DO THE ARTS PLAY AN ESSENTIAL ROLE IN STEM SUBJECTS?

HOW STEAM PROFESSIONAL DEVELOPMENT AFFECTS TEACHER INTENT

TO TEACH SUBJECTS IN AN INTEGRATIVE MANNER

By

Stacy Noelle Young

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Committee Membership

Dr. Eric VanDuzer, Committee Chair

Dr. Kenny Richards, Committee Member

Colby Smart, Committee Member

Dr. Eric VanDuzer, Graduate Coordinator

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Abstract

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STEAM, an acronym for Science, Technology, Engineering, Arts and Mathematics, is an approach to teaching that integrates these subjects together for deeper inquiry and innovation. I surveyed teachers prior to the region 1 STEAM conference in January 2017 and after to determine if they intended to change their teaching practices to integrate what they learned at the conference. Follow-up interviews were conducted to clarify survey results. Research suggests that professional development is a key component to changing teacher practices. This study seeks to extend the assertion that a conference can be the catalyst professional development tool to change teacher practice.

A mixed-method was used for this study, including two surveys and interviews, to examine the scope of STEAM and how it impacted teachers. The 79 teachers who participated in the study attended the Region 1 STEAM Conference in January 2017.

Study findings indicated that teachers found STEAM to be a highly motivating and engaging strategy for increasing academic outcomes for students. Results suggest that more time is needed for teachers to plan STEAM lessons effectively.

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Introduction

I first learned about the concept of STEAM (Science, Technology, Engineering, Arts and Mathematics) as an integrated teaching strategy and philosophy from a workshop during the unveiling of the California Department of Education's "Blueprint for Creative Schools" ("Blueprint | createCA," n.d.) given in Oakland, California in January 2015 at the CREATE/CA Convening. I was so enthused by the potential of STEAM, I immediately sought permission from my Superintendent to put on a STEAM conference for our region in January 2016. My hope was to have 150 attendees, you can imagine my pleasure when 270 people attended. STEAM really resonated with our region's teachers.

In the spring of 2016, I was asked to write a STEAM module for the California County Superintendents Educational Services Association (CCSESA) for whom I serve as the Region 1 Arts Lead. The training module is designed for K-8 teachers and teachers of teachers to be able to offer a unit of study incorporating STEAM, principles of Design, principles of Reuse and Environmental Education. The module was piloted to K-8th grade teachers in October of 2016 and was met with enthusiasm. It is now available on the CCSESA Arts Website ("Module 18 - Reuse STEAM," n.d.) and is freely available. During this time, I decided to continue with my master's program and to use the upcoming STEAM conference in January 2017, as the basis to answer the question, "What effect will a short professional development conference have on teachers' interests in and intention to employ STEAM pedagogy?"

As the Visual and Performing Arts Learning Specialist and the coordinator of professional development for multiple subjects teachers and discrete arts (Dance, Drama, Music and Visual Arts) teachers, this study was developed to determine the arts role in STEM subjects. According to Congressional research records, STEM (absent the arts) has been gaining momentum in education for the last 15 years and yet, Math and Science scores are not necessarily increasing proportionally (Kuenzi, 2008). This research examines whether or not teacher practices were influenced by the STEAM conference and whether or not attendees felt that students would experience increased academic outcomes when taught using STEAM strategies as a precursor to adoption.

Chapter Two provides an overview of literature on STEAM education, arts integration, access and funding, student engagement, academic outcomes, student discipline, demographic sub-groups, and creativity.

Chapter Three details the methods used to conduct this mixed-method study. The development of the surveys (pre and post conference) and the interview are discussed and the study constructs are defined. A description is given about how the sample was chosen and the method of data collection.

Chapter Four presents the results of the study. The results include demographics of the sample, the surveys and interview results.

Chapter Five provides an analysis of the data collected. Connections between the relevant literature and findings of this study are presented. This chapter also includes the factors which prevent teachers from teaching using STEAM strategies, as well as challenges and limitations of the data.

   Chapter Six concludes the thesis. It gives particular attention to the highlights of STEAM education and its effect on educators' views of STEAM. Finally, the implications of the study are presented, followed by recommendations for further research.

Literature Review

Creativity is Intelligence having fun.

– Albert Einstein

Introduction

This study investigates the correlation between STEAM education (integrating Arts into Science Technology Engineering and Mathematics [STEM] subjects) and teacher's perceptions of its effects on learning outcomes for students. Evidence supports the conclusion that teaching deliberately with arts, either as integrative or discrete subjects, promotes increased academic outcomes in Language Arts, Social Studies, and is not limited to STEAM subjects (Catterall, 1997; Deasy, 2002; Dwyer, 2011; Elpus, 2013; Mishook & Kornhaber, 2006; Rabalais, 2014; Scheuler, 2010; Smithrim & Upitis, 2005). There are three categories of arts education: arts curriculum, arts integration and arts-enhanced projects. This literature review will explore arts curriculum and arts integration, exclusively.

"Arts curriculum" refers to the study of a discrete art. The requirement to teach arts curricula can be found in California Education Codes 51210 and 51220. Visual and performing arts include dance, music, theatre, and visual arts, with an emphasis upon development of aesthetic appreciation and the skills of creative expression. Explicit curricula for inclusion in visual and performing arts programs is included with each grade level, pre-kindergarten through grade eight and in grades nine through twelve. Curricula is articulated and sequential, with an assumption that instruction is given each week in all

four subjects: dance, drama, music and visual art ("California Education Policy |

California Alliance for Arts Education," n.d.). "Arts enhanced" is identified as an arts

project that does not require knowledge in the arts standards, e.g.: drawing a picture after

a book report. "Arts integration," as defined by ArtsEdge, a website created by the

Kennedy Center, is an approach to teaching in which students demonstrate their

understanding of a different content area through an arts medium. This demonstration

must meet content standards in both the non-arts and arts subjects ("ARTSEDGE: What

is Arts Integration?," n.d.). English Language Arts and Social Studies are the most

common subject areas for the arts to be integrated. This review will focus on arts

integration within these subject areas, in addition to STEM subjects.

This literature review is a synthesis of previous research, articles, current

methodology and theories as related to arts curriculum and arts integration and their

connection to STEM subjects. The topics outlined in this literature review include: access

and funding, engagement, grades, standardized tests, college pursuit, discipline,

demographic subgroups, and creativity. This literature review will examine how

including articulated discrete arts studies or arts integration in STEM increases academic

outcomes for all students.

Access and Funding: 1970's – present

Public schools in California were well-funded until the passage of Proposition 13

in 1978. Most students and teachers had a rich arts education until that time. Proposition

13 changed the way California schools were funded. Proposition 13 eliminated the ability

for school districts to levy local taxes and increased their dependence on the state of

California to finance their schools. According to Jeffrey Chapman in his article for the

Public Policy Institute of California, Proposition 13 had unintended consequences for

public education (Chapman, 1999). Jeff Camp reports that in 2014-15, California ranked

42nd in the United States for per pupil spending, after adjusting for the cost-of-living

(Camp, 2016). Prior to Proposition 13, California's per pupil spending was in line with

the national average (Chapman, 1999). According to 2014 U.S. Census data, since the

implementation of Proposition 13, California has consistently spent less per pupil. In

addition, spending for California public schools has decreased 5.7% since 2010 (Moore

& Samples, 2016). This changed the relationship education had between the state of

California and other agencies. Proposition 13 placed education in competition with other

state agencies for limited funding. Multiple propositions have come out in the years since

Proposition 13 passed, some established a minimum and others a maximum for school

spending. In 2012, Proposition 30 passed in California. This proposition was designed to

temporarily tax persons in the highest income tax bracket and gradually bring per pupil

spending back to 2008 levels. This change was anticipated to be achieved by 2020;

however, the tax would sunset in 2018. Proposition 55 officially titled "Tax Extension to

Fund Education and Healthcare" was on the 2016 California ballot to extend the taxes

levied on incomes exceeding $250,000 until 2030 ("California Proposition 55, Extension

of the Proposition 30 Income Tax Increase (2016) - Ballotpedia," n.d.). Proposition 55

passed on November 8, 2016 and the ramifications are anticipated to be an increase of $4

- $9 billion annually until 2030. K-12 schools will receive 89% of the funds and

community colleges 11%. In designated years, up to $2 billion will be apportioned to healthcare. The cost of this revenue to taxpayers averages $370 per person ("California Proposition 55, Extension of the Proposition 30 Income Tax Increase (2016) - Ballotpedia," n.d.).

During the decline of per pupil spending as well as emphasis on high stakes testing, arts education is often the first to feel the blade of the budget cut. Humboldt State University (HSU) retired arts education professor Mimi Dojka has seen how the "pendulum of change" has swung over her 30-year career. One example she relates is that until the mid-1990's a multiple subject credential candidate spent a semester each in visual art for education or in music for education. Currently, credential candidates are offered only three hours (not units) in either visual art or music. This is a marked decrease in the standards and expectations for teachers. Many teachers have neither participated in visual art or music in their school experience, nor learned how to teach it in their credential program (M. Dojka, personal communication, November 30, 2016). The decline in funding and teacher preparation in the arts, along with the simultaneous increase of high stakes testing, resulted in a swing away from arts education. With the federal mandate of No Child Left Behind Act of 2001 (NCLB), students were exposed to high-stakes testing in language arts and mathematics. Correspondingly, teachers felt the pressure to teach to the test and students were only given information that was going to be tested. In addition, due to reduction in non-tested course offerings and increased instructional time dedicated to tested content, students became less able to learn the

breadth and depth of other subject areas. This has impacted arts courses, their budgets and, ultimately, their offerings diminishing (Mishook & Kornhaber, 2006).

The pendulum is now swinging back to pre-No Child Left Behind (NCLB) era opportunities for arts integration and curriculum. The Every Student Succeeds Act (ESSA) is NCLB's successor. This legislation passed in 2015 and places the primary responsibility for student achievement with the states. In ESSA, states must identify one non-academic quality for improvement: student engagement, teacher engagement or school climate (McGuinn, 2016). California expanded ESSA further with its Local Control and Accountability Plan (LCAP). The LCAP contains eight state priorities including Pupil Engagement. Schools, Districts and County Offices of Education must set forth a plan that details how student engagement will be achieved, and the plan must be approved by local stakeholders, including: educators, parents, students and community. Now that President Trump's Administration and Secretary of Education Betsy DeVos has changed some of the ESSA law, it is uncertain how much stakeholder input will be required (Klein, 2017). For example, Secretary DeVos' 2018 Education Budget proposal included eliminating the Arts in Education program with a $1.8 M cut (Devos, 2017) . California law currently requires this stakeholder input, regardless of federal law. Stakeholder engagement is the cornerstone to California school funding, because it raises the level of engagement among key groups per California Education Code Article 4.5 Local Control and Accountability Plans (52060d3). Engagement is a key factor in both student and teacher success.

Engagement

Engagement can be defined as the involvement of the sensorimotor or physical, emotional, cognitive, and social dimensions (Smithrim & Upitis, 2005). Smitherim and Upitis' research "Learning Through the Arts" reveal that it is the intensive study of the arts over a period of at least three years that yields the greatest increase in engagement for all subjects. Engagement is a large predictor of student success (Smithrim & Upitis, 2005). For a student to be successful, s/he must be in attendance to participate in the curricula. Attendance increases when students are engaged in what they are learning. This fact is a critical component to budgeting, as nearly all public California schools are funded based on Average Daily Attendance (ADA). Schools with high student arts enrollment show significantly increased student attendance regardless of socio-economic status (Scheuler, 2010). Furthermore, students who create, innovate, and interact with curricula to deepen their knowledge are able to synthesize and analyze to a greater degree (Cook, 2012). This deepening of the knowledge base is directly transferrable to an increase of grade point averages and standardized test scores.

