International Journal of the Whole Child
2022, VOL. 7, NO. 2

STEAM
STEAM Education and the Whole Child: Examining Policy and Barriers

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Abstract

Whole Child education nurtures five tenets of the child to ensure they are healthy, safe, engaged, supported, and challenged during their time at school. STEAM programs coincide with the Whole Child approach as it allows them to expand their critical thinking and problem-solving skills, build their social-emotional needs, and be prepared for the 21st century workforce. STEAM programs are designed to emphasize inquiry and an interdisciplinary approach that reflects the tenets of the Whole Child paradigm. Much of the research that has been done in STEAM and Whole Child education pushes for further implementation of high-quality programs in schools so students can learn in a way that best fits their needs. However, there are many barriers and funding issues that preclude schools from the full implementation of high-quality, Whole Child STEAM programs that foster equity and accessibility especially for marginalized populations. These barriers and suggestions for overcoming them are discussed through a policy lens so curriculum can be flexible and more interdisciplinary and so that students have multiple opportunities to be nurtured in their creativity.

Keywords: STEAM, STEM, play, inquiry, policy, whole child

Introduction

STEAM programs have taken off in the past few years and have gained popularity due to the cross-curricular nature and hands-on experiences provided to students. In return, students are learning 21st century skills that are equipping and preparing them for the future, which would include increased engagement and employment in STEM fields. Students' passions and interests

can be fostered when they are meaningfully engaged in STEAM education, and elements of the Whole Child are nurtured if the implementation of STEAM instruction is of high-quality. Numerous benefits arise when students can actively explore their own interests rather than passively receiving content that is required through a narrow, isolated, discrete and non-contextualized curriculum. Skills include problem solving, empathy, critical thinking, persistence, and confidence. Teachers can become a facilitator and guide students in their learning. When these traits are woven together with content areas and learning is situated "within a context that is authentic to student questions" (Schumacher, 1995, p. 76), students will build on their competencies and skills.

The purpose of this work is to explore Whole Child STEAM programs through a policy lens and to expose any barriers that prevent STEAM education from being used to its fullest extent in schools. Furthermore, practical strategies are provided to promote high-quality STEAM education that can be implemented with confidence due to the numerous benefits it provides to children. Policymakers and educators see the importance of STEAM education, especially as it relates to elements of the Whole Child, but state and federal funding barriers often preclude schools from adopting these types of programs. Substantial evidence from the literature supports the many, and varied benefits that children develop through meaningful STEAM engagement, but the path to accessibility and training teachers is paramount so all children regardless of socio-economic status can have the opportunity to participate in an inquiry-based environment.

Relevant Background and Literature

STEAM (Science, Technology, Engineering, Art, and Math) evolved from the STEM framework which has similar benefits and continues to increase in its usage across the United States. STEAM education was created so students could meet the needs of a 21st century economy and skillset after graduation (STE(A)M Truck, 2020). Despite quality STEAM program development, the traditional education system is lagging and has not evolved for the better over many decades even with educators and policymakers advocating for reform efforts to better serve students. This is especially true for students of color who have been historically underrepresented in STEAM fields and have not had the same access as their white counterparts in schools across the country.

The research literature clearly provides evidence for the importance of STEAM education and its various benefits. When students are exposed to STEAM from an early age, they are more likely to enter a STEAM field during college (STE(A)M Truck, 2020). STEAM allows for integration "in multiple disciplines in ways that preserve their individual integrity" (Dell'Erba, 2019, p. 2). Through an interdisciplinary approach, teachers can allow students to explore and inquire while still meeting learning goals and state standards. In a study where literacy and math were integrated, the results showed a positive impact on cognitive development with an increase in skills in both subject areas (The Institute for Arts Integration and STEAM, 2022). Students can reflect meaningfully on collaborating with their peers and the work produced which simultaneously requires them to reflect "through new experiences and perspectives" (Dell'Erba, 2019, p. 2).

Children's critical thinking and problem-solving skills increase dramatically through meaningful, integrated STEAM programs. Students are afforded the opportunities to be able to see different viewpoints, think divergently, and relate their learning to real-world contexts. In other words, STEAM programs improve students' abilities to innovate, think and operate independently, and connect their knowledge through daily activities (Widya, 2019, p. 1). STEAM programs also foster problem-solving when students utilize the scientific or engineering design process. Furthermore, students use their critical thinking and problem-solving skills to prioritize tasks and demonstrate understanding through various means. Creativity also increases and knowledge is gained through real-world situations when students apply problem-solving skills when there are multiple solutions. STEAM education also expands on skills students already have such as social-emotional learning (SEL). Students collaborate and are able to build empathy, motivation, engagement, perseverance, and regulate emotions. This all helps students adjust their emotions in relation to others' actions and feelings (Dell'Erba, 2019, p. 2) which are needed for 21st century workplaces.

