STEAM and the Role of the Arts in STEM

State Education Agency Directors of Arts Education

State Education Agency Directors of Arts Education (SEADAE) supports the professional effectiveness of its individual members and provides a collective voice for leadership on issues affecting arts education in order to achieve quality, comprehensive, sequential, standards-based education in the arts for all students PreK-20. The membership consists of those persons at state education agencies whose responsibility is education in the arts (Dance, Media Arts, Music, Theatre and Visual Arts).

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STEAM and the Role of the Arts in STEM

A paper for educators, parents, and other constituents of successful student learning

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Introduction

The competencies that comprise arts learning are critical to solving the complex and ever-evolving needs facing our workforce**.** The artistic processes of creating; presenting, performing, and/or producing; responding; and connecting are not only fundamental to arts education, they are fundamental to student success across all domains. These artistic processes also increase learner empowerment, interest, and engagement; and students' ability to make connections and transfer knowledge.

The education community has established that, for our future generations to be prepared to address global challenges, they must be able to think creatively and innovatively. By effectively integrating instruction for students in the areas of Science, Technology, Engineering, the Arts, and Mathematics (STEAM)**,** educators can better help learners prepare for these challenges.

> The State Education Agency Directors of Arts Education (SEADAE) defines STEAM[1] as an intentional, collaborative pedagogy for teachers that empowers learners to engage in real-world experiences through the authentic alignment of standards, processes, and practices in science, technology, engineering, the arts, and mathematics.

STEAM education empowers and immerses students and educators in inquiry, dialogue, problem-solving, and experiential learning that deepens understanding of all fields in their educational experience. Neuroscience shows that practices used effectively in STEAM education can improve cognitive performance (Chapman and Kirkland, 2013). Studies indicate that students in arts-

integrated and STEAM classrooms tend to outperform their counterparts in both math and language arts on standardized tests (Inoa et al., 2014, p. 3). Contextualized instruction establishes a connection between content and application, allowing learners to transfer constructs situationally.

Given the constraints of the school day and the growing expectations for students' success with the evolving needs facing today's workforce, it is SEADAE's belief that STEAM content must be taught in collaboration with others to maintain educational fidelity. SEADAE has developed this whitepaper to guide future practice and instruction in STEAM. The following five areas have been identified as critical aspects for implementing STEAM education:

- Effective Pedagogy
- Learner Empowerment
- Teacher Empowerment
- Intentionality
- Growth and Innovation

Chapter 1 – Effective Pedagogy

STEAM is how the world works. STEAM education provides an opportunity to make the educational environment look, feel, and function more like the real-world by developing authentic connections between academic content and practice. With STEAM at the center of educational practice, students can learn to solve real-world problems using cross-content skills and knowledge, enabling and strengthening their creative and innovative thinking. This practice clearly recognizes a real-world role of the arts in STEAM:

- The arts share a commonality of language with all content areas, evoking a richer and more creative level of communication about the world.
- The arts bring to learning unique habits of mind[2], inspiring deeper levels of creating, producing, responding, and connecting to the resolution of real-world problems.
- The arts provide unique ways in which students learn about themselves and others, opening opportunities to identify, uncover, and discover real-world problems and their requisite solutions.

STEAM and STEM: Definitions and Distinctions

In comparison with STEM, STEAM education develops a holistic education model. STEAM and STEM education often exist as two distinct pathways[3]. STEM education is defined by Tsupros (2009) as "*an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy.*"

STEAM is often confused with arts integration. The goal of arts integration is to foster learning across the curriculum in and through the arts and tends to integrate the arts with one other subject. The John F. Kennedy Center for the Performing Arts defines arts integration as "an approach to teaching in which students construct and demonstrate their understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both" (Kennedy Center, 2008). When implemented well, the outcome of arts integration is a deeper understanding in both the arts and at least one other subject area (Dell'Erba, 2019). However, this paper is intended to address the uniqueness of STEAM and reveal the value of its broadness and genuinely holistic educational focus. STEAM can be understood as the blending of multiple subjects to enhance learning in preparation for future endeavors.

By specifically examining the impacts of STEAM education, SEADAE and its partners in the educational research community are in a position to help policymakers and practitioners understand more concretely the benefits of STEAM education and better ground STEAM policies and practices in evidence. The arts are positioned to introduce new competencies and skills, including active learning; social, emotional, and interpersonal skills; divergent thinking; and cultural competency. These skills have unique applications to school, work, and life. While STEM education can also foster these habits of mind, the arts provide an opportunity to strengthen learning and cognitive development in meaningful and intentional ways (Dell'Erba, 2019).

