, 20% A/PI, 20% L, 8% AA, & 12% M	Grades 9 - 12	2 - 3 hours/ week/1 year	3 & 5	<ul style="list-style-type: none"> <li>Girls' confidence and performance improves when they are given specific, positive feedback on things that challenge them but are within their control to overcome</li> <li>ISE settings are uniquely situated to support girls to engage in and reflect on ill-defined problems or activities</li> <li>Inclusive, collegial, and nurturing spaces that allow girls to build relationships and a collective identity strengthens their STEM identity</li> </ul>
Scott & White, 2013	Computer Science	Informal - Summer & after-school courses	Qualitative	41	All F; 74% L & 19% AA	Ages 13 - 18	2 years	4	<ul style="list-style-type: none"> <li>Programs that are collaborative and community focused benefit girls' sense of belonging</li> <li>STEM identity development is complex for girls of color who must negotiate multiple power dynamics and stereotypes</li> <li>An individual's sense of belonging can be influenced by the perception that STEM fields are lonely, white, masculine, and unfriendly to women and people of color</li> </ul>
Simpson & Maltese, 2017	STEM	NA	Qualitative	99	Mixed sex; 83% W, 11% A, 4% Mix, & 2% H	Adults	1 time point	3	<ul style="list-style-type: none"> <li>Girls' confidence and performance improves when they are given specific, positive feedback on things that challenge them but are within their control to overcome</li> <li>Cognitive dissonance can have positive impacts on learners' understanding of science and mathematics</li> <li>Girls' sense of belonging and potential for STEM success can be challenged when mistakes are associated with low achievement rather than necessary productive struggle</li> </ul>
Stewart-Gardiner et al., 2013	Computer Science	Informal - After-school program	Quantitative	57	72% F & 28% M	Ages 11 - 14	5 weeks	1	<ul style="list-style-type: none"> <li>Programs that allow girls to drive the design around personally relevant topics improve their science and technology interests and attitudes</li> </ul>
Tan et al., 2013	STEM	Formal / informal - School / After school science	Qualitative	16	16F; Non-W	Middle school	3 years	4	<ul style="list-style-type: none"> <li>Stereotypes associated with the concept of being a good science student, particularly for girls of color, are present in school science</li> <li>Girls are often penalized or punished for not exhibiting STEM skills even though the behaviors that they are expected to conform to prevent them access to such skills</li> <li>As youth grow older stereotypes increase and are reinforced by parents, peers and educators</li> </ul>
Thomas et al., 2017	Computer Science: Computational Thinking	Informal - Summer, academic year, & field trips	Qualitative	23	All AA F	Grades 6 - 8	3 years	1 & 3	<ul style="list-style-type: none"> <li>Programs that allow girls to drive the design around personally relevant topics improve their science and technology interests and attitudes</li> <li>ISE settings support girls to engage in and reflect on ill-defined problems</li> </ul>
Toh & Kapur, 2017	Science	Formal - Science classroom	Qualitative	208	135 F & 73 M	Grade 9; Ages 14 - 15	1 unit	3	<ul style="list-style-type: none"> <li>Cognitive dissonance can have positive impacts on learners' understanding of science and mathematics</li> </ul>

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Warshauer, 2015	Mathematics	Formal - Mathematics classrooms	Qualitative	327	Mixed sex; 32% W, 56% H, & 12% O	Grades 6 & 7	1 week	3	<ul style="list-style-type: none"> <li>Girls come to develop expertise and confidence in their abilities when the struggles they encounter are framed as part of the learning process</li> </ul>
Weisgram & Dickman, 2017	Science	Formal - K-18 education	Quantitative	487	326 F & 161 M; 88% A, 4.5% AA, 3% A, 2% H, .5% NA, 1% Mix & 1% O	Grade 7, Grade 10, & college	1 time point	6	<ul style="list-style-type: none"> <li>Engaging girls, particularly girls of color, with role model counters stereotypes related to who succeeds and belongs in STEM</li> <li>When girls can relate to role models as multidimensional people with diverse lived experiences, they develop broad mental pictures of STEM people and they expand their vision of what is professionally and personally possible in these fields</li> </ul>

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