All these STEAM skills are built through high-quality instruction and planning that is authentic and relevant to students. Students are the ones who are identifying the problems that will "occur at the natural intersections between the arts and STEM fields" (Dell'Erba, 2019, p. 2). Through this, the National Art Education Association (2022) asserts in their position statement that "STEAM education encourages creativity and innovation and problem-solving" (2022). The STEAM framework was based on the premise of preparing children for the job market and to close the gender gap even between ethnic groups. It is apparent that STEAM education benefits the child for years to come, but the paucity of implementation in schools due to barriers and funding demonstrates that these benefits to the Whole Child are severely lacking.

STEAM History

STEM education was introduced to place a greater emphasis on math and science education in the United States in the 1980s (Breiner et al., 2012, p. 4). After *A Nation at Risk* was released, the American Association for the Advancement of Science intended to help students become more literate in math, science, and technology. More programs proceeded, but in 2001 the National Science Foundation (NSF) created SMET which eventually changed names to STEM. The nation adopted this program at various levels as it became a "focus for educational reform and renewed global competitiveness for the United States" (Breiner et al., 2012, p. 4). The focus of STEM was to draw attention to the respective fields and to retain people working in those fields to continue research and innovation for the 21st century. STEM jobs will continue to play a crucial role in helping the economy grow and be competitive with other industries in the future (STE(A)M Truck, 2020).

When *Race to the Top* was introduced in 2011, more federal funds were invested into STEM education as the government was increasing accountability efforts for schools to invest in helping students achieve 21st century skills. Four years later in 2015, the Every Student Succeeds Act (ESSA) was signed by President Obama so educators could "create hands-on learning experiences with a focus on higher-order thinking skills" (Chandler, 2018, p. 21). This new direction was to establish a well-rounded educational experience for students. STEAM began earlier in 2006 as the brainchild of Georgette Yakman (Flocchini, 2022), but it began

increasing in popularity through the mid 2000s and leading up to the passing of ESSA. An arts integration in the program allows educators to help students be creative and see connections across discipline areas through hands-on experiences. The arts can include music, dance, drama, and visual art. Some would also argue that the arts include the humanities as well, which could provide real-world contexts for STEM explorations. Arts education enhances a child's learning and not only makes learning more enjoyable, but their engagement is higher.

STEAM education is implemented through an interdisciplinary approach so that subjects are no longer taught in isolation and connections can be made. High quality programs can improve educational outcomes for students and prepare them for their future in a workplace that requires 21st century skills (STE(A)M Truck, 2020). Students with STEAM experience will have better preparedness once they graduate high school and will have many opportunities to apply their knowledge in higher education and through their career.

STEAM Benefits on the Whole Child

STEAM education has numerous benefits on Whole Child education; however, the current educational system doesn't recognize nor prioritize the importance these connections have on child development. Whole Child education places a child's developmental needs at the forefront so that "every child reaches their fullest potential" (Learning Policy Institute, 2022) in and outside of school by deepening their educational experiences. Additionally, it is important to keep in mind that when students are engaged in STEAM education, it is the job of the educator to ensure that they "design thinking as a means for individual learning, social responsibility, and creative problem solving" (Rolling, 2016, p. 4) so that students can utilize their critical thinking and problem-solving skills while taking initiative in their learning when engaged with an engineering design process.

The Association of Supervision and Curriculum Development (ASCD, 2022) has five tenets that reflect the Whole Child approach to promote development in all children, including: healthiness, safety, engagement, support, and ensuring that children are challenged. Each of these tenets will be analyzed in how it best supports STEAM education in the Whole Child.

Healthy

ASCD (2022) defines *healthy* as students going to school each day healthy and learning how to live healthy lifestyles. At first glance, it may appear that STEAM education does not tie directly to this tenet. However, both physical and mental health can be interwoven with the STEAM framework. Perhaps students could undertake scientific investigations into health-related issues that directly benefit them. Furthermore, children need social-emotional support and opportunities for healthy development. Providing STEAM education in a Whole Child approach in conjunction with social-emotional learning (SEL) has significant value for students. Since STEAM utilizes an active approach, teachers can aid students by building SEL into their STEAM experiences. These may include collaboration, reworking problem-solving approaches, and managing processes (Larmand, 2022). Additionally, teachers can "promote students developing character traits" as students are developing empathy and building relationships with peers (Larmand, 2022) while learning how to be effective communicators.