Effective Pedagogy

In pedagogical models defined as STEAM, instruction is grounded in clear learning standards and a significant degree of interdisciplinary and transdisciplinary engagement across the sciences,

technology, engineering, the arts, and mathematics in a manner that draws strength from cross-content intersections, yet preserves their individual integrity. The resulting approach is flexible and allows teachers to guide student exploration, inquiry, and creativity, while ensuring that students meet established learning objectives. Academic standards in all content areas need not be equally represented or share equal weight in all projects. In addition, the opportunity for including appropriate standards from all content areas should be explored as part of pedagogical preparation and evaluated when assessing student outcomes. Student learning should look like the result of an intentional curriculum in which the content areas inform one another and authentically honor and deepen each other's contributions.

In examining the relationship between educational theory and practice, it is necessary to think of the various disciplines as a feedback loop in which each simultaneously affects the other, each influencing the other for the benefit of learners. Good theory makes good practice, and good practice makes for good theory (Wilson, 1997). Furthermore, educational theory often equates the value of what is learned with its practical application and contribution to greater social purpose (Dewey, J., and Archambault, R. D., 1974). This makes the consideration of what is taught arguably as important as the why or how instructional content is delivered.

For STEAM learning to be authentic, students need to explore real-world challenges, subsequently experiencing both the processes and products of their fully-synthesized learning. In addition, those problems must occur at the natural intersections among STEAM disciplines.

STEAM pedagogy cannot be the domain of only one teacher instructing in all content areas. STEAM pedagogy requires that teachers in all content areas have a foundational understanding of

standards from all content areas and opportunities to plan and develop a group understanding of natural intersections among content areas. STEAM principles guide the creative workflow, subsequently framing the design of a STEAM curriculum that authentically aligns standards-based learning in all STEAM content areas. Instructional project design and planning require collaborative efforts from all teachers involved, which requires schools to restructure their modes of instructional delivery to provide teachers with common planning time as well as co-teaching opportunities.

The arts play an integral role in STEAM pedagogy, if authentic engagement with real-world experiences is the intentional outcome, and can be the impetus for STEAM curriculum. When the arts are authentically included in STEAM pedagogy, future-forward agenda in education like cultural relevance, social-emotional learning, workforce development, and issues yet unknown can be purposefully addressed.

Chapter 2 – Learner Empowerment

STEAM education reduces the silos of single-subject learning to create a more holistic, engaging education that empowers the learner, both immediately in the classroom and for lifelong problem-solving. Focusing on arts within STEAM elevates student interest and engagement in the classroom.

Interest and Engagement

Research reveals that student interest and engagement in the classroom is a concern for educators and administrators (Segarra, et al., 2018). Segarra (2018) goes on to state that learners who are not easily engaged by traditional separate subject instruction are often more engaged in STEAM

classrooms. Engagement in the artistic processes (creating; presenting, performing, and/or producing; responding; and connecting) naturally ignite learners' focus and dedication, encouraging learner confidence as students work to create, present/perform/produce, respond, and connect through the arts (Strauss, 2013).

The arts give learners agency through creativity, challenge, and diverse instructional strategies. As a result, they become more engaged, self-confident, and motivated about their learning experience. In addition, learners have greater self-regulation when comparing arts classes to non-arts classes (Nichols, 2015). When working in challenging arts coursework, learners have a greater feeling of self-efficacy and persistence. A STEAM classroom authentically engaged in the arts can lead to the same outcomes. STEAM learners approach difficult situations with a positive, self-confident attitude.

The benefit of STEAM (over STEM) to learner empowerment is the inclusion of a discrete set of creative processes for problem-solving. STEAM encourages learners "to be curious, experiment, and take risks—key dispositions artist habits of mind engender" (Bequette and Bequette, 2012). They are also focused and creative, using a variety of methods, as they work to find solutions to the problem (Strauss, 2013). STEAM encourages the inclusion of learner voice in their education. "Additionally, they believe they are expected to think about their own views when learning new things more in an arts class than in a non-arts class" (Nichols, 2015).

