International Journal of the Whole Child
2020, VOL. 5, NO. 1

STEAM

STEAMING Ahead by Challenging Thinking

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Introduction

Teaching in the U.S. is currently being driven by political bureaucracy. Under the design of "common core," the political solution to achieving equality is a pre-packaged curriculum and standardized testing where all children are provided the exact same learning experiences with the same high-stakes assessments. The expectation for teaching, learning, and assessment is "sameness." However, considering the whole child, developmental processes, and the characteristics of a diverse society, sameness should not be the priority of the educational system. This paper showcases a different approach taken in one elementary art classroom. Instead of using a pre-packaged curriculum, the teacher provided students with the opportunity to guide their own learning through STEAM (Science, Technology, Engineering, Art, and Mathematics) activities.

The short film, Alike (Lara & Méndez, 2016) was produced in an effort to elicit the emotional dilemma that society may face with a population who all think alike. The film follows a father and child through a personal account of how people are trained for productivity by society, highlighting how our educational system fosters alikeness for the purpose of career readiness, but

devalues creativity. The film warns of the coming travesty for the future of our children and society as a whole. Throughout the film, the child struggles with completing worksheets and attempting to maintain creativity in his learning experiences. However, the teacher continues to insist on learning without creativity. At the same time, the father visibly sees the change in his son as each day of school passes. Eventually, the child succumbs to the demand for output without creative energy, and the father realizes the damage caused by a lack of the arts in education. “Is this the ideal model for teaching our future leaders, to be alike and to stifle creativity?” This paper demonstrates the need for arts-based education and provides an example of how arts can be integrated with other subjects.

Background

The current push in education has a laser focus on teaching language arts and mathematics to better prepare our students for an ever-changing world. The concern is this initiative leaves little room for the teaching and integration of the arts. In an interview, Judith Ramaley, while president of the National Science Foundation in 2001, shared her vision and process for coining STEM, standing for Science, Technology, Engineering, and Mathematics (Christensen, 2011). Ramaley’s intent was to capture the connection between subject areas in education (Christensen, 2011). Her work intended to call attention to the importance of science and math in order to understand the universe using technology and engineering (Christensen, 2011). This perspective started a national recognition of STEM curriculum valuing a balanced education.

The STEM movement became a front for math and science education advocacy efforts. In 2001, No Child Left Behind legislation intensified a need for literacy education in the classroom with consequences for schools that did not show improvement in test scores (Wexler, 2018). This push for literacy education left no place for the teaching of science in the classroom. Due to a lack of teacher preparation or requirement to teach in the areas of science and math, the National Science Foundation and Science Partnership identified a crisis in the school system (National Academies Press, 2006). It was not until No Child Left Behind legislation in 2007, that standardized testing was expanded to include science education. Prior to this time, literacy education was the highest priority in the public-school system (Christensen, 2011; Hallinen, 2019; Wexler, 2018). For this reason, the STEM initiative represented a new aspect of teaching science, technology, engineering, and math in the classroom.

The STEAM Movement

With STEM education taking an active role in the school system, Ramaley envisioned the inclusion of arts education to broaden student learning and intensify teaching experiences (Christensen, 2011). Yakman (2008) first coined STEAM education by adding the “A” standing for “arts.” Yakman’s work showcased a model for learning in the language of mathematical thinking through art education. By adding the arts into STEM education, teachers were provided an avenue for allowing creativity through art, movement, and representational thinking in learning experiences. For some educators, the STEAM movement proved to be the needed reasoning for allowing creativity back in the classroom. Now, after years of STEAM education, progressivists predict the incorporation of reading to be the next logical step in the STEM

movement, using the acronym STREAM. Many educators are already adopting these practices, adding literacy education components to STEM and/or STEAM lessons. Many educators find it to be a logical and natural inclusion in the integrated learning process.

As defined by Jacobs (2004), the integrated movement as exemplified by STEAM, involves a conscious effort to apply knowledge, principles, and/or values to more than one academic discipline simultaneously. The disciplines may be related through a central theme, issue, problem, process, topic, or experience. STEAM education can be viewed as a partnership between the arts and sciences. All the disciplines easily compliment and strengthen one another (Christensen, 2011).

Building STEAM into Teaching

By blending subjects together, students make stronger connections, and meaningful learning outcomes are increased. The interplay between subjects should be fluid as one flows into the other. Educators who struggle with incorporating STEAM instruction in their curriculum may be asked by administrators to reflect on current lesson plans and student learning outcomes for the purpose of identifying ways to incorporate other subjects that could flow smoothly together. The key to infusing STEAM in an already developed curriculum is not to change everything that has been planned, but to identify one specific concept and develop a plan for incorporating other subject areas into the learning experience. Some teachers may find planning STEAM activities to be overwhelming, and the key is to start slowly. By taking integration one step at a time, the educator can find success. This may instill the confidence to attempt further integrations into teaching experiences; rather, than trying to integrate across all STEAM areas at once and getting lost in the process. The inclusion of the arts is only enriching when thoughtfully considered as an integral part of the learning process. Educators should not just add art to check off a box; instead, educators consider the quality of every learning experience.