The partnership between the classroom teacher and teaching artist has been a model that has been successful for decades, and has had several labels such as Project Based Learning, Whole Learning, and now STEAM. Gresock and Steinwald (2016) recount using music and theater for students to internalize scientific concepts of weather and water conservation. Water conservation is an abstract concept for students to understand. When arts were employed, young students role-played an ever-shrinking

waterhole, they had to imagine the water supply decreasing and problem solve a solution. They were committed to saving their imaginary animals from hypothetical death and were highly engaged in the role-play and the collaborative effort involving math and science to solve the problem. The students were also able to transfer the knowledge to their own classroom and brainstorm ways to conserve water at school. As a result, Gresock and Steinwald (2016) reported that students who participated in the arts integration model gained the equivalent of more than one month in their math competencies, noting how students' faces would "light up" when using arts to demonstrate knowledge, an indication of engagement. The content serves as the vehicle for students to become *artists* (Gresock & Steinwald, 2016). When a student is engaged, not only are they physically and emotionally present, they are linked to the content in a way that can be measured. The literature reveals numerous studies on grades, standardized tests, and higher education as related to the measurement of the effects of the arts on student learning.

Grades, Standardized Tests and Higher Education

James Catterall released his landmark study related to standardized tests in 1997 with a sample comprising 25,000 students. This study revealed advantages for students highly engaged in the arts during 8th and 10th grades when compared to "arts-poor" students. In Catterall's study, the arts refer to: music, drama, visual art, dance, and/or digital media. Arts-poor students do not participate in visual and performing arts coursework from a credentialed arts teacher during their secondary school day. Students

participating in instrumental and/or choral music, as well as drama and the visual arts had

higher results in academic grades, standardized test scores, measured reading levels, and

attitudes of citizenship. The pattern was consistent across the two years of data collection,

including, most importantly, for students in the lowest 25% of family education and

income (Catterall, 1997). Family history of education level achieved can be an indicator

for children to continue post-secondary training. Higher levels of education of a family

member increases the likelihood of children attending post-secondary training (Catterall,

1997).

Kenneth Elpus (2013) researched the effects of high school arts education courses

on the pursuit of post-secondary education. His primary goal was to prove that arts

education was not a significant disadvantage to students pursuing college, regardless of

their course of study. For example, it was neither an academic disadvantage nor an

indicator of future success for a student to take a music course in lieu of an elective

science or math course. Nationally, there was no significant disadvantage to students

seeking admission to study arts or STEM subjects in college. Students enrolled in high

school arts courses are 29% more likely to pursue post-secondary education (Elpus,

2013). Further, 21% of students enrolled in the arts in high school are more likely to

attend post-secondary education (Elpus, 2013).

Several states have pursued studies to determine if arts education plays a role in

academic achievement as measured by grade point average (GPA) and standardized test

scores. Outcomes measured in the last seven years in Florida, New York and Missouri

report that nearly all students enrolled in visual arts and/or music courses have higher

GPA's and standardized test scores (CAE, 2009; Kelly, 2009; Scheuler, 2010) than

students who are not enrolled in some type of arts education. In addition to the impact on

academic achievement, discipline is also reduced among students enrolled in arts

education (Scheuler, 2010).

Discipline

In 2009, research was conducted by the University of Northern Iowa, Department

of Curriculum and Instruction comparing an integrative curriculum with a traditional

(non-integrative) curriculum. Integrative curriculum uses an art form as the tool to

demonstrate understanding in a subject area. Non-integrative curriculum does not

generally use art forms to demonstrate understanding. Fourteen hours of observation were

collected from the control group (non-integrative curriculum) and the experimental group

(integrative curriculum). In the non-integrative curriculum, the teacher directed

instruction and managed behavior. The students followed directions and worked

individually. In the integrative curriculum model, the teacher served as the facilitator of

teamwork and offered options, while students made choices and worked collaboratively.

Results showed that student discipline through behavior management is reduced in

integrated curriculum settings (Zhbanova, Rule, Montgomery, & Nielsen, 2010).

Integrative approaches are student-centered, establishing a motivated and collaborative

atmosphere that contributes to the overall socio-emotional health of students.

> Art integration is a rigorous teaching strategy that helps students understand
> complex, multifaceted subjects. It's uniquely well-suited to strengthening
> students' social-emotional learning and creating personal identity narratives that

expand their understanding of self and others. Children's personal identity narratives can—and should— be ambiguous and ever-shifting. The quest to see one's personal identity in new light, to shape and reshape it, and then to share it with others is a reflective process that impacts students' confidence and behavior. The art-rich iterative process of taking what is familiar, challenging it, and expanding it—to look at "who I am" in a new context—is a powerful way of developing a sense of self (Sterman, 2016, p. 2).

In 1982, President Reagan created the President's Committee on Arts and Humanities (PCAH), an advisory committee to the White House on cultural issues. In 2008, President Obama charged PCAH with investigating the condition of arts education. When considering discipline and self-actualization, the arts can be an ideal conduit for students to synthesize their understanding of themselves in the larger world. Rather than finding themselves manifesting a behavior or discipline problem, the arts might help students seek knowledge of themselves in relation to the world around them. Instead of suppressing behaviors, students are guided through a reflective process (Dwyer, 2011).

There is also a correlation of specific demographic student sub-groups having the least access to arts education and the highest percentage of disciplinary action in public schools. According to the PCAH review "Reinvesting in Arts Education" released in 2011, there is substantial evidence that arts integration increases academic outcomes and closes the achievement gap. However, the review also shows a decline of arts education offerings to African-American students (45%) and Latino students (40%) since the 1980's (Dwyer, 2011). A closer look at these sub-groups shows increased evidence of inequity in available arts coursework.

Demographic Sub-groups

Catterall's 1997 research continues to show that students in the lowest socio-economic status (SES) have the highest gains in terms of engagement and outcomes when participating in the arts (Catterall, 1997). The connection between arts integration and increased academic outcomes validates the need to include arts integration in more than English Language Arts and Social Sciences. Utilizing arts integration strategies in STEM subjects allows students to delve deeper into content while synthesizing, analyzing and creating new ideas about the content. Rabalais (2014) studied the integration of arts in STEM primarily as a means to increase science and math achievement. Rabalais' (2014) findings, based on the 2009 NAEP (National Assessment of Educational Progress) dataset, confirms that students with a higher amount of Visual and Performing Arts credits achieve higher scores in mathematics and science. This achievement held true with control groups for gender, race and socio-economic status (Rabalais, 2014).

One must consider whether arts integration is the strategy for increased achievement in STEM subjects, or if the discrete learning of arts is the catalyst. Both arts integration and discrete arts discipline yield creativity in the process. Is there evidence that there is greater creativity and achievement in arts integration or a discrete arts discipline?

Creativity

Opposing views must be considered when analyzing the literature for STEM vs. STEAM. There is a long-held conservative political principle that arts should not be funded by the government, nor taught in our public schools (Thelan, 2000). When budgets are threatened, arts programs are routinely first on the chopping block, from local schools to national programs. As of the spring of 2017, the Humboldt County Office of Education is submitting a grant to the NEA for Region 1 to continue arts education in STEAM professional development. The model is ideal for rural schools as 60% of the professional development is done online and asynchronously. Due to lack of funding, there are two local school districts who are also competing for this same grant, professional development in arts education. The $1.4 million grant will be announced in September. Cutting Arts Education funding became the official stance of the Republican platform in 1996 in which it sought to abolish the National Endowment for the Arts (NEA) (Thelan, 2000). The Republican Leadership argued that because the NEA is not mentioned in the United States Constitution, it shouldn't be funded. The National Endowment for the Arts (NEA) was established in 1965 as an independent agency by Congress. Since that time, the NEA's mission "gives Americans the opportunity to participate in the arts, exercise their imaginations, and develop their creative capacities. Through partnerships . . . the NEA supports arts learning, affirms and celebrates America's rich and diverse cultural heritage, and extends its work to promote equal access to the arts in every community across America" ("About the NEA | NEA," n.d.).

As NEA budgets have fluctuated, it is important to note that the 2016 allocation was just

a few million dollars less than the 1979 allocation. See Table 1 ("National Endowment

for the Arts Appropriations History | NEA," n.d.). Currently, the NEA is threatened with

being defunded entirely. As of this writing, President Trump's budget had not been

finalized. According to the NEA website, grants awarded in 2017 would still be honored

and grant applications for 2018 would still be taken until final word comes from

Congress ("Grants for Organizations | NEA," 2017).

Table 1: National Endowment for the Arts Appropriations 1966-2016

Year	Appropriation[1]	Year	Appropriation[1]
1966	$ 2,898,308.00	1991	$ 174,080,737.00
1967	$ 8,475,692.00	1992	$ 175,954,680.00
1968	$ 7,774,291.00	1993	$ 174,459,382.00
1969	$ 8,456,875.00	1994	$ 170,228,000.00
1970	$ 9,055,000.00	1995	$ 162,311,000.00
1971	$ 16,420,000.00	1996	$ 99,470,000.00
1972	$ 31,480,000.00	1997	$ 99,494,000.00
1973	$ 40,857,000.00	1998	$ 98,000,000.00
1974	$ 64,025,000.00	1999	$ 97,966,000.00
1975	$ 80,142,000.00	2000	$ 97,627,600.00
1976	$ 87,455,000.00	2001	$ 104,769,000.00
1976 T[2]	$ 35,301,000.00	2002	$ 115,220,000.00
1977	$ 99,872,000.00	2003	$ 115,731,000.00
1978	$ 123,850,000.00	2004	$ 120,971,000.00
1979	$ 149,585,000.00	2005	$ 121,263,000.00
1980	$ 154,610,000.00	2006	$ 124,406,353.00
1981	$ 158,795,000.00	2007	$ 124,561,844.00
1982	$ 143,456,000.00	2008	$ 144,706,800.00
1983	$ 143,875,000.00	2009 [3]	$ 155,000,000.00
1984	$ 162,223,000.00	2010	$ 167,500,000.00
1985	$ 163,660,000.00	2011	$ 154,690,000.00
1986	$ 158,822,240.00	2012	$ 146,020,992.00
1987	$ 165,281,000.00	2013	$ 138,383,218.00
1988	$ 167,731,000.00	2014 [4]	$ 146,021,000.00
1989	$ 169,090,000.00	2015	$ 146,021,000.00
1990	$ 171,255,000.00	2016	$ 147,949,000.00

1   Appropriation less enacted rescission/s
2   In 1976, the Federal Government changed the beginning of the fiscal year
     from July 1 to October 1, hence the 1976 Transition (T) Quarter.
3   Excludes $50M provided by the American Recovery and Reinvestment Act of
     2009.
4   Appropriation less enacted rescission and sequestration.

The NEA supports programs, artists, and research. A recent research study funded by the NEA was "How Creativity Works in the Brain." The research focused on defining creativity, analyzing how it works, how it effects schools, and the creative economy. While the report is not conclusive, it does point to science partnering with the arts as a way to understand and teach creativity (Gute & Gute, 2015).

In Steven Johnson's recent TED Talk, "The playful wonderland behind great inventions," (Johnson, 2016), he relates the development of the modern computer to the playful creativity of innovation. He takes the viewer on a 43,000-year journey in 7 minutes to illustrate that necessity is not the mother of invention, it is play. It is commonly understood that the development of computers was from the military, and they did play a role. However, Johnson relates the development of the flute from mammoth bones to the first music box as the idea from which came hardware and software. This was an innovative leap forward that could not be anticipated. Johnson (2016) asserts that the future will be found wherever people are having the most fun.

A meta-analysis of eight studies on arts learning, as related to creativity, concluded that while there is causal effect of arts learning on creativity, more research needs to be done (Deasy, 2002). Deasy edited a compendium of research for a dual purpose: 1) to provide a recommendation to researchers and their funders for paths of inquiry in arts learning and 2) to provide curriculum and instruction with strategies to deepen arts learning. The compendium is divided into 6 categories: Dance, Drama, Multi-Arts, Music, Visual Arts and Overview. The overarching theme of the 62 studies included in the compendium point directly to arts education as way to increase academic and

social-emotional outcomes. More importantly, it heralds the need for more research and new assessment tools to bring about reform for greater academic outcomes in schools and education policies (Deasy, 2002).