Connections and Transference

Well-designed STEAM classrooms are highly collaborative. Students work together to grasp new information, often using multiple access points to address problems. These collaborative experiences also sharpen students' communication skills and ability to work with others (Segarra, et al., 2018). The visual and performing arts give students a perspective on how others perceive, interpret, and evaluate the intention of their work. This teaches students to follow-through on ideas, defend their thoughts, and take pride in the finished product (Reilley Michaud, 2014). Through the arts, students are able to make connections with their peers, other subject areas, and the world around them. In a student reflection example provided on the National Coalition for Core Arts Standards (NCCAS) website[4], the student stated that engaging in the collaborative process "taught me to be cooperative with our partners. Also [it] taught me to back up an opinion using [information]." (National Core Arts Standards, n.d.).

Through STEAM, learners make connections more easily between content areas that were previously taught in silos. Design learning offers an opportunity for students to create, respond, reflect, connect, and produce in an interactive way. A fifth-grade student who created a visual arts product, using the Scientific Method to distinguish between dependent and independent variables, remarked, "This project helped me to better understand the terms we are using in our science class. I also liked that I was able to be creative." (Jackson Hole pARTners, n.d.).

STEAM classrooms empower students to identify and tackle real-world problems with increasing engagement, creativity, collaboration, and connections to diverse content areas. As students integrate knowledge and make connections across disciplines, STEAM instruction prepares students for

college and careers in the 21st century, while helping them be better-prepared for the challenges ahead.

Chapter 3 – Teacher Empowerment

STEAM education empowers teachers to build a strong community of learning. This learning community inherently offers an opportunity to develop holistic and comprehensive curricula that address academic standards in multiple subject areas through rigorous STEAM lessons, units, and assessments. This benefits learners and has a positive impact on teachers, as well.

Empowerment through Curriculum and Instruction

Teachers play a key role in STEAM pedagogical practice. An important consideration for instruction within a STEAM model is to ensure that all teachers have a foundational level of understanding in the multiple STEAM disciplines and that they use the processes of creating; performing, producing, and/or presenting; responding; and connecting. Effective instruction relies on a commitment by all STEAM teachers to honor process, product, and habits of mind in the arts with that of other content areas. STEAM educators have a communal responsibility to ensure that the intersections among all content areas and their standards are identified and appropriately observed in curriculum designs, lesson plans, and student work output.

Empowerment through Training: Pre-service Experiences

Pre-service teacher education programs in all STEAM disciplines play a vital role in preparing future educators to teach within and maintain STEAM programs. When designing and providing curricular experiences, colleges and universities should incorporate input and collaboration by quality providers who work, research, train, and/or advocate outside their campuses.

Empowerment through Training: Professional Development

Colleges, universities, and other service providers should consider making ongoing professional development available to educators as they design and implement STEAM programs. These providers could be groups or individuals whose work is based in research or practice that informs high-quality pedagogical practices in STEAM learning. Programs like those found at the Rhode Island School of Design (RISD)[5] stand out as models for providing practice across the curriculum[6] and STEM to STEAM Institutes[7]. Organizations like the Innovation Collaborative[8] are structured to provide both research[9] and training[10] on Effective K-12 STEAM learning settings[11] to diverse institutions.

SEADAE recognizes the need for research in all areas of STEAM education, including professional development models that specifically address high-quality pedagogical practices. Access to high-quality, research-based instructional materials and meaningful professional development is essential to learners' success with STEAM. As research continues, it may be helpful to draw on a recent, multi-year study generated from an arts integration perspective.

The 2012-2015 Perpich Arts Integration Network of Teachers (PAINT)[12] project identified eight key aspects of instruction as areas where teacher arts-integration practices could improve student learning:

1. Collaborating with colleagues for professional learning
2. Creating arts-integrated units
3. Aligning learning goals with assessment activities and evaluative criteria
4. Reflecting on student work
5. Modifying instruction in response to student evidence of learning
6. Improving assessment design and application
7. Increasing knowledge of integrating the arts with other subjects
8. Using technology and intensive project support

A 2016-2018 Innovation Collaborative study[13] of active STEAM teachers, a majority of whom were from arts backgrounds, revealed the importance of:

1. In-person, high-quality STEAM training that presents the arts and STEM disciplines as equal partners
2. In-person and virtual teambuilding that encourages team members to develop a safe environment in which they can ask questions, solve problems, and share successes
3. Developing STEAM teaching skills over multiple years
4. An awareness of the STEAM continuum – from multidisciplinary (beginning integration) to interdisciplinary (deepening the integration) to transdisciplinary (providing integration so deeply that one does not know whether one is doing sciences, technology, engineering, the arts, or mathematics, which often occurs around problem-based

learning); Teachers and students can engage with this continuum wherever they are comfortable, but always with transdisciplinary learning as the ultimate goal.