STEAM education also links to promoting a growth mindset in children, which is "based on the belief that your basic qualities are things you can cultivate through your efforts" (Dweck, 2021). This approach is also taught to children as "The Power of YET!" which teaches children that "you're on a learning curve" (Dweck, 2021). By adding the word 'yet,' it gives children more confidence and shows them how to persevere through difficult tasks while simultaneously shifting their mindset. When children participate in STEAM, they are pushed outside of their comfort zone and will become resilient when positive praise is used. Children are also taught soft skills such as the importance of failure in the process of learning and how to try again, which can cause a shift in their mindset and abilities. Self-confidence is another important trait that can be taught through STEAM education and is applicable in any curricular environment while setting students up for success. The experiences children are given in STEAM build upon and enhance their SEL while simultaneously caring for their mental health.

Safe

ASCD (2022) explains *safe* as students who are physically and emotionally ready to learn in a safe environment. Most of the characteristics of this tenet from the Whole Child approach also apply to the tenet of being healthy. In a STEAM classroom, it is imperative that children feel safe not only physically, but also emotionally and mentally. STEAM is designed in a way that children will encounter mistakes and make errors that require them to try again. Even the "perfect" child will fear failure, but it is the job of the teacher to create a space for children to practice trial and error; otherwise, they may "not take the academic risks necessary for lifelong learning" (Aglio et al., 2019). A STEAM classroom allows for students to experience failure as a part of the learning process, but also allows them to take risks in a safe environment. Furthermore, STEAM programs can and should adjust for the child's individual learning needs based on what the child is experiencing in an inquiry-based environment.

STEAM allows different groups of students to be able to work together across various skill levels which brings out their individual strengths and "challeng[es] them in a non-threatening environment to meet higher levels of critical thinking" (Overby, 2011, p. 109). This helps students feel safe to make mistakes and trust their peers in the inquiry process if they are collaborating in a group. When student collaboration takes place, it "emphasizes students' self-governance of their interactions" and helps "articulate their ideas and engage in a disciplined social process of inquiry" (Pederson & Liu, 2003, p. 59), which aligns with the Whole Child and constructivist approaches to education. Lastly, as teachers build relationships with students, they are also building trust which will allow students to feel more comfortable talking to their teacher about anything. By providing a safe and welcoming learning environment that is student-centered, students will thrive in their learning.

Engaged

ASCD (2022) defines the third tenant, *engaged*, as actively learning, and connecting that learning to the school and the greater community. "Traditional" educational systems have operated by forcing students to passively receive information using worksheets, lectures, and assessments which correspond with lower engagement. According to Bloom's taxonomy, this

would be considered a lower level of thinking that requires students to regurgitate their often-memorized knowledge. Conversely, STEAM education allows for authentic engagement as students can develop their own perspectives and views while being supported in them (The Institute for Arts, 2022).

To create a learner-centered, engaging learning environment, teachers need to create a curriculum that is integrated across subject areas and disciplines. However, this curriculum needs to be thoughtfully constructed while utilizing student questions and interests. It must also be relevant to today's world. The Institute for Arts Integration and STEAM (2022) suggests that when students are engaged in STEAM learning in an authentic manner, "students must be allotted the opportunity to demonstrate knowledge in a variety of ways," which will help them utilize higher order thinking skills on Bloom's taxonomy as well. Students can be more engaged in STEAM programs through a variety of products or materials, allowing diverse perspectives, role-playing, and creating games or competitions (The Institute for Arts Integration and STEAM, 2022). When students have autonomy over their learning and can follow their interests, not only are they more engaged, but they are also asked to "think and learn on their own" while also "link[ing]… content with real life" (Hong, 2017, p. 96).

STEAM education also expands students' views to encompass current problems and may encourage them to take action to find a resolution. This in turn, "invites students to seek deeper learning by connecting students and their lives to local communities and communities around the world through educational experiences in the sciences and arts" (Chandler, 2018, p. 24). This will help children become problem solvers and critical thinkers at an early age while providing them with a drive to learn, and it will help them create relationships with community members.

Supported

The fifth tenant of ASCD (2022) acts to ensure children feel *supported* and can access their own learning through adults who are caring and qualified. This tenant includes crossover with other tenants including a child feeling safe and engaged in their learning.