Academic Outcomes

According to Eisner (1998), researchers are asking the wrong question. It shouldn't be how do the arts effect academic performance outcomes, but rather, how do other academic subjects effect higher performance in the arts? Eisner goes on to summarize research that is ineffectual in ascertaining if the arts do effect academic outcomes. He cautions against the dangers of allowing arts education to be the silver-bullet to fix basic needs, because someone will come along with another silver-bullet and would leave the arts vulnerable to a new value system (Eisner, 1998). Eisner proposes thinking of what the arts teach in three tiers: 1) Arts-based Outcomes of Art Education, 2) Arts-related Outcomes of Arts Education, and 3) Ancillary Outcomes of Art Education.

An example of an arts-based outcome of Arts Education would be student analysis of a piece of music, dance, script or visual art to compare and contrast with a piece that they are creating. An Arts-related Outcome would be a student's ability to perceive and comprehend aesthetic features in the general environment, without calling the outcome art. For example, being able to speak with inflection, nuance and articulation would be an outcome from studying theater, even if the student is giving a report in another class. The Ancillary Outcomes, the ones that "justify" arts education in non-arts settings, are the ones that are found in most research. For example, nearly 1.5 million

high school graduates had higher verbal and math scores on the Scholastic Aptitude Tests (SAT's) in 2005 as they continued to take arts courses (Ruppert, 2006). Studies show an increase of up to 40 points between students who took four years of arts courses when compared to students who took one-half year or less of arts courses, see Table 2.

Table 2: Arts Course-taking Patterns and SAT Scores, 2005

Number of Years in Arts-Courses	Verbal Scores	Math Score
4+ years	534	540
4 years	543	541
3 years	514	516
2 years	508	517
1 year	501	515
½ year or less	485	502
Average for all SAT Test Takers	508	520

What is not clear is whether or not the sample included a representational sub-sample of SES or Special Education (SPED) students. Generally, students who are not considered to be college-bound, would not be taking the SAT's and therefore, not included as a sample, (Ruppert, 2006).

Conclusion

This review investigated the literature regarding the effectiveness of an arts education on STEM (science, technology, engineering, and mathematics) subjects. The

integration of the arts with STEM is also known as STEAM. The topics presented in this review are: access, engagement, grades, standardized tests, college pursuit, discipline, demographic subgroups, and creativity.

The review of the literature highlights the ebb and flow of access to arts education as a standard for teachers and students alike. While much of the literature reviewed the benefits of an arts education either as a discrete art or as integrated with other subjects, research is fairly new in the area of STEM subjects. The research has become more quantitative in the last 20 years and in addition to the great body of qualitative research showing the benefits of arts education on student outcomes. Students are more engaged and enjoy the increase in grade point averages and standardized tests scores as a result. This engagement transfers to an increased likelihood in attending post-secondary training or institutions. Engagement reduces disciplinary problems among all students, and to a larger degree in demographic sub-groups. Finally, the greatest advantage to having a strong arts program is the power it has to ignite creativity. As quoted by Albert Einstein, "Imagination is more important than knowledge." The transformative power of the arts that can ignite human discovery and creativity.

Absent from the literature is a body of research on professional development as it seeks to integrate the "A" into STEM and influence teacher practice. This study will seek to find the correlation between teacher attitudes and delivery of STEAM education after a regional STEAM conference. The quantitative approach will study teachers' attitudes about STEAM education before and after the conference. The qualitative format will

study the teachers' attitudes, expectations and delivery through interviews. The

methodology of quantitative and qualitative research will be outlined in the next chapter.

Methods

This chapter details the methodology used to investigate teachers' practices reflecting what they learned about STEAM at a recent STEAM conference and how those experiences have impacted their teaching and perceptions of student learning. The STEAM conference is a 1-1/2 day professional development opportunity for K-12th grade teachers. Renowned keynote speakers begin each day of the conference with their STEAM aligned message, followed by multiple breakout sessions designed to engage teachers in the type of practice we want them to incorporate in their classrooms, see Appendix A. By having the teachers learn through engaging, hands-on lessons, they are more likely to encourage integration of this philosophy of teaching into their own practice. To the extent that teachers reported impacts on teaching and learning based on practicing STEAM, this study also aimed to identify the components of the STEAM conference that were most responsible for those impacts. Using a mixed methods study involving pre- and post-surveys (Appendices A and B, respectively), with both closed and open-ended questions and interviews, this study examined how teachers are implementing STEAM strategies as well as collecting detailed information about teachers' attitudes and experiences with STEAM in their classroom as a direct result of attending and participating in the STEAM conference.

The Conference

The 2017 STEAM Conference took place on a Friday and Saturday. This was the second STEAM Conference for Region 1. The dates were strategically selected to be

after the Winter Break, before the end of the first semester and on a weekend when not much else was scheduled. Having it occur outside the school day was also important as Region 1 is lacking enough qualified substitutes for teachers to be released for professional development. Friday began with a breakout session, see the program in Appendix A. There were 7 sessions to choose from, all hands-on learning from local, regional, and national educators. A call for presenters went out in September and 30 sessions were selected by the planning committee. It was my job to schedule the presentations in an appropriate room size based on presumed attendance, and provide a balance across disciplines, as well as balance across registrants' expertise and interest.

Friday night's keynote speaker was an Education consultant with the company littleBits, which is a modular electronics company which created open source coding for magnetic pieces that snap together for prototyping and learning. Her keynote had an inspiring theme, "Use Technology to solve other people's problems," however, many attendees felt that her message was lost in the 'sales' of the product and received low satisfaction ratings. In contrast, the second day keynote address by Nirvan Mullick received the highest ratings of the conference with 98.6% rating his keynote address positively.

Mr. Mullick's message was about how each of us could change the world by paying attention and having fun. Mullick closed his presentation with his documentary of Caine's Arcade (Mullick, 2009) and how this has led to an imagination revival (Mullick, 2012). Finally, he led the entire conference in a cardboard challenge, see photos Appendix B. Attendees were inspired to create with their students. Annie Lindquist,

second grade teacher said, "I've been trying so hard to 'control' my second graders by giving them more and more seatwork, I've been doing it all wrong. I can't wait to get back to my class on Monday and inspire them, like I've been inspired!"

Mr. Mullick's keynote and cardboard challenge were followed by three more breakout sessions such as how to make paper, see program Appendix A. Attendees' responses were indicative that they would be implementing change in their teaching practice from the moment they returned to school, they were excited and inspired.

The Research

The questions for the study were generated based on a review of the relevant literature and informal interviews with conference attendees. The review of the relevant professional literature identified a set of essential components of STEAM strategies, indicators of teaching effectiveness, indicators of student learning and key issues involved in STEM and STEAM, which were incorporated into the surveys and interview schedule (for complete surveys see Appendices C and D).

Sample Selection

Teachers, coaches and administrators representing all levels of education from Pre-Kindergarten to College, who registered for the Humboldt County Office of Education STEAM conference in January 2017, were invited to take the pre-conference and post-conference surveys. Registrants were primarily (80%) from Humboldt County, with 10% from the remainder of Region 1. Region 1 is comprised of Sonoma, Lake,

Mendocino and Del Norte counties. A few participants came from areas outside Region

one including 4% from other California counties and the remaining 6% from New

Mexico, Ohio, Oregon, Virginia and New York. Only those who attended the STEAM

Conference were included and results were collected from the 79 registrants who chose to

participate in the study out of the 285 who were invited to participate for an overall

response rate of 28%.

Survey Construct

The surveys were researcher designed to gain insight into teachers' experiences

with STEAM strategies including how different teachers were practicing STEAM or

STEM +/- Arts, and the degree to which individuals perceived their experience with the

STEAM conference had impacted their teaching and affected student learning. The

surveys informed the researcher about participants' perceived understanding and

motivation to teach using STEM or STEAM strategies before and after the conference.

The follow-up interviews were designed to discover if or how participants' perceived

their practices changed as a direct result from attending the STEAM conference. To the

extent that teachers reported an impact based on their experiences from the conference,

the survey also aimed to measure which components of STEAM were associated with

which type of strategies.

There were three parts of the two surveys: demographics, experience, and

attitudes. The first section of the survey asked demographic questions such as, county of

residence, grades and subjects currently teaching. The first context questions sought to

determine if the respondent was currently practicing STEM or STEAM and the degree of experience the individual had with STEAM now or in the past. Participants were also asked about the reasons they decided to attend the conference, why they chose to use STEAM and the types of STEAM training they had prior to the conference. The final question in the context section of the survey asked teachers "Are you more likely to teach using STEAM strategies?" The answers were "yes, no, unsure, or decline to state." This was followed by a short answer to "why or why not?" While future intention questions are a poor measure of actual future actions, this was designed to reveal the effects of the conference on teachers' attitudes. These context questions employed both objective and open-ended responses. The remainder of the survey contained items designed to measure teachers' attitudes about a number of factors associated with STEM and STEAM. The survey included 4 additional items to directly compare teacher attitudes and intentions regarding STEM and STEAM.

Two open-ended questions were asked to examine past positive or negative experiences with STEAM, and to gain information about how attendees connected their experiences at the STEAM conference with thoughts about future actions. The last question gave attendees the opportunity to add anything else about the STEAM conference that had not already been addressed.

At the end of the post-survey, attendees were asked if they would be willing to participate in a follow-up interview. Those who were willing to participate, were asked for contact information and notified that while their answers would continue to be confidential, they would no longer be anonymous.

Implementing the Surveys

In an attempt to increase the survey response rates, advanced notice was sent to all registrants inviting them to participate in the surveys. Additionally, follow-up reminders were sent to all registrants to give everyone multiple opportunities to complete the survey. The survey took most participants 10-20 minutes to complete and was administered as a Google Form. The initial request for participants to take the pre-conference survey was included with registration information regarding: parking, meals, HSU unit of credit, and so on. Asking the group of registrants to complete the survey when they were registering to attend the STEAM conference resulted in a 24% (65 of 270 registrants) response rate overall. All of the registrants were invited to participate except 15 people who registered at the conference and therefore did not receive the pre-conference survey. This initial round of data collection occurred over two days prior to the conference.

At the closing session of the conference attendees were encouraged to complete the post-conference survey and then emailed the link 10 minutes after the conference ended and again one week later. This resulted in a 28% response rate (79 of 285 attendees) over 20 days. As the surveys were anonymous, it was impossible to tell if the same individuals answered the pre and post surveys, although the demographic information of grades taught suggest that the same representational subgroups did answer both surveys.

Within a week after sending the first email invitation to take the Post-conference survey, I sent a follow-up email to the full group thanking those who had already completed the survey and letting those who had not yet completed the survey know that there was still time and again provided the link.

Follow-up interview sample selection and implementation

When asked on the survey, 46 participants (58%) indicated they were willing to participate in an interview. The research design called for interviews with 10% of those available. A follow up email sent to those who had indicated a willingness to participate resulted in 13 participants (16% of Post-conference survey responders) affirmed a willingness to be scheduled for an interview. All 13 interviewees (or 6% of conference attendees) were selected based on their willingness to participate in response to the follow-up email.

At the agreed upon time, each interview was conducted via phone or in person and was between 15-25 minutes in duration depending on how much the respondent wanted to share. Permission was given by each interviewee to transcribe the conversation as it took place. Immediately following each question, their responses were recited to the interviewee for accuracy.

Interview

The interviews were based on a semi-structured interview protocol using probes for clarification and further insights (See Appendix E). The interviews were designed to

elicit a deeper understanding about the teacher's experiences with STEAM, the conference and how they saw STEAM practices change or enhance strategies in their classrooms to improve student learning. In particular, this aspect of the study aimed to identify any STEAM related changes in their feelings of efficacy as a teacher.