5. Consciously integrating arts habits of mind and STEM process skills. Experts feel that this is where the most STEAM learning power lies.

Additional findings of the study revealed that, through these practices, both elementary and secondary students demonstrated large increases in creative thinking, and that STEAM was able to close gaps between white and non-white students' creative thinking.

Empowerment through Training: Professional Development in Practice

Providing professional development for practicing teachers is important. Teachers in all content areas need to be confident that they can teach their students efficiently and effectively, and STEAM teaching is no exception. Teachers are often assigned by their administration to lead and participate in STEAM settings for reasons that may be unclear to the teacher. Teachers may wonder what qualifies them to be part of a STEAM team and/or request appropriate professional development.

Several findings from the Innovation Collaborative 2016-2018 study align with findings from the Perpich study regarding the purpose of professional development:

1. STEM teachers embrace STEAM if they can be shown how it relates to their disciplines.
2. Elucidating the commonalities between the science process skills and the arts habits of mind fosters acceptance of STEAM pedagogy for participating teachers.
3. Core STEAM processes become the backbone of teacher-developed curriculum, as opposed to random "plug and play" pre-packaged lesson plans.

At one end of the professional learning spectrum, there are a number of fully credentialed programs offered through the following institutions, with more programs in development across the country. These include:

- University of San Diego's STEAM Master's Degree
- Clemson University's STEAM Education Certificate
- Concordia University's STEAM Master's Degree

Online resources, such as EducationCloset[14], offer teachers STEAM-powered experiences in their classrooms. EducationCloset provides an online STEAM curriculum planning toolkit[15] and an online Arts Integration Specialist Certificate for those interested in deeper learning in the field of STEAM education. Additional arts-based organizations like Crayola[16] provide online materials and professional development training programs oriented to STEAM pedagogy.

Professional development need not be solely delivered to teachers through higher education, organizations, and companies. The establishment of collaborative professional learning communities within individual school districts or a consortium of districts can help build teacher capacity through the recognition and development of individuals' strengths and interests. (Grimmett et. al., 2010). "A successful program must not only inspire a shared vision of the program intentions through adequate professional development, but also acknowledge the unique strengths and interests that individual teachers bring to the practice of teaching" (p. 63). Accordingly, investing in professional development leads to high quality arts and STEAM pedagogy, directly impacting learner experiences.

Empowerment through Systemic Support

A cohesive, school-wide STEAM curriculum must be guided by a collaborative team of teachers, administrators, and other stakeholders well-versed in the multiple disciplines involved. Not only must each teacher have a solid foundation within their content area, they must also be able to provide instruction that focuses on content-area intersections and juxtapositions. Administrators and other stakeholders have a responsibility to inform and support teachers in their efforts to provide pedagogy from a STEAM perspective. To be successful, teachers need strong support from administration to give them ample resources and time to co-plan and develop instruction and materials that may require more time than a quick lesson.

As expressed in the research of both the Perpich Center and the Innovation Collaborative, teachers who are supported and encouraged to acquire professional development and new instructional strategies that support STEAM pedagogy find their work as educators to be innovative and creative, leading to a sense of inspiration. This finding is similar to the types of responses students often express identifying a strong sense of engagement in lessons that actively include the arts in their learning. Teachers thus empowered share a common mindset toward the benefits of a STEAM education in preparing students for future success, assuming the role of coach, liaison, and/or facilitator of learning toward meeting the goals identified in STEAM-based projects. It is a mentality of effective content synthesis that can make or break a successful STEAM experience for learners.

Chapter 4 – Intentionality for Success and Sustainability

To ensure acquisition of the competencies that strengthen learning across STEAM disciplines and lead to deep content knowledge, standards-based assessment of and for student learning must be intentionally embedded in instruction. Appropriate, well-designed assessments, in turn, guide pedagogical focus. Experiential learning provides opportunities for students to develop awareness of the intersections inherent in STEAM curricula and delivers critical tools for learners to demonstrate achievement.

STEAM pedagogy promotes intellectual development through several important cognitive processes: planning, interpretation of figural relations, interpretation of visual-spatial patterns and relationships, verbal reasoning, nonverbal reasoning, memory and memory retrieval, and quantitative and qualitative relationships (Baker, 2013). Accordingly, STEAM pedagogy supports a variety of instructional models, such as Universal Design for Learning, that creatively engage a diverse body of learners. STEAM pedagogy also encourages use of authentic assessments, commonly used in the arts, which may increase the likelihood that acquisition of challenging STEAM content can be measured, especially among students with various learning abilities.