Quality STEAM programs include motivation, engagement, and real-world context where students apply meaningful math and science content (Moore et al., 2014). STEAM teaching evidences inquiry-based and student-centered methods. Teamwork and communication become the vehicle for students to engage in the design process in order to effectively solve engineering challenges. By providing a safe environment, students are encouraged to think critically and creatively, while given opportunities to promote a growth mindset.

In order to deeply appreciate STEAM education initiatives, it is necessary to investigate how students are most inclined to learn. Gardner (2016), focusing attention on the implications of multiple intelligences, highlighted possibilities in which to differentiate for different learners. Multiple Intelligences theory determines how students are able to gain and apply new information. This theory supports the magnitude to which students learn in diverse and unique ways (Gardner, 2011).

To use Gardner's Multiple Intelligence theory in teaching, educators first reflect on how they themselves learn. For example, "Are educators asking students to learn in ways that would be challenging for adults?" If so, they could be unintentionally stifling the learning experience for students by limiting the delivery method. Everyone has different strengths and intelligences, and

these differences make us unique in our contributions to society. There is no average student and not all students learn in the same ways. Why should educators abandon the Multiple Intelligences, as some currently suggest, when it is evident that all students learn differently?

Many early childhood and elementary students demonstrate their natural creativity in diverse ways. They are confident and capable of creating a dance, developing a song, or designing a masterpiece through the visual arts. However, by the time these students become seniors in high school, very few will consider themselves to be creative at all (Lehrer, 2012). So how can a teacher create a classroom where students are not only encouraged to think divergently, but are supported in realizing the power behind their creative ideas? Creativity is not bound to a specific content area; it is the underlying opportunity within everything children learn and do.

Study

Jacobs (2004) suggested that the movement to integrate involved a conscious effort, and the American Society for Engineering Education (Moore et al., 2014) added that the context for learning must be motivating, engaging, and applicable to the real world. Accordingly, some educators are taking the leap to create real-time, integrated learning experiences. This study describes one elementary art teacher from a rural school district in mid-Missouri. This article follows her experience creating challenge-based learning opportunities for fourth grade students in her classroom spanning across a year of instruction, all while maintaining district curriculum requirements. After an initial year of experimental design, this educator was able to replicate the process in subsequent years. Students in her classroom have benefitted from the unique integrated approach as described in the following section.

Sarah Willard, a fourth-grade art teacher, started the year by introducing and defining the term, *collaborative relief sculpture*. She set project parameters through a presentation on possible color schemes, and provided her students a selection of artists available to research. Students were initially tasked with individually studying an artist of their choosing and creating a digital presentation focusing on the artist, the style, and the inspiration. Students were given tablets to facilitate the research process, and began to narrow down their artist preference according to style, color, and subject matter. This component of research instilled personal understanding of the artist and motivated later design elements for the project.

Throughout the research process, students were tasked with determining for whom the sculpture would be created, where and how it would be displayed, and the purpose for the work. Students held meaningful discussions based on audience, message, and needs. Some students suggested the work be displayed in the hall of their school, while others wanted to serve a greater need by donating the sculpture to a children’s hospital or community center to give hope to others. Based on student discussions, Mrs. Willard reached out to potential clients while students continued researching concepts.

Upon completion of the research process, students were able to create a relief sculpture design based on the different artist’s particular elements derived from research. Early in the project, students were still working individually on designs for a finished sculpture. Once initial designs were sketched, students worked in teams to collaborate on the project, deciding on one of the

individual designs to support as a team. Each team created a student design presentation utilizing the SAMR model (Substitution, Augmentation, Modification, Redefinition (Puentedura, 2006) to enhance technology integration and support the selected design.

Each team shared their final presentation with the whole class for review. Teams provided artist information along with their selected design concept. Once all teams presented their designs, the class held an election to determine the winning design for the collaborative relief sculpture project.

With a final design concept selected, the entire fourth grade class was able to begin creating the sculpture as designed. Throughout the process, Mrs. Willard led discussions but included the winning team in the leadership and execution of the work. The class divided into groups to work on different aspects of the project, referring back to the original design throughout the process.

During this final stage of the project, students were still discussing what to do with the completed sculpture. Some students suggested selling and donating the money to a charity, while others suggested donating the work to an office, school, or hospital. Mrs. Willard gave students full rights to determine the best direction for their work. This incorporated a meaningful and empowering component to the work that is essential for student learning and growth. During these conversations, there were no definable boundaries between the teacher and students. Instead, all participants worked in a collaborative group, which identified needs and wants, and then reached a desired goal.