The first part of the interview asked teachers broad questions about their views on teaching STEAM which included theories on teaching and learning, influences on student learning, and perceived benefits of professional development in the form of the STEAM conference. These insights provided a context through which to view responses to more specific questions regarding experiences practicing STEAM strategies.

The second part of the interview focused directly on the individual teacher's experiences practicing STEAM. First, I asked teachers to describe their overall STEAM experience. From the responses, a teacher's definition of what constituted STEAM became clearer, as well as some of their feelings about what they experienced. Next, I asked them about the most positive aspects of practicing STEAM and if there were any negative aspects of their STEAM experience. After gaining information on how the individuals experienced the STEAM conference, I asked questions which sought to find out if s/he perceived that practicing STEAM had impacted her/his teaching or student learning within her/his classroom. A question about teaching confidence was also included based on a preliminary analysis of the survey data. At the end of the interview, I asked each teacher to rate the STEAM conference based on the degree to which they felt it was useful. The interviewees were asked for both a numerical rating and an explanation for each rating.

Human Subjects Protocol

This study was reviewed by the Humboldt State University Committee for the Protection of Human Subjects in Research and approved (#16-118). To help ensure confidentiality pseudonyms were used throughout the reports on the study results when individuals were identified. Each participant in this study was required to agree to terms outlined on an informed consent email and on the surveys which informed potential study participants of the study procedures and potential risks. The informed consent also gave contact information for the researcher, research advisor and chairperson of the humans subjects review committee. See Appendix F for a copy of the full informed consent.

Data Analysis

The Pre-survey was anonymous and confidential. The Post-survey was confidential, but those who agreed to participate in the follow-up interview had to give identifying information for me to be able to contact them. The interviews were confidential and interviewees provided pseudonyms. The qualitative data and the quantitative data were analyzed separately and then considered together. Researcher-designed, Likert-type scale questions sought to find out about teachers' experiences with STEM and/or STEAM. The open-ended questions asked participants to report on specific STEAM impacts for teaching strategies and student outcomes. Areas in which the data differed will be discussed in the analysis chapter.

Qualitative data

Qualitative data was gathered both through open-ended questions on the survey and during the interviews. The open-ended responses and interviews provided additional detail which was used to validate, clarify and expand on the analysis of the survey results. Responses to open-ended survey questions were thematically coded and then examined within coding categories. Interview responses were analyzed in two ways. First, the interview responses were examined for areas in which they could provide a deeper understanding of why teachers found specific components of STEAM to be valuable to their teaching and student learning and how they as conference participants saw evidence of the impacts of STEAM. Secondly, responses were coded and analyzed by emergent themes.

Results

  This chapter reports the results of the study including the pre- and post- surveys

and the interviews. First, an overview is given of the study population demographics,

context and general results and then more detailed results are presented. General themes

of responses are identified in this chapter and are further discussed in the following

chapter. Two hundred and seventy STEAM conference registrants were invited to take

the pre-conference survey two days prior to the conference. The link to the survey was

emailed to all registrants and the link was closed at the start of the conference to ensure a

valid pre-conference measure. Sixty-five preconference surveys were completed and

returned for a response rate of 24%. After same day registration there were ultimately

285 STEAM conference attendees. All attendees were emailed the link to the post-

conference survey at the close of the conference. All registrants were emailed again four

days later. Of the 79 responses on the post survey 46 participants or 57% indicated a

willingness to be interviewed and were emailed to schedule the interviews over the

following three weeks. Of the 46 respondents indicating a willingness to be interviewed,

13 completed the interviews. The 13 interviewees represented 16% of those who took the

post-survey and nearly 6% of those that attended the conference.

Demographics

  The pre-conference Survey's 65 respondents indicated that 84% were teachers. Of

those 24.6% self-identified as primary teachers, 23.1% as upper elementary teachers, 30.8

% as Middle/Jr. High School teacher, 9.2 % were High school teachers, 4.6% Post-

Secondary and 16.9% selected Coach of Teachers. Respondents could select multiple

answers, thus the percentages exceed 100%. See Figure 1.
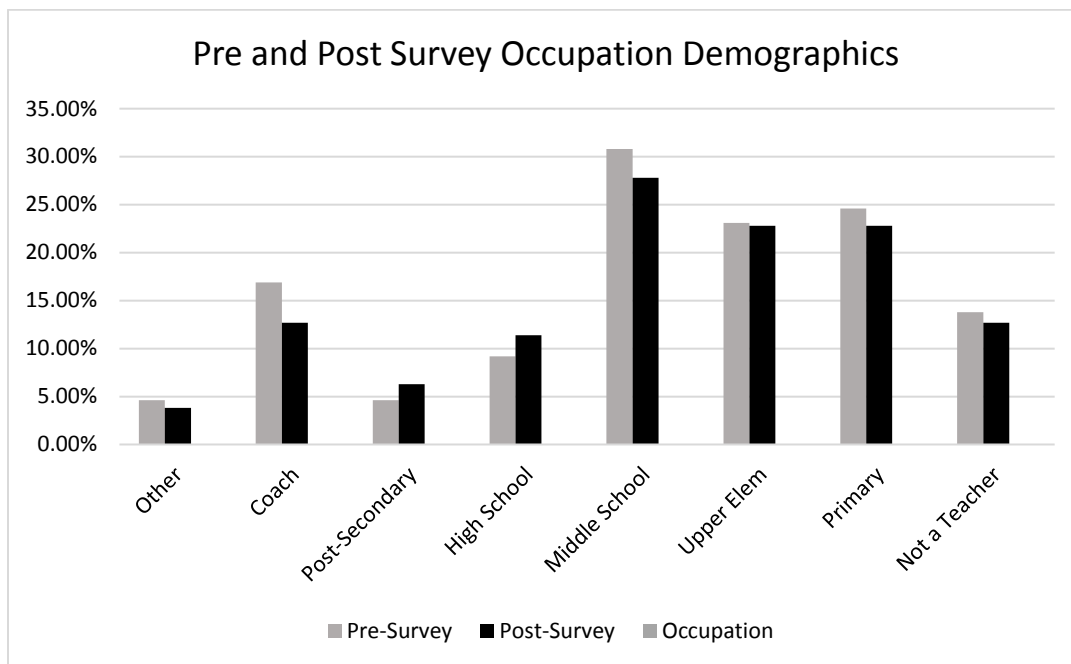
Figure 1: Pre and Post Survey Occupation Demographics

The distribution of responses are reasonably consistent even though 20% more people

answered the post-survey than the pre-survey. Additionally, the question regarding

subjects taught revealed some interesting statistics. In both surveys, respondents

identified as more than 50% teaching Science and Mathematics. Language arts had a

slight difference with 54% of pre-survey respondents and 47% of post-survey

respondents. This question asking which subjects were taught is of particular interest

because respondents could identify teaching multiple subjects and were not limited in

their selections. The results suggest that 48% of the attendees teach multiple subjects

which eases the opportunities to teach STEM and/or STEAM because teachers who are

assigned one subject to teach, as is often the case in secondary settings, have more difficulty integrating subjects.

STEM and STEAM Strategies

It was important to ask registrants their teaching practices in STEM and in STEAM separately to determine if there was a gain or loss when adding the arts to their teaching practices. When comparing the questions in the pre-survey, "To what degree do you currently teach STEM?" with "To what degree do you anticipate teaching STEM going forward?" nearly 25% of respondents said they do not teach STEM at all, with only 13.8% indicating they did *every day*. In the post-survey, when asked about "going forward" only 3.8% of respondents replied that they did not intend to use STEM in the future compared to 25% in the pre-survey, and 35.4% marked *daily* more than double the 13.8% in the pre-survey. Of the pre-survey respondents, 35% indicated they teach STEM *nearly every day* or *daily* while post-survey responses increased to 79.8% planning to teach STEM *nearly every day* or *daily*. See Figure 2.
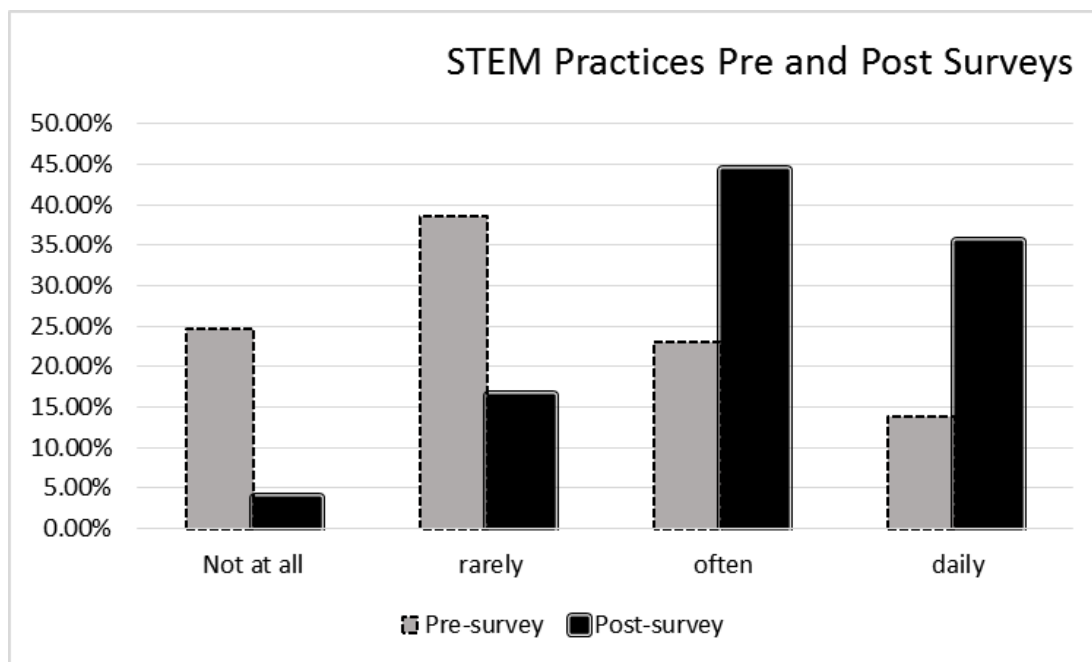
Figure 2: STEM Practices Pre and Post Surveys

Similar results were found, comparing the questions about STEAM, "To what degree do you currently teach STEAM?" with "To what degree do you anticipate teaching STEAM going forward?" Before the conference 27.7% indicated that they did not teach STEAM at all, after the conference, 96.2% planned to teach STEAM going forward. Only 6.2% of pre-survey respondents indicated teaching STEAM *daily* compared with 34.2% of post-survey respondents selected anticipating teaching STEAM *daily*. When combining responses of "never" and "rarely" taught STEAM prior to the conference, 72.3% of pre-survey respondents indicated they *never* or *rarely* taught STEAM. This is the inverse of the post-survey respondents who when combining the responses of *daily* or *often*, 79.8% of post-survey respondents indicated they anticipated teaching STEAM *often* or *daily*. The mean response to the question, "To what degree do you anticipate teaching STEAM

going forward?" was 3.1 which equates to *often*, but not *daily*. This was a 70% increase

to current STEAM teaching. Overall, 86% of post-conference respondents indicated that

they were likely to use STEAM strategies frequently. Of the 30.4% of respondents who

indicated that they did not plan to increase their current STEAM practices there were

generally two explanations: 1) they either taught STEAM practices daily and therefore

couldn't increase, or 2) did not have an integrative program in which they could fold in

STEAM strategies, as they were either not a teacher or a single subject teacher in a

secondary setting. See Figure 3.