Since STEAM education is inquiry-based and child-centered, it is imperative the child feels supported in their learning through the personalized curriculum that is implemented by teachers. For this to be successful, STEAM education must move "the teacher from the center of learning to the role of facilitator" (Chandler, 2018, p. 25). When the learning environment is student-centered, the teacher can deepen student knowledge through inquiry solely from the child's interests and experiences. The teacher can then guide the student in exploring the current topic(s) further and finding similar ones as well. Whether STEAM education takes place through free play or during a more structured time, it promotes and builds social-emotional learning skills. During free play time, a child will make discoveries that will prompt further investigations and/or find relationships between topics (Teacher Time, 2022).

However, it is essential that teachers help students understand what they are learning by scaffolding content. By doing so, a child will feel safe to make mistakes in their learning but also realize the teacher is there to help guide them. When teachers prompt children in their learning and ask questions, model, or give examples, they are helping children "develop their own

understanding of the world," and are helping "walk [them] through increasingly complex ways of thinking" (Teacher Time, 2022). Teachers help children reinforce previously held knowledge and correct any misconceptions they may have which lets students learn more than they would on their own. Scaffolding can also include individualizing instruction, materials, defining vocabulary, or reducing the number of steps in a task so all children can participate at their level.

Challenged

The last tenant of ASCD (2022) is for a child to be *challenged* academically so they are prepared for a future career and are also able to apply critical thinking skills. STEAM education provides students with the opportunity to demonstrate their understanding of a topic in various ways rather than sitting down for a traditional paper and pencil assessment. Some of these assessments include observations, projects, presentations, reflections and more. Assessments such as these "enable students to demonstrate their knowledge and skills in ways that are authentic, meaningful, and appropriately challenging" (Chandler, 2018, p. 26). Again, students will feel challenged as they make connections to solve real world problems when they are engaged and feel supported in their learning.

Not only are students challenged in demonstrating their knowledge, but STEAM education also prepares students for 21st century skills. STEAM education helps children build their skills in technology and media, literacy, productivity, flexibility, social skills, and communication (National Inventors, 2022). Skills such as these "are transferable to other real-life contexts, such as post-secondary education and the workforce" (Bertrand and Namukasa, 2020, pg. 46). Students can take the skills they learned in one grade level and apply it to the next grade or in another context. STEAM also prepares students for careers in science, technology, engineering, arts, or math. Teachers must recognize the importance and benefits that STEAM education provides. These benefits would include students' learned skills that can be applied to real-life situations since "learning is best conceived as a process" (Bertrand and Namukasa, 2020, p. 54).

Policy Barriers & Practical Solutions to STEAM

STEAM education aligns with the Whole Child approach as it provides students with numerous benefits and skills. Policymakers have pushed for STEAM to be implemented in education due to its importance. However, schools must overcome challenges to implementing high quality STEAM programs including a lack of funding and prohibitive local and state policies. Three major barriers to incorporating STEAM education and to making learning more student-centered are described below.

Funding STEAM Programs

STEAM programs are now funded through the Every Student Succeeds Act of 2015. The language in this law was reworded to include the arts and music and not just the core subject areas. This ensures funding is "used to support educational opportunities through a variety of subjects" (The Institute for Arts Integration and STEAM, 2022). Funding for art and music education comes under Title I, II, and IV as well as grants. The bill also includes programs such as the Assistance for Arts Education which provides funding for disadvantaged students as well

as professional development and training for teachers. States have also provided funding for STEAM programs by either designating this in their per pupil formula or funding a certain number of positions. States have also set up grant programs to be used toward STEAM implementation. Other organizations also have grant programs available for schools and educators to apply for funding.

Despite these main funding sources, there still is not enough to go around and fully support STEAM education. Policymakers and stakeholders need to urge the states to clarify and increase funding pathways regarding the use of funds and how they can be used for STEAM activities (Dell'Erba, 2019, p. 9). This can help Title I schools expand educational opportunities for disadvantaged students and allow these students to have access to the effectiveness of STEAM programs (Success story, 2017).

Curriculum and Time Restraints

Many schools are bound to teach to the state standards as well as the curriculum that is adopted by the district. Little to no flexibility is given and teachers often find themselves teaching to a scripted curriculum and teaching to the tests. States and districts may not be fully implementing STEAM education due to the lack of clarity on how the national arts, science, and math standards can be integrated in STEAM. Additionally, there is no common assessment on STEAM education which limits or prevents schools from using instructional time in this area (Dell'Erba, 2019, p. 7). Schools also run short on time and the capacity to run STEAM programs in an effective manner. If STEAM is utilized in school, the benefits won't be reaped immediately as "STEAM skills are hard to acquire with just one experience and require ongoing exposure" (Dell'Erba, 2019, p. 7). STEAM requires teachers to collaborate and plan amongst subject areas and grade levels. Any open times that teachers must plan are usually taken by other professional development opportunities or meetings.