Each year, Mrs. Willard's fourth grade class has created a collaborative relief sculpture for a different audience and to serve a different purpose. The first year of the project, fourth graders donated a sculpture with the word *Hope* to the Children's Mercy Hospital Philanthropy office to give hope to children and their families. The next year, the Children's Mercy Hospital Education Department reached out to the fourth grade class to commission a sculpture as well. The final collaborative relief sculpture had a focal point on the word *Study*. The third year of the project, fourth graders were commissioned by the University of Central Missouri to create a sculpture. The class created their own version of the United States flag incorporating stars and stripes into the design. The fourth year of the project resulted in a 5-foot tall gumball machine to be sold and money donated to a charity of the class' choosing.

Preparing students for a changing world

Immersive projects like the collaborative relief sculpture foster creativity and innovation, which are necessary characteristics in a complex, changing society. Preparing students for an ever-changing world should not happen through traditional teaching and testing. Kim (2011), after studying the effects of rote teaching and the use of standardized tests to train students' minds, describes how this type of teaching has increased the fear of failure, and as a result, has led to decreased creativity. With standardized tests weighing so heavily on the minds of districts and administration, students are often taught to memorize content through teacher-led activities rather than student-centered experiences. This type of traditional teaching removes the natural curiosity students have for learning, stifling a deep understanding of concepts and their potential real-world applications. Students often demonstrate a lack of interest in rote memorization tasks,

which typically precludes the meaningful exploration of topics and diminishes students' interest and excitement for learning.

To expand on this idea of creative, integrated approaches in education, consider the following example. Integrating STEAM components in classroom teaching is just one possibility. Educators should refocus their efforts to expand thinking opportunities, and help students feel confident in striving for the seemingly impossible, like reaching for the moon. "Moonshot thinking" is a model created by Teller (2013) involving goals that are difficult, or perhaps even impossible to achieve. It is not actually a new concept. One of the most iconic examples of Moonshot thinking occurred in 1962 when President John F. Kennedy announced in a television broadcast that the United States would go to the moon. He said he did not know how and he did not know when, but that it would happen. Teller (2013) states it is easier to project for improving at ten times rather than ten percent in a given situation. Willard, from the art classroom described above, could have supported students in improving ten percent capacity in classroom problem solving skills. Instead, she pushed beyond the classroom to extend their problem-solving skills to the local community and beyond. By exceeding the goal and envisioning what appears impossible, students and adults find the internal drive for success. The hardest things to achieve are the most worthwhile. In this way, perseverance and grit are necessary traits.

It is important for educators to provide opportunities for students to develop perseverance and grit for greater success now and in the future. It may be difficult to look at teaching from a STEAM perspective and immediately shift one's practice to an integrated approach, but the hardest things to do, those that seem impossible, are the most worth doing.

Another example is Challenge-based learning, a concept introduced by Apple Corporation under the umbrella of STEAM, which was designed to challenge society to take action and make a difference in the world (Nichols et al., 2008). Challenge-based learning, which is an extension of problem-based learning in the sense that students exceed what seems possible, is a collaborative learning experience in which teachers and students work together to learn about compelling issues, propose solutions to real problems, and take action. The approach asks students to reflect on their learning and the impact of their actions, and publish their solutions to a worldwide audience. The Challenge-based learning framework emerged from the Apple Classrooms of Tomorrow—Today (ACOT2) project initiated in 2008 by Apple, Inc. to identify the essential design principles of a 21st-century learning environment (The Challenge Institute, 2008). Challenge-based learning can possibly make implementation of creativity in the classroom more feasible. Sometimes, teachers start by taking too big of steps and quickly become overwhelmed with the changes occurring in the classroom. By starting with Challenge-based learning, the teacher can take steps to move students toward a more creative mindset and incorporate STEAM practices in their classroom.

Re-envisioning teaching

To take the first step, the role of the teacher changes from lecturer to mentor/coach. Teachers become willing to share their classroom practices, goals, and discussions with their students. Mrs. Willard demonstrated a willingness to share control, and the results were beneficial for

everyone involved. Teachers can share their power with the students with whom they work by creating a vision together. Every child deserves to be taught in a way that enriches their minds, unlocks their true potential and provides them with the skills to flourish in the modern world. By changing the paradigm from teacher as authoritarian to teacher as facilitator/guide, real change can occur in education.

