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Abstract

STEM teacher educators are aware that we teach far more than content-specific methodology. Educators need to guide STEM teachers in the knowledge and skills to support emergent multilingual students (English language learners, or ELLs) by simultaneously developing their STEM content learning and scaffolding their language acquisition (Hoffman & Zollman, 2016; Suh, Hoffman, & Zollman, 2020). Research identifies the family unit having a profound effect upon student learning and educational choices. Educators, educational researchers, and policymakers alike recognize the importance of family involvement in education (Grant & Ray, 2019). Although previous family engagement initiatives have focused on teaching families from a school-based perspective (Bush & Cook, 2016), we advocate for a STEM family engagement model which honors and grows out of families' existing funds of knowledge. This article lays out an argument for STEM teacher educators explicitly addressing multilingual family engagement as a key part of STEM education. We explain purposes, pitfalls, and practical steps STEM teacher educators can utilize that have a positive impact on diverse students' STEM learning. We also encourage STEM educators to address "STEM mindset" in addition to STEM literacy skills and interdisciplinary STEM content knowledge.

Keywords: English language learners, ELL, cultural and linguistic diversity, CLD, family engagement, parental involvement, STEM mindset

"STEM Education" has hit the mainstream—not just as a buzzword in education but also in retail and marketing. Walk through any bookstore, toy store, or even large supermarket and you will see a wide range of activity kits and toy sets marketed as promoting STEM (Science, Technology, Engineering, and Mathematics) skills. This trend suggests families' investment in building their children's STEM knowledge through purchasing products or experiences, such as summer camps. Families of school-aged children can influence their children's pursuit of STEM careers (Nugent et al., 2015), and the nationwide shortage of highly skilled STEM workers has received increasing public attention. STEM educators can build upon this cultural trend as an opportunity to engage with family interest in STEM as an interdisciplinary approach extending beyond traditional disciplinary boundaries.

Previous research on family engagement shows us what efforts are more successful as well as which families are sometimes left out (Evans, 2013). Even though we know that families play a key role in casting a wide vision for their children in STEM careers, educators sometimes have trouble connecting to families from different linguistic or cultural backgrounds (Goldsmith & Kurpius, 2018; Colegrove & Krause, 2017; Evans, 2013; Lawrence-Lightfoot, 2003). This article builds upon earlier research on supporting STEM education among English language learners or ELLs (Hoffman & Zollman, 2016), to whom we refer as "emergent multilingual students" (Canagarajah & Wurr, 2011; Catalano et al., 2018). In this article, we summarize research on family engagement in STEM education, literature on culturally relevant and culturally sustaining pedagogy (Gay, 2002; Paris, 2012), as well as our own family involvement outreach work with families of emerging multilingual students (Zollman, Hoffman, & Suh, 2020; Hoffman, 2014). We use an integrated approach to STEM literacy (Zollman, 2012) and introduce the concept of "STEM mindset" to outline some information STEM educators need to know for engaging families of emergent multilingual students. We also infuse some examples from our own experiences with engaging multilingual families with STEM.

Why STEM Educators Need to Think about Family Engagement with Linguistically Diverse Families

Significant linguistic and cultural differences can exist between home and school (Shanahan & Echevarria, n.d; Tarasawa & Waggoner, 2015). Family engagement efforts especially are important for multilingual students and connecting between home and school language and knowledge. Family engagement is critical for incorporating academic language into conversations in the home language and supporting students' academic English skills (Philadelphia Education Research Consortium, 2016; Shanahan, & Echevarria, n.d.). Higher levels of family engagement at the K-12 level are attributed to increases in graduation and postsecondary enrollment, positive regard for school, placement accuracy, and attendance for students from a variety of linguistic backgrounds (Henderson & Mapp, 2002). Strategic school-family-community partnerships have been linked to increased academic achievement and positive attitudes towards school, among other advantages (Philadelphia Education Research Consortium, 2016). Research also has documented the benefits of family engagement in STEM disciplines. Family members can play central roles in encouraging students' STEM career pursuits (Archer et al., 2012). In their study of 480 primary students in Nigeria, Olatoye and Olajumoke (2009) found parental involvement to be a significant predictor of science and mathematics achievement, and family engagement was shown to positively impact emergent multilingual preschool students' mathematical problem-solving skills as well as students' language acquisition (Naughton, 2004). Family engagement was identified as an essential component to teaching science to emergent multilingual students (Valadez & Moineau, 2010).