Key stakeholders who interact with policy need to advocate for supporting teachers and students by producing higher-quality instruction. Educational leaders will need to examine the instructional minutes set forth by the district and allot proper planning time for teachers and instructional time for students to engage in projects. Furthermore, state and school leaders can create a framework that allows for assessments and schedule adjustments to ensure there is adequate planning across content areas and grade levels (Dell'Erba, 2019, p. 8). Scripted curriculum programs also need to be analyzed to allow for more student-centered learning that aligns with students' interests and is also developmentally appropriate. If curriculum is unable to be adjusted, policymakers need to advocate for units to be aligned to real-life scenarios and include projects that can expand across other curricular areas. This will allow for students to still benefit from building problem-solving, critical thinking, and divergent thinking skills to be a global thinker.

Lack of STEAM Preparation for Teachers

Teachers often feel a need to keep up with new practices and those who have been in the field for a while may not know how beneficial STEAM is for children. With many acronyms in education, STEAM is one more to learn, but there is not a shared definition or language of what

it entails. Teachers also may not be aware of the benefits that STEAM provides to students or how to implement the program effectively through science, technology, engineering, arts, or music integration across other subject areas. Dell'Erba (2019) also discusses how a lack of STEAM implementation is more common amongst elementary educators as teacher preparation programs don't widely include arts integrated practices (p. 9). States and districts also struggle to find time to inform teachers of new content in professional development meetings which undermines student learning. This leads to teachers' feelings of self-confidence and self-efficacy dropping as teachers tend to continue teaching in their usual ways and find it hard to adopt new practices.

To better support teachers, policymakers and educational leaders will need to create time for highly effective professional development surrounding STEAM education. Implementation will need to be carried out over a long time so that teachers have the confidence to begin and continue the program on their own. Teachers will be changing their pedagogy, attitudes, and fidelity to the program when utilizing arts integration which contributes in a positive way to student outcomes (Dell'Erba, 2022, p. 6). Universities will need to examine their teacher preparation programs to include STEAM classes for preservice teachers to build the prerequisite knowledge and skills to teach STEAM. States will also need to analyze their teacher licensure requirements to require teachers to have either a STEAM certification, arts integration class, or professional development encompassing a STEAM field. By updating policies, states and districts will show their commitment to STEAM education and ensure qualified teachers are carrying out the program with the support they need.

Even with the plethora of research on the benefits of STEAM education, policymakers and educational leaders are still finding themselves pushing for change so that students are well-prepared for the 21st century. More research on STEAM education needs to be conducted so the data collected can be used to inform program evaluation and allocate more funding to STEAM in the future.

Manageable Solutions to Start

Policies at the district, state, and local level will take time before they can be changed. However, there are current solutions that teachers can implement until STEAM education becomes a priority including carrying out small scale projects in the classroom. When teachers start small with STEAM and are consistent in allowing students to explore, a grass-roots movement could allow STEAM to be more widely accepted in schools. Teachers can use materials they have in their classrooms, ask for donations from families or outside businesses or organizations, and continue to make a list of needed items during the school year. If teachers are unsure of where to start with STEAM, they can invite professionals in the field to speak to the students and provide a hands-on activity for them. Even just by using STEAM vocabulary and reading literacy books, it will help expose students to various topics (Teacher Time, 2022). One of the most positive things teachers can do is to ask students what they want to learn. From here, teachers can plan around student interests and let them take control. Engagement will increase and the teacher can fully dive into shifting their pedagogy and practice.

Conclusion

STEAM education and the Whole Child approach complement each other in promoting healthy development for the child. Both approaches advocate for developmentally appropriate practices for the child in an inquiry-based environment where curiosity and essential cognitive skills are developed through cross-curricular disciplines. Furthermore, STEAM engages with the five tenets of the Whole Child to ensure they are healthy, safe, engaged, supported, and challenged. Not only do students benefit from STEAM, but teachers also learn from them, and a trusting relationship is built between both parties. Policies and barriers may hamper schools from adopting STEAM, but the evidence is clear that students benefit greatly from exploring new possibilities in other discipline areas while using divergent thinking skills. When students are participating in STEAM education they become “wide-awake” to possibilities and problems around them, and that excitement will carry with them as they go through life (Greene, 1995).

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