Student Assessment

Standardized assessments are widely used in schools to create a comparison between the work of groups of students, as viewed through the frame of either norm-referenced or criterion-based assessment instruments. Commonly, students are assigned a numerical rank or letter grade that provides them with limited, often nebulous, and sometimes delayed feedback regarding degrees of

proficiency in a given subject. A more holistic approach to STEAM assessment balances standardized methods with formative and summative authentic assessments. This approach more closely mirrors real-world tasks and expectations to capture data that paints an increasingly comprehensive picture of academic growth and achievement.

Experiential learning through STEAM pedagogy must include predetermined standards-based outcomes and demonstrate a convergence of practices, processes, and content for diagnostic, summative, and formative assessment purposes. Performance-based and portfolio assessment designs best align with STEAM pedagogy and provide both the teacher and student with rich information about student progress. These designs honor the authenticity desired in STEAM learning and establish a feedback loop that informs curriculum and assessment. Dependent on the nature of the task, authentic assessment has the potential for more nuanced feedback between what is learned and what is assessed.

In addition to demonstration of content knowledge, observation of student engagement provides further evidence of student learning. Questions, problem-solving strategies, interpersonal strategies, and the ways in which content and/or constructs are applied are all essential components of authentic assessment. This inquiry-based approach to instruction provides learners practical ways to demonstrate their learning. Consequently, teachers must know how to use observational assessment data to inform instruction and when teaching for mastery. Arts educators have been using performance assessment successfully for centuries and are particularly skilled at using authentic assessment data as a pedagogical tool to inform the allocation of subsequent instructional time and focus.

Because STEAM education is typically reliant on experiential and project-based learning, using performance assessment as a means of demonstrating student achievement of content standards is critically important. Standards-based STEAM assessment practices often require collaboration among students, fellow teachers, community experts, and others. Although arts teachers regularly use project-based and performance assessments, it is important for arts teachers to continue to develop skills in assessment literacy as part of their leadership within the STEAM setting.

Program Evaluation

Program evaluation is an inquiry-based model that uses multiple data points to optimize learning by determining the effectiveness and efficiency of instruction. Serving as quality assurance for curriculum review, sound programmatic evaluation practices inform the allocation of instructional time and resources, and identify areas in need of improvement. Data may include qualitative and quantitative sources, such as student, teacher, and parent surveys; student academic performance data; school culture and climate data; and other data on school-based initiatives that may affect the efficacy of instructional delivery and student outcomes.

Key indicators of success to be considered when evaluating the efficacy of STEAM programs include:

- inclusiveness of all content areas, including multiple arts disciplines
- a collaborative network inclusive of community, post-secondary, business, and other partners
- a curriculum supported by school data and research
- resources to implement all strategies outlined in the curriculum

- on-site classroom space "conducive to an integrated plan of study," including effective and on-going access to appropriate technology
- authentic connections among content matter
- "trans-disciplinary relevance and real-world application" of standards
- clearly-defined expectations and applications of skills related to problem solving
- active work-based learning opportunities
- regular opportunities for teachers to collaborate including horizontal and vertical planning time
- professional learning opportunities unique to STEAM pedagogy
- a school and program culture that recognizes parity across all subjects
- active preservation of partnerships among students, school leaders, teachers, and community collaborators
- equitable access to all students, including under-represented groups and special populations
- ongoing communication to community members about STEAM program activities
- student choice and voice in STEAM activities and initiatives

A sustainable and high-quality STEAM program design is strengthened by an evaluation that focuses on measuring these key indicators.

Sustainability

Among the most common reservations about STEAM education are the challenges of collaborating across disciplines and the significant work that is required. The most reasoned response to these concerns is that STEAM educators embark on this path because it provides a holistic, evidenced-

based way to engage a variety of learners with real-world applications and focused preparation for the workforce. Through commitment and strong leadership, students reap immense benefits from a well-designed STEAM program.

Such commitments and benefits sound simple, but often require significant cultural, financial, and structural changes that school and district administrators may be hesitant to undertake. Driven by the need to raise or maintain standardized test scores and overcome varying degrees of faculty reservations, administrators may struggle to provide STEAM programs with adequate time to prove their merit as a viable pedagogical approach.