Supporting multilingual students' content language acquisition in both English and the home language requires that STEM teachers recognize the importance of families' funds of knowledge—in other words, the knowledge and skills essential for functioning in the home or community which family members have acquired over time and through interactions with others (Moll et al., 1992). Family funds of knowledge are considered to be central to students' learning, and current models of family engagement position family funds of knowledge as central to student learning. STEM educators can incorporate the funds of knowledge outside the school that are valued by families and communities into STEM learning. WIDA (2017), a consortium which provides assessment

and pedagogical professional development for K-12 teachers of emergent multilingual students, outlines three essential components to effective family engagement: (a) Awareness and advocacy, (b) brokering and building trust, and (c) communicating and connecting to learning. Additionally, STEM educators should learn from and incorporate families' goals or aspirations for engaging with the school—and how families' aspirations and needs alike are infused with the local context and families' experiences therein (Coady, 2019).

When STEM teachers honor families' funds of knowledge as a component of meaningful engagement to learn, they are enacting culturally responsive (Gay, 2002) and culturally sustaining (Paris, 2012) pedagogy. Gay (2002) explains that a culturally responsive educator is one who uses students' "cultural orientations, background experiences, [and] ethnic identities as conduits to facilitate their learning" (p. 614). Culturally sustaining pedagogy reaches even further by working to promote and sustain aspects of a student's culture that might be stifled in the midst of other dominant cultures. STEM educators can play a role in sustaining the cultural wealth of communities of color and linguistic diversity. We encourage STEM educators to adapt a critical theory perspective to family engagement: They must acknowledge the possible rift between families and schools within the current system and be open to hearing from families how to restore families' epistemic content knowledge (Booker & Goldman, 2016). Ishimaru et al. (2015) argue that STEM educators need to learn directly from family perspectives on both how the current system has failed to engage them as well as how mathematics (and STEM as an integrated discipline) are routine aspects of their daily and cultural practices. Culturally sensitive and contextually rich teaching strategies are dependent upon strong family-school relationships. Family engagement strategies must be responsive to cultural and community backgrounds (Grant & Ray, 2019).

The importance of family involvement in children's learning has received increased focus from a growing number of professional organizations focused on STEM or language acquisition (i.e., National Association for the Education of Young Children, n.d.; National Academies of Sciences, Engineering, and Medicine, 2018; WIDA 2017). Table 1 shows STEM learning shares many commonalities with both English language learning and learning with families.

Organizing family engagement initiatives is intimidating for many teachers and may seem especially overwhelming for STEM educators who frequently have received limited training in family engagement (Zollman et al., 2020). We believe that all STEM teachers—and their students—can benefit greatly from knowing some basic information about engaging the families of emergent multilingual students.

What STEM Teachers Need to Know

Culturally-sensitive and contextually-rich STEM teaching strategies are dependent upon strong family-school relationships, and family engagement strategies must be responsive to cultural and community backgrounds (Grant & Ray, 2019). The following are suggestions of what STEM teachers need to know about engaging the families of emergent multilingual students in order to facilitate learning for all students.

Cultural Understandings of School and Family Roles in Education Vary

When working with students and families from linguistically diverse backgrounds, STEM educators first need to know that family engagement varies across cultural contexts and that parents from different cultural backgrounds may have divergent expectations about their roles in

children's formal schooling (Georgis et al., 2014; Huntsinger & Jose, 2009). For example, in some cultures it is common to confer a great deal of respect on teachers as the source of all knowledge. Families from these cultural contexts may not be accustomed to being invited to collaborate in educational endeavors (Goldsmith & Kurpius, 2018). Some schooling systems rely more on learning through rote memorization rather than inquiry-based or project-based approaches. Some schooling systems promote competition more than collaboration. Although we offer up these examples here, we caution against generalizations that suggest parents from particular backgrounds will share an assigned set of expectations, because culture is dynamic and families each have specific histories and experiences (Poza, Cantu, & Tedrake, 2014).