Classroom teachers can start right where they are right now. Substantial changes are not necessary to see meaningful results in student thinking. There are endless opportunities for changing *what* teachers do and *how* they do it. The first step is for a teacher to think about what they are teaching right now and how they can maximize the learning through content integration. Perhaps the best way to begin integrating is to add a relevant technology piece or include an engineering element. From there, a teacher may begin to naturally make STEAM connections to their own work in the classroom. When considering lesson planning, teachers thoughtfully examine if there is a project in which they could release control and allow students to develop solutions on their own or in small groups. Sometimes teachers limit their work with students by thinking small. The teacher purposefully includes elements of Moonshot thinking or Challenge-based learning throughout project work. Those learning experiences where students can experiment with solving real-world issues - directly from the classroom context - prove the most meaningful and relevant. Allowing students to take control of their own learning will increase student motivation and engagement levels.

Conclusion

The short film Alike (Lara & Méndez, 2016), described previously, demonstrated the dangers of training students' minds to conform rather than encouraging the creativity within. There are educators working diligently to ensure their students receive the opportunity to think creatively. There are other educators who want to make a change in how they teach, but are unsure where to begin. When educators determine to make a change in how teaching occurs, they may become immediately overwhelmed with the task of reinventing teaching. Before getting overwhelmed in a plan to make big changes, it is necessary to consider some ways creative thinking is already built into the classroom. Sometimes educators are doing more than originally realized.

By starting with what is already working and is part of an overarching goal for shared learning in the classroom, educators can find ways to integrate learning across subject areas while also challenging the thinking of their students. The fear of failure and ability to teach students to embrace failure is an integral part of learning in STEAM education. It is important for students to see the teacher embrace failure and observe the teacher's reaction to making a mistake. It is through example that students begin to understand the value in learning from mistakes. Big thinkers transform, inspire, and challenge.

References

Christenson, J. (2011, November 13). *Ramaley coined STEM term now used nationwide*. Retrieved from https://www.winonadailynews.com/news/local/ramaley-coined-stem-term-now-used-nationwide/article_457afe3e-0db3-11e1-abe0-001cc4c03286.html

Gardner, H. (2011). *The unschooled mind: how children think and how schools should teach*. New York: Basic Books.

Gardner, H. (2016). Multiple intelligences: prelude, theory, and aftermath. In Sternberg, R. J., Fiske, S. T. and Foss, D. J. (Eds.) *Scientists making a difference*. Cambridge: Cambridge University Press, pp. 167–170.

Hallinen, J. (2019, June 28). *STEM: Education curriculum*. Retrieved from https://www.britannica.com/topic/STEM-education

Jacobs, H. H. (2004). *Interdisciplinary curriculum: design and implementation*. Moorabbin, Vic.: Hawker Brownlow Education.

Kim, K. H. (2011). The creativity crisis: The decrease in creative thinking scores on the torrance tests of creative thinking. *Creativity Research Journal, 23*(4), 285–295. doi: 10.1080/10400419.2011.627805

Lara, D., & Mendez, R. (2016). *Alike: A short film*. Retrieved from https://www.youtube.com/watch?v=PDHIyrfMl_U

Lehrer, J. (2012). *Imagine: how creativity works*. Rearsby, Leicester: W.F. Howes, Ltd.

Moore, T. J., Glancy, A. W., Tank, K. M., Kersten, J. A., Smith, K. A., & Stohlmann, M. S. (2014). A Framework for quality K-12 engineering education: Research and development. *Journal of Pre-College Engineering Education Research (J-PEER), 4*(1). doi: 10.7771/2157-9288.1069

National Academies Press. (2006). *Rising above the gathering storm: energizing and employing America for a brighter economic future: Committee on prospering in the global economy of the 21st Century: An agenda for American science and technology; Committee on Science, Engineering, and Public Policy*. Washington, DC.

Nichols, M. H., & Cator, K. (2008). *Challenge based learning white paper*. Cupertino, CA: Apple, Inc.

Puentadura, R. (2006). Transformation, technology, and education. Retrieved from https://podcasts.apple.com/us/podcast/as-we-may-teach-educational-technology-from-theory/id380294705

Teller, A. (2013, November 13). *Moonshot thinking* [Video]. Youtube. https://www.youtube.com/watch?v=cA_8IO3vbFs

The Challenge Institute. (2008). *Report on Apple Classrooms of Tomorrow-Today Learning in the 21st Century* (pp. 1–37). Retrieved from http://cbl.digitalpromise.org/wp-content/uploads/sites/7/2017/07/ACOT2_Background.pdf

Wexler, N. (2018, April). Why American students haven't gotten better in reading in 20 years. *The Atlantic*. doi: https://www.theatlantic.com/education/archive/2018/04/-american-students-reading/557915/

Yakman, G. (2008). *ST∑@M Education: An overview of creating a model of integrative education*. Pupils Attitudes Towards Technology (PATT) proceedings. Retrieved from https://steamedu.com/wp-content/uploads/2014/12/2008-PATT-Publication-STEAM.pdf