Figure 3: STEAM Practices Pre and Post Surveys

The survey followed-up the question "Are you more likely to teach using STEAM
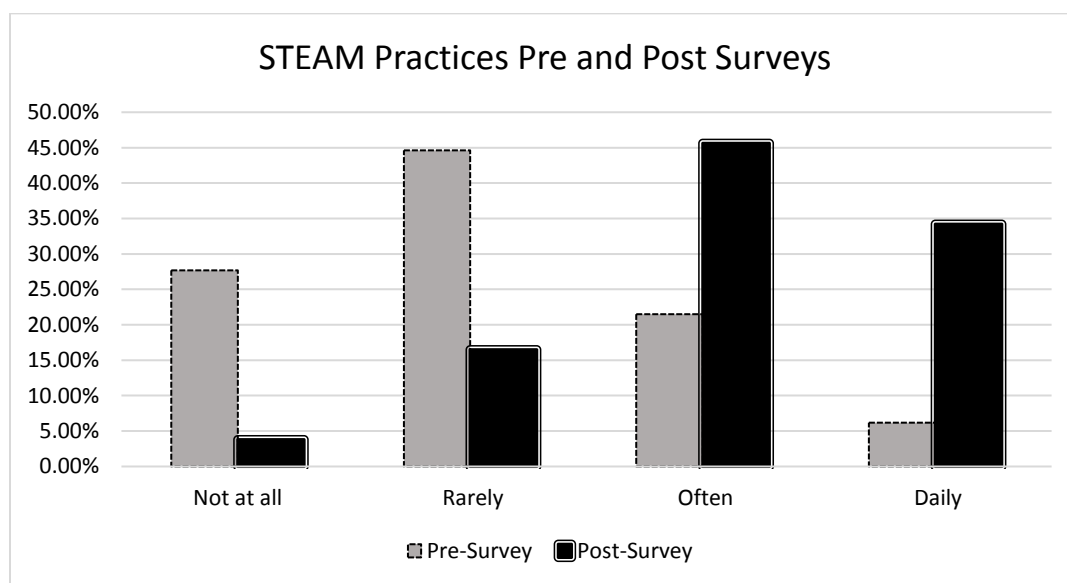
strategies?" with the question "Why or why not"? The results were evenly split, 34%

cited student engagement as the main reason their STEAM practices would increase

whereas 32% cited professional development, a direct outcome of the STEAM

conference. Five percent of respondents cited engagement AND professional

development as the key to increasing their STEAM practices.

Interviews

Interviews were conducted either by phone or face-to-face two months following

the STEAM conference to determine if teachers had changed teaching practices to

increase using STEAM strategies as the post-survey indicated they would. I began the

interview with their consent to proceed. I transcribed their answers as we spoke, and read

them back for accuracy. The interview started with determining whether STEM practices

had increased since the conference with 61% of interview participants answering yes.

Similarly, 75% of interviewees claimed their STEAM practices had increased since the

conference. However, further questioning indicates that they perceive the increases to be

small. Only two respondents indicated that their STEM practices increased to daily,

whereas only one respondent indicated their STEAM practices increased to daily, and

this respondent was one of the two who had also increased STEM. Twenty three percent

of interviewees responded that they had increased STEAM compare with 79.8% of

survey respondents who reportedly planned to. This disparity may be due to the inherent

limitations of future intentions data, or suggest that it takes longer than two months to

develop and implement the changes in curriculum. Answering this question will require

more research.

When asked how STEAM was increased in the classroom, one respondent said,

"Now that I'm aware of the arts standards, when I look at a unit, I try to fold in the arts

standards, for example, color palette. It hadn't been explicit before." Interviewees were asked "To what degree do you anticipate teaching STEAM going forward?" and responses were consistent with the survey predictions: 76.9% of interviewees indicated they would teach STEAM nearly daily or daily.

This was followed by the demographic information as it was on the surveys. I inserted this in the middle partially to ease the interviewee's anxiety by asking familiar questions that by nature, have no perceived "wrong" answer. The demographics of the interviewees were similar to those of the survey respondents.

Student Engagement

Interviewees were asked if they would be more or less likely to teach using STEAM strategies going forward and why or why not. Seventy-five percent of interviewees said they were more likely to teach using STEAM strategies. The reasons cited include: improved learning and retention, skills for multiple areas, encourages divergent thinking and collaboration, and STEAM engages all kids especially the disengaged. Interviewees were then specifically asked "What outcomes to student learning and/or engagement have you discovered?" and every interviewee indicated that greater student engagement was an outcome when using STEAM strategies. Primary teachers noted that students made more connections between content areas, while high school Career Technical Education teachers described how STEAM had transformed the way students engage with school in design projects. As one put it "They are really, truly creating and inventing things that are their own." One interviewee responded that there is

100% engagement from the severely developmentally disabled to the high academic achiever when using STEAM strategies. However, another interviewee cautioned that it takes a lot of time to plan and articulate STEAM strategies successfully. She felt that when STEAM is done well, it increases academic rigor. Of concern is, "teachers are not given much time to plan or collaborate, the arts may be best suited as its own academic discipline in tandem with a STEM program. Arts integration is difficult to do well because many students do not have the foundational skills to build on in STEAM."

Analysis

This study examines the effects of a STEAM conference on teacher attitudes, strategies and perceptions about student engagement. Overall, teachers reported that their STEM and STEAM teaching increased following the STEAM conference demonstrating the effectiveness of the conference in promoting these pedagogical models. With the post-survey showing nearly double the percentage of respondents indicating interest in applying STEM/STEAM and a reduction by half of those not using these pedagogies. Following the conference, 80% of respondents indicated they intended to increase their STEM and STEAM teaching strategies to daily or nearly daily as a result of attending the conference. Clearly, the conference was a powerful form of professional development. Further, while the immediate post-conference survey showed a significant increase in interest, this appeared to be sustained over time when the follow up interviews were conducted two months after the conclusion of the conference.

There are several possible explanations for the conference's effectiveness in promoting its goals. For example, the large proportion of respondents who attended as part of a grant may have increased the effects of the conference, however given the overall results this cannot explain the significant effects of attending. Over 70% of attendees were teachers in K-8 classrooms where curricular integration is easier than in high school. Nearly 50% of respondents taught in self-contained elementary classrooms and another 17% were teaching coaches who are unconstrained by the potential for curricular integration in the schools. The demographics therefore, support the effectiveness of the conference. Finally, 75% of the participants were using some

STEM/STEAM prior to the conference. While 13.8% indicated that they were not using these pedagogies, the large proportion (62%) of attendees who were already predisposed towards and familiar with the pedagogies explains some of the conference's success in increasing the intention to use STEM/STEAM in the future.

Participants also developed more positive attitudes about the effectiveness of the STEM/STEAM pedagogy over the course of the conference. For example, one participant described how the conference also helped attendees develop a broadened understanding of where and when STEAM can be taught. In addition, through both post-surveys and interviews teachers reported that students are more engaged when using STEM/STEAM strategies. Many indicated that they believed that STEM/STEAM approaches include more academic rigor than non STEM/STEAM strategies. Nearly half of the explanations for why post-survey respondents felt more inclined to utilize STEM/STEAM specifically cited the effects of the conference.

Given the consistency and magnitude of positive changes in attendees' attitudes towards employing STEM/STEAM the evidence is clear that the conference was successful in its goals of increasing awareness and use of these pedagogies and represented effective professional development.

Conclusion

Overview of the Study

There is a great body of work studying teacher effectiveness, student engagement and even arts integration, yet there is little research on STEM education and even less about STEAM education. This study sought to determine if a regional STEAM conference could influence teacher practices to engage students.

In part, this study sought to measure the effect of the STEAM conference on teacher attitudes and practice. Based on the review of the literature, a set of constructs were developed to measure attendee attitudes prior to and following the STEAM conference. A mixed-methods approach was used to collect data. In this study attendees were given two surveys that included both scales and open-ended questions. Follow-up interviews were conducted two months after the STEAM conference to determine the stability of teacher attitudes and practices.

Overall, the attendees made significant increases in their intent to teach using STEAM strategies as a direct result of the STEAM conference. Nearly 80% of attendees indicated they would increase their STEAM strategies. Based on aggregate feedback from the survey, the reasons for this were two-fold: 1) attendees felt teaching using STEAM strategies increased student engagement, and 2) teachers benefitted from having professional development opportunities that tell them *how* to implement the strategies. This feedback leads to the assertion that the Arts do play an important role in STEM

subjects when used for the purpose of increasing teachers' STEM/STEAM practices to engage students' future learning.

Implications

The implications of STEAM in relation to student engagement and teacher practices could be far reaching. Integrative learning replicates the way in which our world functions. According to "STEAM: A National Study of the Integration of the Arts Into STEM Instruction and its Impact on Student Achievement", Rabalais conducted a national study of 36,000 students who have strong arts education, defined as 3 units or more in high school. Across demographics, students with a strong arts education outperformed students without. While all students showed increased achievement, the greatest impact was for students with low socio-economic status, and non-white students (Rabalais, 2014). In this study, the survey constructs were limited in scope and focused primarily on teacher practice and student engagement. While Rabalais' study highlights the effects of STEAM on student engagement, to generate these opportunities, the evidence suggests that professional development can have a significant effect on the level of implementation and therefore the potential overall effect of STEAM practices.

Limitations

Limitations to this study include the limited predictive value of measuring intent. Intent did not appear to wane from the conference to the follow-up interviews. However, while 80% of respondents on the survey indicated the intention to integrate

STEM/STEAM practices daily or near daily, the interviews found much lower utilization two months after the conference. It is unclear what proportion of the difference between intentions and implementation is related to the short time span between the conference and the interview and what is related to enthusiasm's inevitable confrontation with daily classroom reality. Further research could provide evidence as to the full effect of the conference. The relatively small number of interviewees also offers opportunities for further research to expand and deepen our knowledge of how the conference content translates into practice. An additional limitation was the survey construct itself. If the survey construct had included the depth and breadth of the Arts and the Socio-Economic Status of the schools the respondents teach in, correlative analysis could be measured. If the Arts are not taught in a sequential, articulated manner, then STEAM will be more difficult to integrate.

Recommendations for Future Research

While this study focused on the Arts' role in STEM subjects in relation to professional development at a STEAM conference, it is clear from the literature review and research in the field that not enough is known about STEAM education. Further research should include Arts integration in STEM as delivered by Classroom and/or STEM teachers, as well as a strong Arts education in tandem with STEM as delivered by discrete Visual and Performing Arts teachers. A correlating study on both of these worthy research subjects would be important to the field. This researcher intends to continue the study of professional development in STEAM at subsequent conferences.