Table 1
Examples of Connections Among STEM, ELL, and Family Learning Opportunities

Opportunities for STEM Learning	Opportunities for English Language Learning	Opportunities for Learning with Families
Multiple opportunities to hear and use language to express STEM understandings	Multiple opportunities to hear and use both social and academic English	Multiple opportunities to hear, use, and value home languages for academic purpose
Rich contexts to help illustrate STEM concepts, and the opportunity to engage and contribute to the classroom STEM learning community	Rich contexts to help language comprehension, and the opportunity to engage and contribute to the interactive learning community	Authentic contexts for multilingual learning and communication between home and school
Appropriate supports for STEM concepts — e.g., hands-on student engagement, multiple representations, scaffolding strategies for STEM - specific vocabulary	Instructional supports for written and spoken language — e.g., intentional student grouping, multiple representations, scaffolding strategies for different tiers of English vocabulary	Supporting connections between school and community knowledge and ways of knowing — e.g., inviting parents and community members to share how they use STEM concepts to solve problems or in their everyday or professional lives
Promoting inquiry and ideas over concern for precise discipline-specific terminology	Promoting authentic communication over concern for perceived standard academic English	Promoting authentic communication and collaborative exploration e.g., encouraging risk-taking, problem-solving, and cooperation rather than competing to finding "the right answer"

Note. Adapted from Hoffman & Zollman (2016); adapted from Riley & Figgins (2015)

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An example of common generalizations is the assumption that parents from Asian backgrounds value STEM achievement but that families from Latin American backgrounds tend to know little about STEM and are more likely to value fields such as musical achievement. This stereotype is not supported by research (Gonzales & Gabel, 2017). In our own research on multilingual family engagement with STEM, event attendance, survey responses, and administrator feedback all indicate that multilingual parents from a range of cultural backgrounds see a need for strong STEM education and are interested and engaged in supporting their children's learning.

Families are Equitable Partners and Experts in the Educating of Their Children

One common response to such cultural differences is to acculturate parents to school expectations. This approach can be unintentionally alienating to families by belittling their cultural values and assigning value instead to a narrow set of school expectations. Families who are not part of the socially dominant U.S. culture may have different types of cultural capital that is not valued in U.S. schools, and educators can unwittingly pressure families to gain the types of cultural capital valued by dominant U.S. society. Pressure to assimilate to (often White, middle class, English-only) norms and to teach their children particular forms of cultural capital can make parents feel unwelcome in schools (Gonzales & Gabel, 2017). We urge STEM educators to avoid the common pitfall of building family engagement efforts from a "deficit ideology" that focuses on individual student shortcomings rather than recognizing the systemic inequities the students face (Hoffman, 2014; Valencia, 2010; Gorski, 2008). Such approaches to family involvement, that are still prevalent in many schools and communities, attempt to "improve" parents in order to "save" their children from the shortcomings of their local community (Flores, 2007). Additionally, deficit ideology is reflected in assumptions that all parents' school involvement should mirror the preferences of dominant middle class families (Brantlinger, 2003) and that family engagement necessitates parents be physically present at school events and able to help children keep up with their schoolwork by providing technology and extra resources (Hoffman, 2014). For example, we have previously experienced family engagement attempts that assumed most parents could attend events at particular times of the day, necessitated purchasing materials from a book fair, or consisted only of prescriptive programming such as instructing parents how to help their children with mathematics at home.