Implementation and sustainability require clear alignment to standards, strong pedagogy, authentic formative and summative assessment, and a combination of collaborative and discrete roles for content teachers. STEAM instruction presents an opportunity for collaborative planning, co-teaching, and partnership with the community, workforce, and experts from STEAM-related fields.

Using experiential learning as the primary STEAM instructional strategy creates opportunities for community involvement, cross-school exchanges, collaboration among educators, and student ownership of their learning. Experiential learning often includes instructional tasks that reflect, to some degree, what is important to students, their community, and the world. Thus, learners construct their sense of the world by applying their old understandings to new experiences and ideas (Shulman, 1999). Through the depth and breadth of STEAM tasks, students experience learning that is authentic, personal, and meaningful.

The likelihood of embedding STEAM practices in the nation's schools may ultimately rest on recognition of the synergy among science, technology, engineering, the arts, and mathematics the cognitive processes of creating; presenting, performing, and/or producing; responding; and connecting. This synergy will flourish as educational leaders study the relationships among what were once seen as discrete content areas.

Chapter 5 – Implications for Research

The United Nations Educational Scientific and Cultural Organization has stated:

> The benefits of introducing the arts and cultural practices into learning environments showcase a balanced intellectual, emotional, and psychological development of individuals and societies. Such education not only strengthens cognitive development and the acquisition of life skills – innovative and creative thinking, critical reflection, communication, and interpersonal skills, etc. – but also enhances social adaptability and cultural awareness for individuals, enabling them to build personal and collective identities as well as tolerance and acceptance, appreciation of others. (2006)

Current education agendas often address workforce development, social-emotional learning, and life-long learning. Deasy (2002) states that "STEAM pedagogy creates opportunities for positive emotional experiences for participants, build self-confidence, and contributes to positive student behavior and social interaction. When compared to students who do not participate in arts-integrated programs, participants report positive academic experiences and are more deeply connected to school."

SEADAE is committed to preparing and empowering learners to engage in real-world experiences through the authentic alignment of standards, processes, and practices in the sciences, technology, engineering, the arts, and mathematics. On-going conversations and additional research on how pre-service and in-service teachers learn to provide STEAM instruction will play a key role as the nation focuses on preparing students to enter the workforce.

Policymakers, practitioners, and researchers continue to ask whether STEAM should replace STEM. While STEAM education is not a new practice, researchers have not yet studied its impact as extensively as STEM learning. Therefore, the National Science Foundation, National Endowment for the Arts, and the U.S. Department of Education have encouraged data collection by funding STEAM projects for more than a decade (Dell'Erba, 2019).

The opportunities for students in STEAM programs are significant, as are the rewards for students and teachers. The challenges can be met and are worth the effort. With certified, experienced educators, schoolwide support, and teacher confidence in their ability to provide STEAM education effectively, educators can prepare their students to address global challenges.

With guidance and support from SEADAE and its partners, future research will address the myriad benefits of STEAM education in preparing learners to solve more adeptly the complex and evolving needs facing today's workforce**.** Further research will address pre-service programs and professional development in support of educators working in a STEAM setting. Future generations *must* be prepared to address global challenges by thinking more creatively and innovatively.

Links Cited

[1] SEADAE's STEAM definition [https://www.seadae.org/home/resources]

[2] Habits of mind in the arts [https://www.cesvt.net/habits-of-mind/]

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[9] Innovation Collaborative research [https://www.innovationcollaborative.org/rationale.html]

[10] Innovation Collaborative training [https://www.innovationcollaborative.org/history.html]

[11] Effective K-12 STEAM learning settings [https://www.innovationcollaborative.org/k-12-effective-practices.html]

[12] Perpich Arts Integration Network of Teachers (PAINT) [https://www.legacy.mn.gov/projects/perpich-arts-integration-project-fy12-fy15]

[13] Innovation Collaborative study [https://www.innovationcollaborative.org/k-12-effective-practices.html]

[14] EducationCloset [https://educationcloset.com/]

[15] STEAM curriculum planning toolkit [https://educationcloset.com/curriculum-planning-kit/]

[16] Crayola [https://www.crayola.com/education/created?utm_source=house&utm_medium=email&utm_campaign=jny_pd&utm_content=headertext&utm_source=Education_Publication_List_&utm_mediu

m=email&utm_campaign=EDU_STEAM+Email+2&utm_content=https%3a%2f%2fwww.crayola.com%2feducation%2fcreated%3futm_source%3dhouse%26utm_medium%3demail%26utm_campaign%3djny_pd%26utm_content%3dheadertext&EncodedEmail=]

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