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Appendix A

STEAM Conference Program
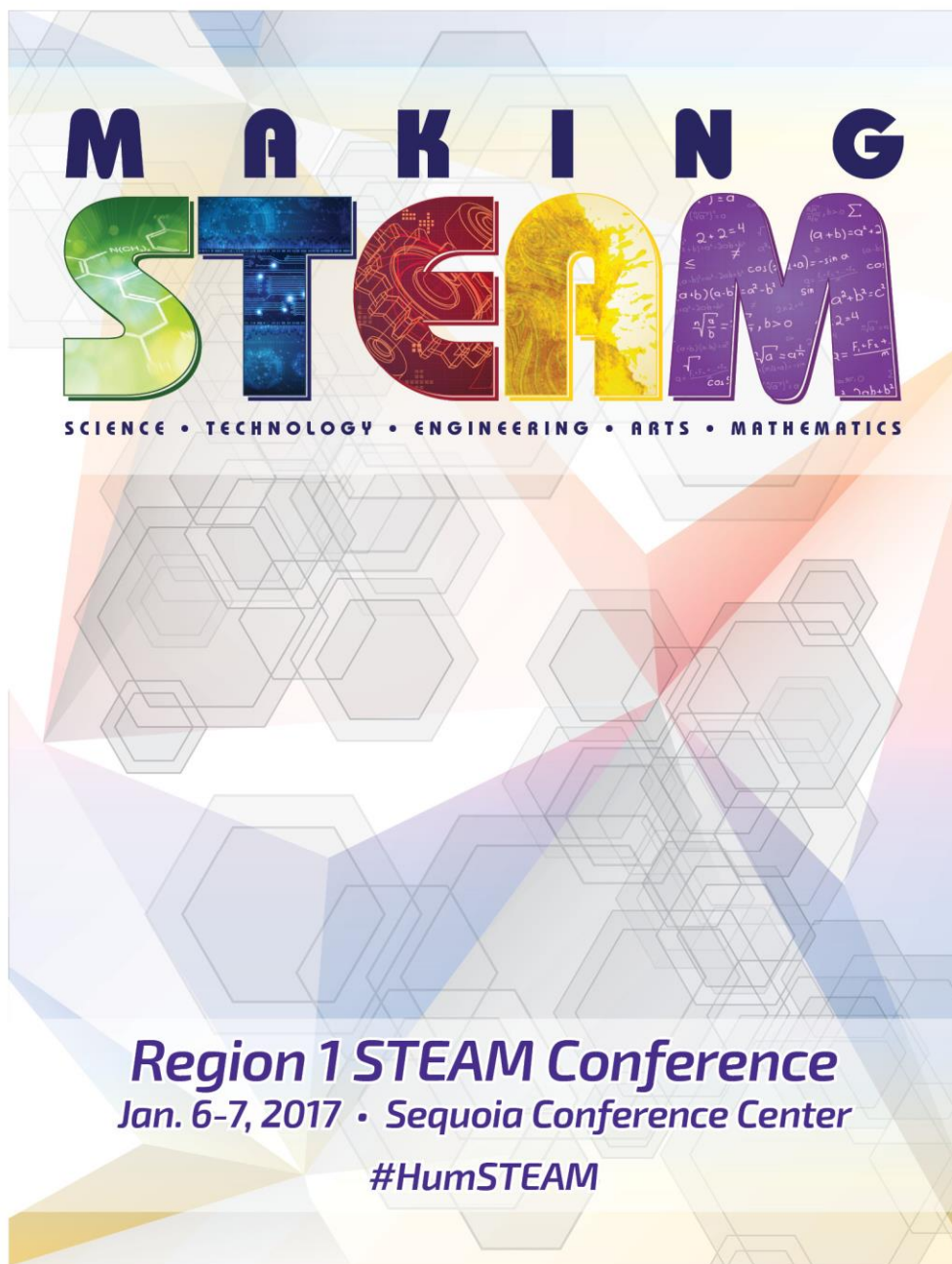
OVERVIEW/AGENDA

Day One: Friday January 6, 2017
4:00 – 8:30 PM

4:00 – 4:30 PM	**Registration**	**Sequoia Conference Center**
4:45 – 6:00	**Breakout Session 1**	**See Breakout Descriptions**
6:00 – 7:00 PM	**Dinner**	**Sequoia**
7:00	**Welcome Address** *Garry T. Eagles, Ph.D.*	**Sequoia**
7:15 – 8:30 PM	**Keynote** *Erin Mulcahy*	**Sequoia**

Day Two: Saturday, January 7, 2017
9:00 AM - 4:30 PM

9:00 AM - 10:45 AM	**Welcome back** *Jon Sapper, Ed.D.*	**Sequoia**
	Keynote 2 & Cardboard Challenge *Nirvan Mullick*	**Sequoia**
	Humboldt Math Festival Display *Ken Pinkerton*	**Sequoia Lobby**
	HISI Display *Michael Kauffman*	**HERC Lobby**
11:00 AM - 12:15 PM	**Breakout Session 2**	**See Breakout Descriptions**
12:15 - 1:00 PM	**Lunch**	**Sequoia**
1:00 - 2:15 PM	**Breakout Session 3**	**See Breakout Descriptions**
2:30 - 3:45 PM	**Breakout Session 4**	**See Breakout Descriptions**
4:00 - 4:15 PM	**Closing**	**Sequoia**
4:15 – 8:00 PM	**Community Maker Event**	

KEYNOTE SPEAKERS

Erin Mulcahy
Preparing Students for the Careers of the Future

It is impossible to prepare students for what we think—today—will be the careers of the future. Erin Mulcahy explores how littleBits is designing learning experiences using STEAM, ambush learning, and other unique educational experiences while remaining focused on keeping it fun and relevant.

Erin has developed educational products & programs to help bring invention-based learning to over 12K educators around the world. She has also led workshops and demos at several events, including ISTE, FETC, SXSW, ACTE, Internet Librarian, WIRED UK, and MakerFaire. Prior to littleBits, Erin received an MA from Columbia University and a BS from Cornell University. She has also held positions at the Earth Institute and The National Research Council.

Nirvan Mullick
Caine's Arcade: From a Movie to a Movement –
Imagination and STEAM at Play

Nirvan Mullick is an award winning filmmaker, speaker, and movement maker. Nirvan's short film Caine's Arcade became a viral phenomenon in 2012, receiving over 10 million views, changing the life of a 9 year old boy, and sparking a global movement of creative play with cardboard. Inspired by the response to Caine's Arcade, Nirvan founded the Imagination.org, a non-profit that works to foster creativity and entrepreneurship in kids worldwide.

Since 2012, Imagination's Global #CardboardChallenge has engaged over 750,000 kids in 70 countries in creative play and STEAM, and was named a Champion of the Ashoka/Lego Foundation Re-Imagine Learning Challenge. With over 120 "Imagination Chapters" in 14 countries, the impact continues to grow. Nirvan continues to make films and creative work, and speaks around the world about the critical need to foster the creativity of every child and the potential of every moment to have an impact.

EXHIBITS

Humboldt Math Festival – Sequoia Lobby
The Humboldt Math Festival is a "community celebration of math" held every spring in Eureka. The festival is organized and presented by local educators and students. The festival includes displays, presentations, make-and-take activities, puzzles, game and contests. The festival also includes a Student Art and Poster Show, and the Engineering Challenge. Come by the foyer display for information about the festival, how to be involved as a presenter, and how get your students involved. We will also provide information on the theme for the Art Show, and info and materials for the Engineering Challenge - Mouse Trap Racers!

HISI – HERC Lobby
Learn more about Humboldt Interdisciplinary STEM Initiative (HISI) at the STEM Humboldt website built to serve as a hub for all things STEM and STEAM in Humboldt County. We are building place-based resources and curriculum for use across northwest California and beyond. Subscribe to the blog to follow posts for relevant curriculum and resources and watch for guest authors to share successes with STEM in the classroom.

BREAKOUTS — SESSION 1

Paper Paper Everywhere!
*Presenters: **Allison Poklemba & Tibora Girczyc-Blum***   **Annex**
This hands-on session would provide an overview of the K-2 STEAM unit "Paper, Paper Everywhere!" (a project of HCOE and SCRAP Humboldt) where students test the properties of different types of paper, design their own formula for making recycled paper, and paint with paper pulp.

Fabricating the Future: 3D Printing in Elementary (Even If You Don't Have a 3D printer!)
*Presenter: **August Deshais***   **Sequoia B**
Thanks to free (Yes, FREE!) access to a high-quality 3D printer at the HERC, you can now introduce your students to the possibilities offered by 3D modeling and design. We will discuss how printing can be used across all content areas, from engineering and art, to ELA and science using free, online software. Tips and examples for designing whole group with TK-first will be shared, as well as how to get your second through fifth graders designing on their own. All participants will create their own design to be printed on the HERC MakerBot. Please bring a laptop or Chromebook if possible (sorry, no designing on tablets), as additional devices will be limited.

Science and the Arts — A Natural Fit
*Presenter: **Dawn Getzandanner***   **Sequoia A**
This hands-on presentation will focus on how Arts Integration assists students in developing deeper and more meaningful connections to science. Participants will experience several lesson examples and consider connections through the arts that foster creativity and innovative thinking.

Media Arts in your classroom
*Presenters: **Derek Fenner & Jessa Brie Moreno***   **Madrone**
This workshop will introduce participants to resources centered on introducing educators to the Arts & Media standards involved in Career Technical Education (CTE). In this workshop participants will be introduced to tools and resources to inspire young people in participating in the media arts. These lesson plans and learning tools were created for educators working in classrooms, community organizations, science centers, museums, and other settings. These toolkits concentrate on educators teaching CTE and STEAM (including Computer Science), English Language Arts (especially those seeking to engage youth in tech-enabled storytelling), Digital-Age Social Studies and Civics, and Professional/Youth Development.

LED Wrist Cuff with Craft Technology
*Presenter: **Erica Moore***   **Learning Commons**
Learn simple circuitry, design, and simple sewing to create a personalized, light-up, wrist cuff.

Atremathics
*Presenter: **Mrinal Virnave***   **Redwood**
Creating through math; is what most digital artists do. This session will introduce participants to a tools and online resources for creating "Artemathics" games and activities that can be replicated in the classroom to create digital art, 3D graphics and animations. Participants will do the activities and brainstorm on extending the games to fit their own classroom learning objectives.

Game Change: Arts Education Data Project and Arts Now CA
*Presenters: **Robin Hampton, Peggy Burt, & Pat Wayne***   **Alder**
Join us to learn how the Arts Ed Data Project is spurring exciting changes in counties, districts and schools. Pat Wayne of CREATE CA will walk participants through the Interactive Dashboard, the Road Map resources, how to use them and new tools coming online. Attendees are expected to already have looked at the data for their region or community. Robin Hampton and Peggy Burt from of the California Alliance for Arts Education will share strategies being used to address data gaps and build sustainable arts programs in districts around the state.

BREAKOUTS — SESSION 2

Paper Paper Everywhere! Part 2
Presenters: Allison Poklemba & Tibora Girczyc-Blum   **Learning Commons**
This session will guide participants through the making of paper and painting with paper pulp.

Making the Most of Energy: Insulate It!
Presenters: Amy Crispin, David Haller, Jesse Hobba, Mark Huschle, Nick Dedini, & Tyler Vack   **Sequoia B**
This is an engineering/design lesson where participants will use a variety of materials to design a thermos to keep water hot. Using mostly reuse materials, water bottles will be insulated to find the most efficient design. Participants will estimate the shape of the graph of the data, then record data over a 10 minute period, and graph their data. Redesign will be planned and made, time permitting.

Exploring Content Standards through an Entrepreneurial Lens
Presenters: Heidi Moore-Guynup & Karen Brooks   **Sequoia A**
Discover the array of ways to intentionally address Common Core content standards across the grade levels and engage in an interactive low-cost project that leads to the creation of high-end sellable art. Once pieces are created, learn about cost of goods, quality control, branding and marketing. These are all elements of a program called Crafting Up Business. These concepts are adaptable for students between the ages of 9 and high school graduation. Application of these concepts have helped dozens of young entrepreneurs from across Humboldt County schools to earn thousands of dollars while simultaneously seeing the relevance of their instruction.

Innovation and the World of Drones
Presenter: Henry Wotherspoon   **ERC**
A comprehensive lecture that revolves around explaining the advancement of technology and its growing uses in our world, more specifically that of drones and how much innovation in particular has come from the hobby. What exactly goes into them and how much has the technology inside changed over the years.

Spreadsheets Aren't Scary
Presenter: Jesse Wheeler   **Alder**
Learn practical uses of spreadsheets for student activities and to make your job easier. We will be gathering data and manipulating it in kid-friendly ways through Google sheets. Possible applications include comparing measurements of pumpkins from the pumpkin patch, tracking the growth of seeds they've planted, and more. As a bonus, this session will show how to use Google forms as an assessment tool, providing organized feedback helpful in differentiation, reteaching, and grading.

The Session Formerly Known as Raspberry Beret
Presenter: Kerry Bruce   **Madrone**
This is a Raspberry Pi Workshop focusing on introductory computer science, physical computing, and programming with scratch/python.