What is the alternative? In contrast to a deficit ideology, a culturally sustaining approach to family engagement positions families as "equitable partners" and "fellow experts in the teaching

and learning of their children" (Ishimaru et al., 2015, p. 4). For linguistically diverse families especially, educators particularly must support students "in sustaining the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competence" (Paris, 2012, p. 95). This culturally sustaining approach to family engagement focuses on "how families might collaborate with educators to build more empowered and holistic disciplinary identities across students' home, school, and community learning contexts" (Ishimaru et al., 2015, p. 2). Such practices necessarily recognize and seek to develop family engagement in STEM learning. These partnerships open the door to respectful and collaborative family STEM engagement.

What STEM Teachers Need to Do

STEM educators should value and form relationships with family and community partners whose STEM experiences are both relevant to their children's learning and valued by the school. Although parents (from a variety of backgrounds) may believe that they have a passive role supporting their students' STEM development, STEM learning (and all learning) is most effective when it occurs within a partnership between engaged families and the school (Weyer, 2018). Culturally sustaining practices invite family members to view themselves as valued collaborators in teaching their children.

Engage Parents as Allies in Promoting "STEM Mindset"

Comprehensive STEM education includes content area knowledge, STEM literacy skills, (Zollman, 2012), and "STEM mindset." These three aspects of STEM education mirror key aspects of teacher education: knowledge, skills, and dispositions (Danielson, 2007; Council for the Accreditation of Educator Preparation [CAEP], 2019). We consider a STEM mindset as a cognitive perspective focused on the value of inquiry, problem-posing, questioning, and risk-taking. STEM mindset includes the dispositions required for successful inquiry-based approaches to STEM education as well as the value of welcoming failure as a natural part of learning and development (Boaler, 2015). For example, STEM educators can focus on the importance of risk-taking rather than right answers to relieve STEM anxiety. As one administrator noted from our work, "If the families can get on board with STEM activities and the mindset, then the kids will be more willing to try" (Zollman et al., 2020; p. 22).

Assure Parents that STEM Expertise is not a Prerequisite for Partnerships

Given parents' differing exposure to STEM, an important task for STEM educators is to convey to parents that they do not need to be content or language experts in order to be equitable partners in their students' STEM learning. Parents do not need to (re)learn all the content that their children will learn in order to support their children's STEM development. Similarly, parents do not need proficiency in English in order to support student learning. Instead, STEM educators can encourage family members to view themselves as partners in encouraging students' questioning and discovery—in whatever culturally appropriate form that takes. STEM educators can communicate to families the value of fostering a shared understanding of STEM learning as a form of inquiry rather than simply a set of prescriptive knowledge or skills. For example, parents can model problem-posing and sense-making in STEM environments (Weiland, 2015) or communicate the value of STEM understanding in civic education.

Cast a Broad Vision for Students' STEM Potential

Considering the increase in STEM discipline careers, STEM teachers can provide families with information about STEM as an area of study, including applications in lesser-known careers that involve "STEM mindset" and skills. By actively modeling a broader view of STEM and dispelling stereotypes of computer geeks and lab coats, STEM educators can help parents understand the importance of providing students with a strong STEM foundation for later discipline-specific learning in both the traditional fields of science, technology, engineering, or mathematics as well as areas such as finance and entrepreneurship.

A STEM-Based Engagement Activity with Multilingual Families

Family STEM engagement promotes active learning and can serve challenging curriculum, multiple learning approaches, and an inclusive school environment (Suh, Hoffman, Hughes, & Zollman, 2020). We recommend four STEM-based family engagement considerations for building from families' linguistic and cultural funds of knowledge. We frame these recommendations in an experience that represents one possible approach to a family engagement event. This was an evening "Family STEM Night" event hosted at three elementary schools with high numbers of multilingual families. Although we recognize that "family engagement nights" may not reflect the most current forms of family engagement presented in the literature (Baker et al., 2016; Mahmood, 2020), these events are typical in the areas where we work. Such engagement events are one of many ways to honor existing community STEM knowledge and support English language development while simultaneously encouraging students' academic language, conceptual understanding, and meaningful skills.

Center the Event in Existing Community Relationships

Relationships with students are keys to learning families' "funds of knowledge" and finding natural community partners (Moll et al., 1992; Rios-Aguilar et al., 2011). For instance, your community may be home to a particular industry and therefore you may have access to STEM professionals from that field. Keep in mind also that community resources can be outside of commonly "aspirational" STEM fields such as engineering or medicine. For example, a parent working in supply chain or logistics can explain the mathematical calculations involved with determining how far and how much freight can be carried to maximize profit. Sharing such knowledge could inspire an open-ended STEM challenge activity where groups have to move an object from one area of the room to another given specified limitations. In our previous events, university educators served as guest facilitators, but ideally such events could be hosted "in house" by local teachers and community members in order to capitalize on existing family relationships, cultural knowledge, and community partnerships.

Choose a High-Interest, Integrated STEM Exploration Activity

Effective STEM exploration activities for family engagement are ones which encourage hands-on problem-solving but which do not end in one "correct answer." Instead, these activities focus on the process of exploring STEM concepts. Furthermore, an open-ended activity removes some pressure for participants and attempts to avoid "teaching parents." Because these family engagement events occur outside of the regular academic day, they can more easily apply an integrated approach to STEM learning than what may fit into a traditional school schedule. Although students receive instruction in both mathematics and science as a part of their general curriculum, many students have few opportunities to engage in interdisciplinary STEM learning.

In one study, we found that teachers showed interest in interdisciplinary STEM education, but few ventured outside of separate discrete mathematics and science time to plan or implement interdisciplinary STEM learning activities (Zollman, 2012). Nevertheless, teachers and administrators were interested in increasing students' exposure to STEM and recognized family interest in STEM learning (Zollman et al., 2020).

Make the Activity Hands-On and Challenging

A STEM activity we often used is a variation of the "marshmallow challenge." We outlined minimal rules and prompted participants to determine what questions to ask within their groups as to what they were to accomplish. The marshmallow challenge has participants receive 20 pieces of spaghetti, 1 meter of masking tape, 1 meter of string, and 1 regular-size marshmallow. The expectation is to build the tallest freestanding tower out of the spaghetti, masking tape, and string, with a marshmallow on top. Regardless of which activity is used for such an event, we would recommend choosing an activity with a kinesthetic component that invites participants to stand but does not require a great deal of physical movement so that participants of multiple ages and abilities can participate successfully.

As families enter we suggest assigning parents to sit with other parents and students to sit with other students. Similarly, school administrators are assigned to sit as a separate group as are the teachers. We made this choice deliberately as some parents defer to teachers and especially school administrators if they are put in the same group. Each group receives a packet of the same materials.

We found students, in particular, enjoy "competing" with the adult groups. The parents enjoyed working separately from their children. Putting parents in an adults-only group removed the pressure or tendency for the parents to spend time directing or redirecting their children. When placed at a table with other parents, the adults seemed less self-conscious about making mistakes and more likely to laugh with their group members. (Incidentally, in each of the three schools where we did this particular challenge, the student groups outperformed the adult groups.) While we have interpreters on site, we deliberately grouped parents to mix language backgrounds to model that STEM learning can be accomplished with limited verbal communication.

Focus on STEM as Inquiry...for *All* Participants

While facilitating we used a language of inquiry and growth mindset instead of our traditional language of instruction and content delivery. Positioning family members as learners with their students also removes incorrect assumptions that parents need to be English language or content experts in order to support their students' STEM learning. Letting family members be learners as well creates a space for everyone to be silly, make—and learn from—mistakes, and engage in hands-on exploration. Furthermore, it allows adults to participate in STEM inquiry activities themselves without having to be a parent, e.g., to focusing on guiding their child to the "right answer."

After the hands-on activity, we suggest all participants join a large-group reflection discussion to talk about what science, technology, engineering, and mathematics are and are not. For example, solving a real-world problem, such as using geometry to build a tower, connects mathematics to science and to engineering. However, timed basic-fact tests—one activity of a traditional

mathematics class that commonly causes anxiety among students—is not an end mathematics goal. Application of the mathematics is a goal.