Artful Ecosystems
Presenter: Marita Musante   **Annex**
This is a hands-on visual arts lesson in which participants will create a piece inspired by the work of Laurent. The piece will serve as a model of the relationship between terrestrial and aquatic ecosystems. Concepts of geometry (amorphous vs. geometric shapes) as well as the elements of line, color, and texture will be incorporated as well. The lesson meets California Common Core Visual Arts Standards for artistic perception and aesthetic valuing while also addressing NGSS Standards for developing and using models, communicating information, and demonstrating understanding (5-LS2-1, 3-LS4-3).

When Math and Art Collide
Presenter: Ryan Paula Keller   **Redwood**
Join us as we explore low tech and simple tech activities that allow students to reinforce algebraic and geometric concepts while expressing their artistic sides!

BREAKOUTS — SESSION 3

Science and Art: The Value of Integration
Presenters: Anna VanDordrecht, Casey Shea, & Matt O'Donnell   **Annex**
How might art be incorporated into the secondary science classroom? What is the value of viewing and analyzing mixed media with a science bent? What types of integrated projects might students create, and how might this influence their learning? In this session, we'll explore these questions, view examples of science and art integration, and develop lessons and prototypes to be used in your context.

How and Why to Add the Arts to STEM
Presenters: Bill Funkhouser & Heather Gaiera   **Sequoia B**
Integrating STEM subjects seems logical, but how did the Arts come into the picture? What are some easy-to-use strategies that teachers can implement even if they do not have a background in the arts? This session will be a crash course in arts integration philosophy, strategies and projects within STEM subjects. Teachers will leave with a few routines they can implement immediately and an understanding of how to plan for longer arts integration projects.

Using STEAM to Guide Lesson Planning
Presenter: Julie Hayes   **Learning Commons**
Learn how to plan cross curricular units using STEAM as the guiding principal (after the Standards) throughout the day and weeks. Learn about STEAM BUCKETS which are a classroom management tool for early finishers. They are filled with math games, maker supplies, and art tools.

Connecting Kids to our Local Forests
Presenter: Melinda Bailey   **Alder**
Connect local youth to our local forests by integrating math and science concepts using a newly designed life science curriculum. Scientific data will be integrated and utilized to fit your individual program by reviewing a data set from the redwood canopy, calculating classroom biomass, and investigating the dynamics from a forest thinning project conducted in the Headwaters Forest Reserve. Several other lessons will be highlighted along with a chance to discuss and exchange ways this curriculum can be utilized and enhanced in your 21st century classroom.

Citizen Science in the Classroom and Beyond
Presenter: Michael Kauffmann   **Redwood**
Citizen Science is the collection and analysis of data relating to the natural world by members of the general public as part of collaborative projects. In this session we will discover ways to collect citizen science data at or near your school and then put this into action by taking a trip to the woods near HCOE where we will collect our own data using apps and science-journaling techniques. Ultimately, participants will better understand ways to incorporate observation, questioning, and data collection across the school year and for years to come. Multiple resources, including drawing techniques, lesson plans, and collaborative apps/websites will be shared to bring back immediately for classroom use. Please bring: journal, tablet, smartphone, binoculars, and/or hand lens.

Implementing and Creating STEAM--Implementation: The Leadership Perspective
Presenter: Patty Hosfelt   **Madrone**
Designed for the administrator audience, this presentation covers an introduction to the implementation of an arts integration initiative in an elementary school. By using a Creative Pedagogical framework (Teaching for creativity, creative teaching, and creative learning) which incorporates learning with and through the arts, Spring Ridge Elementary is moving full STEAM ahead as we ignite passion and creativity in students and teachers. The session will provide the opportunity to learn how Arts Integration has been implemented at the elementary level and encourage administrators to research and investigate further ARTS Integration best practices in order to consider this approach for their own populations.

STEAM-Ed Vegetables
Presenter: Rosie Slentz   **Sequoia A**
Farm to Table, Farm to School, Field to Fork...digest these terms as we discover ways to deliver integrated lessons about food choices and their impact on economics, nutrition, environment, and culture. Session resources will include a curated collection of food systems curriculum for grades 4-12.

Overview of Maker Educator Certificate Program
Presenter: Dan Blake   **ERC**
This session will provide an overview of the Maker Educator Certificate Program, a unique partnership between Sonoma State University and the Sonoma County Office of Education, and discuss plans to expand the program to other parts of California.

BREAKOUTS — SESSION 4

Art and Logic of Minecraft
Presenters: Agustín Amaro & Mrinal Virnave   **Madrone**

Minecraft has taken the education world by storm. With the recent release of **Minecraft for Education**, educators and content developers are exploring new ways to incorporate this tool in the classroom and extending it to the home. This session will have participants explore the Minecraft game and perform some art and logic challenges individually or in groups of two. Followed by a group session trying out in real-time, possible ideas for integrating Minecraft as a teaching tool to meet teaching goals.

Power to the People
Presenter: Aletta Sauer   **Learning Commons**

Meaningful work resonates with teens, and when you can integrate practical skills like soldering and electronics repair with real community needs, you'll find your students ready and willing to step up their game. This presentation describes a Eureka High Engineering 1 culminating project, where students repaired solar-powered consumer devices that would otherwise be headed to the waste stream. Participants will leave with resources to help them plan a similar, community-service oriented culminating project.

Increasing Student Engagement in STEAM
Presenters: Anna VanDordrecht, Casey Shea & Matt O'Donnell   **Sequoia B**

Participants in this session will learn how to use new tech tools to increase student engagement in STEAM Hands-on activities include creating interactive displays linking analog and digital information with Hyperduinos, viewing and creating Virtual Reality experiences, building and creating citizen science tools like weather stations and wildlife cameras with Raspberry Pis.

Learning in High Definition: Integrated Learning Using Video
Presenter: August Deshais   **Sequoia A**

With just a single tablet and free (or virtually free) video editing software you can fill your classroom with STEAM! Video not only deepens learning, but also meets tech standards and is a powerful way for students to share their learning beyond the four walls of the classroom through a classroom website or Facebook page. Join me for an example-rich, hands-on session in which you will discover how video can address subjects from visual arts to language arts, and more. Note: A limited number of iPads will be available with iMovie installed, so BYOD with iMovie (or the Android video app of your choice) if possible.

Integrating STEAM into the 21st Century Classroom
Presenter: James Brescia, Ed.D.   **Alder**

Since the launch of the Russian satellite Sputnik in 1957, the United States has placed an emphasis on the teaching of science, technology, engineering and mathematics. The Eisenhower and Kennedy administrations' efforts to keep up with global competition are now joined with the arts. The Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS) emphasize the integration of STEAM into the curriculum with evidence-based reasoning. This session will take a step into changing the mindset about STEAM as a separate subject or set of activities outside of the regular curriculum. Session activities and discussions will present practical examples that educators and educational leaders can implement, share and modify in their own learning communities.

Engineering on a Shoestring
Presenter: Ken Pinkerton   **Redwood**

Explore integrating engineering, technology, science, math and art into your classroom with simple projects. This session is a hands-on, make-and-take class in which you can make stomp rockets, tops, optical illusions spinners, simple microscopes, bullroars and mini hovercrafts. We will also share resources, links and ideas. The session will also present info on the Engineering Challenge for the 2017 Humboldt Math Festival – Mouse Trap Racers!

STEAM Studio: Engage Creativity through Kinesthetic Learning
Presenters: Kim Morin & Robert Bullwinkel   **ERC**

"Dance" may (or may not) be your thing, but your students definitely yearn to "dance it out" and increase their comprehension through kinesthetic learning. Discover how dance can be integrated with science and math to create powerful learning in your classroom or lab, no dance studio, and no dance experience, required. This hands (and feet) on session will share practical, real world strategies for enhancing understanding of scientific concepts through (user friendly) movement.

PRESENTERS

Read full presenter bios online at http://tinyurl.com/steampresenters

Garry T. Eagles, Ph.D.
Humboldt County Superintendent of Schools

Garry began his career in education as a special education aide at Nightingale Elementary School in south Stockton in 1971. His journey in the profession has included teaching, site and district administration, and county office service. With the technological resources at one's disposal, and the encouragement that teachers are now being given to be creative in engaging students though cross-curricular approaches like STEAM and maker movement experiential learning processes, he is often overheard to say that today is perhaps the most opportune time to be a classroom teacher.

Jon Sapper, Ed.D.
Humboldt County Deputy Superintendent of Schools

Jon's career in education began as a high school vocational counselor in 1977 with Eureka City Schools. Moving north to Oregon in 1979, Jon was the Chief Student Affairs Officer for Southwestern Oregon Community College. He returned to Humboldt County in 1989 and joined the Humboldt County Office of Education. He has enjoyed 28 years serving local students, teachers, districts and communities. Jon states, "Education was a wonderful alternative 25 years ago in Humboldt County and across this country. However, you could still be a productive, contributing member in our community and society without a solid education. Those days are gone. Successful education today requires a strong foundation in the basics combined with innovative and entrepreneurial curriculum and thinking activities to engage kids and communities. This conference hits the nail right on the head!"

Agustín Amaro
Learning Specialist for English Language Learners & Seal of Biliteracy, Humboldt County Office of Education

Melinda Bailey
Forest Ecology Curriculum Author, HSU Natural History Museum

Dan Blake
Director of Innovation & Partnerships, Sonoma County Office of Education

James Brescia, Ed.D.
Superintendent of Schools, San Luis Obispo County Office of Education

Karen Brooks
Innovation, Creativity and Entrepreneurship Lead, Humboldt County Office of Education

Kerry Bruce
Computer Information Systems Instructor, Central New Mexico Community College

Robert Bullwinkel
Partner at Big Idea, an arts education consulting firm. www.bigideaconsulting.org

Peggy Burt
Lead, Arts Planning Initiative for the California Alliance for Arts Education

Amy Crispin
7th/8th Grade Math Teacher, Sunny Brae Middle School and 2012-2013 Humboldt County Teacher of the Year

PRESENTERS

Nick Dedini
6th Grade Math and Science Teacher at Jacoby Creek School

August Deshais
Kindergarten teacher at Ridgewood School and the 2016-2017 Humboldt County Teacher of the Year

Derek Fenner
Arts Learning Program Manager, Alameda County Office of Education

Bill Funkhouser
Project Coordinator for the North Coast Arts Integration Project, Eureka City and Klamath-Trinity Schools

Heather Gaiera
Project Coordinator for the North Coast Arts Integration Project, Eureka City and Klamath-Trinity Schools

Dawn Getzandanner
Master Science Teacher, Maryland State Department of Education

Tibora Girczyc-Blum
Founder, SCRAP Humboldt

David Haller
7th and 8th Grade Science and Math Teacher, Freshwater Charter Middle School.