As a "takeaways" from such our STEM event we included a bilingual handout with advice for reducing STEM anxiety and supporting a growth mindset for learning (see Appendix A). In our own experience, parents expressed appreciation for such take-home reminders of the event in their anonymous surveys.

Our post-event surveys reported parents and guardians seeing STEM education as more hands-on, enjoyable, and problem-based than expected. For example, one parent reported, "I think my children have viewed it differently because I think they view it funner." Additional parent feedback included mentioning that the learning process was as important as the "answer." Parents also valued communicating in a team, allowing mistakes, and persevering as important aspects of learning STEM (Zollman et al., 2020).

Welcome All Forms of Language

As families and students undertook the cooperative STEM task, we encouraged communication within groups. We assured families that they can complete this activity in any language. We accepted non-technical language or emergent English for concept development. Most importantly, we engaged with the groups to answer questions or offer encouragement. Families appreciated when teachers and administrators circulated around the room during the challenge, particularly when the educators introduced themselves to parents and greeted students by name.

Some of our family engagement events concluded with a brief introduction of age-appropriate technical STEM language corresponding to the activities the families just completed. This debriefing provided an explicit connection between social and academic language and supported students' English development. We recommend such debriefing be relatively brief. Remember that family STEM engagement activities are intended to be collaborative and engaging. Technical lectures would be counterproductive to this goal.

Family nights held at a school may not be new or innovative—indeed, family engagement literature offers many other, newer models—yet the parents who participated in the multilingual STEM events reported the types of activities as new and interesting. No parents in our surveys reported having previous experience in school-based learning that involves communication, problem solving, perseverance, or modelling**.** They liked the various role models for the students in the room, in terms of gender and ethnic diversity of presenters. Finally, they enjoyed being able to participate fully even as adults. Our STEM activity presented adults with a non-standard problem that they could tackle. Rather than interpreting procedures or focusing on word walls, parents—and their children—could directly and immediately engage with real-world STEM content through hands-on activities.

Discussion

In this article, we presented suggestions for STEM educators to partner with families of emergent multilingual students through family engagement events. Our suggestions are not meant to be interpreted prescriptively, neither do we claim to have presented an exhaustive introduction to the critical pedagogies informing our recommendations. In the future, we hope to develop a sustained partnership with the schools to collaborate on future STEM family engagement activities. Ideally, STEM educators who already have established relationships with their students'

families build off of existing partnerships. Educators welcome families into seeing STEM education as hands-on learning involving making, learning from mistakes, while simultaneously supporting students' acquisition of academic vocabulary.

Closing Thoughts

As teacher-educators, we have observed how important "intangibles" such as family engagement for emergent multilingual students are often overlooked in teacher education and professional development. We encourage teachers and parents to practice a STEM mindset, avoiding the pitfalls of reductionist thinking about the content or deficit stereotypes of families. STEM educators can expand the whole family's understanding of STEM as an integrated field of inquiry rather than standalone subjects that are composed of procedures and memorized vocabulary. Moreover, STEM educators can reconceptualize family involvement in students' STEM learning to recognize the relevance of family's linguistic resources and the possibilities of school-family partnerships in linguistically diverse communities.

All students benefit from strengthening the connections between home and school—this is particularly true for those whose families do not share a cultural and linguistic background with the school. We know that students achieve more and are more engaged when educators value students' home language and community ways of knowing. We also know that concrete examples, such as the activity from a family engagement night, give context to an integrated approach to STEM learning based in hands-on inquiry rather than technical disciplinary language. This approach to STEM helps not only linguistically diverse STEM students but all STEM students—using family engagement to learn is good for all (Zollman et al, 2020).

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Appendix A: Supporting a STEM Mindset Handout

Supporting a STEM Learning Mindset at Home

***"STEM" = S**cience, **T**echnology, **E**ngineering, and **M**athematics*

TRY: Encourage children to play with puzzles, build with blocks, and play strategy games.
WHY: Problem-solving play helps children develop a STEM mindset.

TRY: Praise children when they show a desire to solve challenging problems, when they try something difficult, and when they try again after failing.
WHY: Curiosity is the key to a strong STEM mindset. Persistence results in achievement. Productive struggle with difficult tasks is enjoyable.

TRY: Encourage children to use any language to talk about STEM ideas.
WHY: Learning is a process, not a product. Children are learning STEM in whatever language they speak – even when they don't know technical vocabulary.

TRY: Avoid sharing negative mathematics or science experiences from your own childhood.
WHY: Research has shown that children's achievement can be negatively affected when they hear parents say they are "bad at math" or "hated science." Instead, say something encouraging: "That might be hard sometimes. But it will feel good to accomplish it!"

TRY: When children get a wrong answer in STEM schoolwork, find the logic in their thinking. For example, "I can see why you thought 3 times 4 equals 7. Let's use beans to look at it in a different way."
WHY: Children hear encouragement of their logical thinking instead of discouragement for not reaching the right answer on the first try. We don't want children to be afraid of mistakes. We want to teach them that mistakes are learning opportunities!

TRY: Don't worry about speed in solving problems.
WHY: Forcing children to work quickly can cause anxiety. Children can build a stronger STEM mindset without pressure to work quickly or solve problems in their head.

TRY: Look for STEM all around us.
WHY: Children learn science and math skills from baking, gardening, auto maintenance, nature walks, and other daily experiences. Children develop their STEM mindset when families talk positively about science, technology, engineering, and math in daily life.

Note: Adapted from Zollman, Hoffman, & Suh (2020); Adapted from Boaler (2008).

Ayudando al Aprendizaje de STEM en el Hogar

¨STEM¨ = Ciencia, Tecnología, Ingeniería, y Matemáticas

PRUEBA: Animen a los niños a jugar con rompecabezas, a construir con bloques, y a elegir juegos de estrategia.
PORQUÉ: Juegos que resuelven problemas ayudan a desarrollar una actitud de STEM.

PRUEBA: Alabar a los niños cuando demuestran un deseo de resolver problemas, cuando intentan algo difícil y cuándo vuelven a intentar algo después de fallar.
PORQUÉ: La curiosidad es la clave para una mentalidad para STEM. La persistencia resulta en exits. La lucha productiva con una tarea difícil es agradable.

PRUEBA: Animar a los niños a usar cualquier idioma para tratar de ideas de STEM.
PORQUÉ: El aprender es un proceso, no un producto. Se aprende STEM en cualquier idioma, aun cuando no conocen el vocabulario técnico.

PRUEBA: Evite compartir experiencias negativas de vuestra propia niñez.
PORQUÉ: Hay prueba que el éxito de los estudiantes puede ser afectado negativamente Cuando oyen que los padres fallan en ciencia o en matemática. Es mejor decir algo alentador cómo: Quizá parece difícil ahora pero cuando lo logras te sentirás bien!

PRUEBA: Cuando los niños se equivocan en el trabajo escolar, busca su lógica. Por ejemplo ¨Veo porque pensabas que 3 por 4 igualaban a 7. Vamos a volver a verlo.¨
PORQUÉ: Los niños oyen el animo por su lógica de en vez del desaliento por no llegar a la respuesta correcta la primera vez. No queremos que los niños temen a los errores. Queremos enseñarles qué los errores son oportunidades de aprendizaje.

PRUEBA: No se preocupe por la rapidez en resolviendo problemas.
PORQUÉ: Forzando el trabajo rápido puede causar ansiedad. Se puede construir una mentalidad de STEM sin presión por resolver problemas rápidamente o en la cabeza.

PRUEBA: Busca a STEM a nuestro alrededor.
PORQUÉ: Los niños aprenden aptitudes de la ciencia y la matemática con la jardinería, el mantenimiento automóvil, el paseo de la naturaleza y otras experiencias diarias.

Note: Adapted from Zollman, Hoffman, & Suh (2020); Adapted from Boaler (2008).