Robin Hampton
Field Manager, California Alliance for Arts Education

Julie Hayes
First Grade Teacher, Arcata Elementary

Jesse Hobba
Science and Math Teacher, Sunny Brae Middle School

Patty Hosfelt
Principal, Spring Ridge Elementary, Maryland

Mark Huschle
Sixth Grade Teacher, Pacific Union School

Michael Kauffmann
Math and Science Instructional Coach, Fortuna Union Elementary School District

Ryan Paula Keller
Math Integrated Learning and Library Media Specialist, Humboldt County Office of Education

Erica Moore
Art Teacher, Crescent Elk Middle School and Del Norte County Arts Lead

Heidi Moore-Guynup
Coordinator of Humboldt County's Decade of Difference 2020 initiative

Jessa Brie Moreno
Integrated Learning Specialist, Alameda County Office of Education and Faculty, San Jose State University and the California Institute of Integral Studies

PRESENTERS

Kim Morin
Theatre Arts Professor, Fresno State and Partner in Big Idea, an arts education consulting firm, bigideaconsulting.org

Marita Musante
Fourth Grade Teacher, Cutten Elementary School

Matt O'Donnell
Tech Innovation Specialist, Sonoma County Office of Education

Ken Pinkerton
Middle School Science Teacher, Retired

Allison Poklemba
Environmental Educator and Coordinator the North Coast CREEC (California Regional Environmental Education Community) Network

Aletta Sauer
Accounting and Engineering Teacher, Eureka High School

Casey Shea
Curriculum Coordinator for Maker Education, Sonoma County Office of Education

Rosie Slentz
Integrated Learning Specialist, Humboldt County Office of Education

Colby Smart
Coordinator of Learning Support Services, Humboldt County Office of Education and Adjunct Faculty, Humboldt State University

Tanya Trump
CTE (Career Technical Education) and Maker Learning Specialist, Humboldt County Office of Education

Tyler Vack
8th Grade Language Arts and Math, 7th and 8th Grade Science, tech skills, and Spanish, Trinidad School

Anna VanDordrecht
Sonoma County Office of Education

Mrinal Virnave
Director of Service Strategy and Architecture, Blackboard and Former IT Director, New Mexico State

Pat Wayne
Program Director of CREATE CA, California's Statewide Arts Education Coalition

Jesse Wheeler
Fourth Grade Teacher, Cutten Elementary School

Henry Wotherspoon
Innovator and Student, Eureka High School

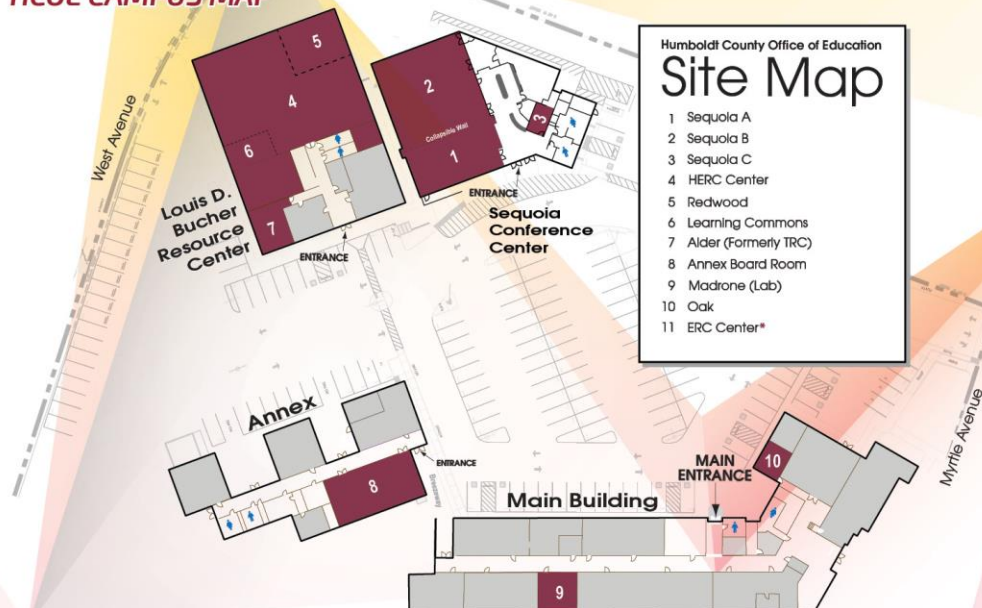**Stacy Young**
Visual & Performing Arts Learning Specialist, Humboldt County Office of Education and Region 1 Arts Lead for CCSESA

MAPS & DIRECTIONS TO ERC

HCOE CAMPUS MAP

Humboldt County Office of Education
Site Map

1. Sequoia A
2. Sequoia B
3. Sequoia C
4. HERC Center
5. Redwood
6. Learning Commons
7. Alder (Formerly TRC)
8. Annex Board Room
9. Madrone (Lab)
10. Oak
11. ERC Center*

ERC MAP & DIRECTIONS

*Breakout sessions are held on the main HCOE Campus, with the exception of those labeled "ERC." The ERC is located a short walk down Myrtle Avenue.

To get there:

1. Exit the Sequoia Center doors and head toward the Myrtle Avenue entrance of the campus.

2. Turn right and walk past the green belt until you get to Sixth Street.

3. The building is a cream building with a blue roof on the corner of Sixth and Myrtle. Turn right down Sixth Street and you will see the entrance.

A shuttle van will also be available.

ACKNOWLEDGEMENTS

Humboldt County Office of Education

Humboldt County Schools are rich in Visual and Performing Arts endeavors from events to education: arts specialists, artists in residence, teaching artists and general teachers integrating arts. The Visual and Performing Arts consist of Dance, Digital Media, Music, Theatre and Visual Arts. The 21st Century Learning Skills of the 4 C's: Creativity, Communication, Collaboration, and Critical Thinking are embedded in the very nature of participating in the arts. Beyond the research of improved brain function and academic success, the arts are intrinsic to human nature. Whether as a participant, an educator or an enthusiastic supporter, we continue to strive to bring arts to every student in Humboldt County.

California County Superintendents Arts Initiative

The California County Superintendents Arts Initiative believes that the visual and performing arts are an integral part of a comprehensive curriculum and are essential for learning in the 21st century. All California students—from every culture, geographic region and socio-economic level—deserve quality arts learning in dance, music, theatre, and visual/media arts as part of the core curriculum. The program creates a safe, affirming, and enriched environment for participatory and inclusive learning in and through the visual and performing arts for every group of students. Visit www.ccsesaarts.org for more information.

The William and Flora Hewlett Foundation

The Hewlett Foundation is a private foundation whose performing arts grant program entertains applications from professional dance, music, opera/musical theater, and theater companies, as well as organizations that present the performing arts. The Foundation also supports arts councils that serve San Francisco Bay Area communities, and service organizations that assist performing arts organizations in all disciplines. The program's geographic focus is the San Francisco Bay Area, however, national grants have been awarded in the past two years. There is a list of grant awards with links available on the site. The Region 1 STEAM conference is supported financially by the generosity of The Hewlett Foundation.

createCA

createCA is a coalition of dedicated and innovative leaders who understand that together we have the power to create lasting change for every California student. Our mission is to ensure ALL students are able to reach their full potential by advancing an education model that promotes creativity and the arts for the 21st century workforce.

Appendix B

Photographs of the STEAM Conference

Appendix C

Pre-STEAM Conference Survey

* Required
To what degree do you currently teach STEM? *

	1	2	3	4	
Not at all	O	O	O	O	Daily

What subjects do you teach? Select all that apply. *

- o I am not a teacher
- o Language Arts
- o Social Studies
- o Science
- o Technology
- o Engineering
- o Arts Integration
- o Mathematics
- o Arts - Visual Art
- o Arts - Music
- o Arts - Drama/Theatre
- o Arts - Dance
- o Physical Education
- o Career Technical Education
- o World Languages
- o Other:

What grade levels do you teach? *

- o I am not a teacher
- o Primary
- o Upper elementary
- o Middle School/Junior High
- o High School
- o Post-Secondary
- o Teacher/Coach of Teachers
- o Other:

To what degree do you currently teach STEAM? *

	1	2	3	4	
Not at all	O	O	O	O	Daily

Why did you register for the STEAM conference? *

- o Interested in STEAM
- o Interested in STEM
- o Part of a grant requirement
- o Other:

In what county do you work? *

- o Del Norte County
- o Humboldt County
- o Lake County
- o Mendocino County
- o Sonoma County
- o Alameda County
- o Fresno County
- o Monterey County
- o Sacramento County
- o San Luis Obispo County
- o Shasta County
- o Trinity County
- o Other:

What do you hope to learn from the STEAM Conference? *

Your answer

Appendix D

Post-STEAM Conference Survey

To what degree do you anticipate teaching STEM going forward? *

1   2   3   4
Not at all   O   O   O   O   Daily

Is this an increase to your STEM teaching? *

- o   Yes
- o   No
- o   Unsure
- o   Other:

What subjects do you teach? Select all that apply. *

- o   I am not a teacher
- o   Language Arts
- o   Social Studies
- o   Science
- o   Technology
- o   Engineering
- o   Arts Integration
- o   Mathematics
- o   Arts - Visual Art
- o   Arts - Music
- o   Arts - Drama/Theatre
- o   Arts - Dance
- o   Physical Education
- o   Career Technical Education
- o   World Languages
- o   Other:

What grade levels do you teach? *

- o I am not a teacher
- o Primary
- o Upper elementary
- o Middle School/Junior High
- o High School
- o Post-Secondary
- o Teacher/Coach of Teachers
- o Other:

To what degree do you anticipate teaching STEAM going forward? *

1	2	3	4	
Not at all	o	o	o	o	Daily

Is this an increase to current STEAM teaching? *

- o Yes
- o No
- o Unsure
- o Other:

Why did you register for the STEAM conference? *

- o Interested in STEAM
- o Interested in STEM
- o Part of a grant requirement
- o Other:

In what county do you work? *

- o Del Norte County
- o Humboldt County
- o Lake County
- o Mendocino County
- o Sonoma County
- o Alameda County
- o Fresno County

- o Monterey County
- o Sacramento County
- o San Luis Obispo County
- o Shasta County
- o Trinity County
- o Other:

Are you more likely to teach using STEAM strategies?

- o Yes
- o No
- o Unsure
- o Decline to state
- o Other:

Why or why not?

Your answer

What was a highlight of the STEAM Conference? *

Your answer

Suggestions or criticisms:

Your answer

Would you be willing to be selected to be interviewed regarding your STEM/STEAM

practices? If you are selected (10% of respondents will be randomly selected) your

identity will be confidential but no longer anonymous.

- o yes
- o no

If you answered yes to the previous question, please type in your email or phone number.

Please note that while your answers will be confidential they will no longer be

anonymous. If you answered no, thank you for completing the survey.

Your answer

Appendix E

Follow-up Interview Questions

Do you agree to participate in this interview and waive your right to documentation of consent?
- o Yes (required to participate)

Have your STEM practices increased since the STEAM conference?

If yes, to what degree?

	1	2	3	4	
Incremental difference	O	O	O	O	Daily practice

If yes, how?

Have your STEAM practices increased since the STEAM conference?

If yes, to what degree?

	1	2	3	4	
Incremental difference	O	O	O	O	Daily practice

If yes, how?

What subjects do you teach?

What grade levels do you teach?

To what degree do you anticipate teaching STEAM going forward?

Why did you register for the STEAM conference?

In what county do you work?

Are you more or less likely to teach using STEAM strategies?

Why or why not?

What is your selected pseudonym?

What outcomes to student learning and/or engagement have you discovered?

Appendix F

Informed Consent

Stacy Young is doing a master's thesis on the effect of Arts in STEM (Science, Technology, Engineering and Mathematics) also known as STEAM on student outcomes. If you volunteer to take the two 10 minute surveys (pre and post conference) it will inform this work on future professional development offerings. 10% of respondents will be randomly selected to be interviewed one month following the STEAM conference to learn more about their experiences at the conference and if they have adopted any new teaching practices as a result. There are no foreseeable risks or discomfort for the respondents. All surveys and interviews will be reported without any identifying information. Interview subjects will be asked to provide a pseudonym that will be used in data collection. Expected benefits will manifest in professional development offerings.

The records will remain confidential until 3 years after the master' degree is conferred, at which time they will be destroyed. No compensation will be offered for participation. Participation is voluntary, refusal to participate will involve no penalty or loss of benefits, and participants may discontinue participation at any time without penalty. Questions regarding the research or in case of research-related injury should be directed to Eric Van Duzer, Ph.D., email: evv1@humboldt.edu HSU Office HGH 209 (707) 826-3726.

Prior to the survey, you will be asked to read and agree to a statement regarding the voluntary nature of their participation. Once you click on agree, you will be brought

to the survey itself. Please print this informed consent form now and retain it for your future reference. If you agree to voluntarily participate in this research as described, please check the box below to begin the online survey. Thank you for your participation in this research.

Stacy Young can be reached at 707-445-7077 or by email syoung@hcoe.org. If you have any concerns with this study or questions about your rights as a participant, contact the Institutional Review Board for the Protection of Human Subjects at irb@humboldt.edu or (707) 826-5165.