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STEM + Visual Art: The Development of an Art Integrated Curricular Resource for K-12 Educators in Idaho

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STEM + VISUAL ART: THE DEVELOPMENT OF AN ART INTEGRATED CURRICULAR RESOURCE FOR K-12 EDUCATORS IN IDAHO

by

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The following individuals read and discussed the project submitted by student Drew Elaine Williams, and they evaluated her presentation and response to questions during the final oral examination. They found that the student passed the final oral examination.

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AUTOBIOGRAPHICAL SKETCH

I grew up in suburban Philadelphia and Pittsburgh, Pennsylvania. The arts were prevalent in my K-12 education, and cultivated by the school districts in these cities which recognized their importance in the curriculum. I spent my summers in Idaho with my father's family, taking art lessons, swimming, and visiting the mountains. I knew well before high school graduation that I wanted to relocate to Idaho for my undergraduate education.

My family and friends in Pittsburgh were always supportive of my dreams and goals, even when they took me over 2,000 miles from where I attended high school. As a child, I was very quiet, shy, and had an active imagination that was manifested through drawings and paintings. My family actively encouraged my artistic pursuits, enrolled me in art classes, provided art supplies, and supported my artistic successes in school. While I also enjoyed English and history, I coasted by with average grades in science and math courses in school, struggling with concepts and becoming easily bored in these classes. As a student, the rote memorization of my times tables and monotony of science class lectures couldn't compete with the excitement and confidence I felt when I picked up a drawing pencil or paintbrush. Nonetheless, my family never tried to persuade me to choose a more "practical" major in college, or select a career path with more viable financial compensation and job opportunities. They did what many might consider

unthinkable in today's economy, but for recognizing that my talents and passion for visual art would better assist me than struggling in a boring, monotonous, but well-compensated, field of work, I am sincerely grateful.

Though I had initially intended to pursue a path that combined my collegiate studies in fine art and business, an education internship at the Boise Art Museum proved to be the catalyst for a life-changing new direction in my career path. Inspired by the art educators who taught me, and having witnessed the incredible, dedicated staff at the Boise Art Museum through my internship, I spent the next several years as an art museum educator. I enrolled in the Master of Arts in Art Education program at Boise State University, and have since committed to learning and practicing the art of teaching.

My professional background as an art educator, and my research interests in inquiry-based approaches towards art education, has led to my interest in developing a curricular resource that promotes the inclusion of visual art in the teaching of other subjects. As mentioned, I was fortunate to spend much of my professional career thus far working for an art museum with an educational mission that emphasized the value of art experiences for all ages. The museum served students and teachers across Idaho with high quality art instruction and resources. Over the course of my time at the Museum, I learned to create strategies and resources for teachers to integrate themes from art exhibitions into other subject areas. This project aims to synthesize the knowledge I have gained through on-going research interests in the M.A. Art Education program along with my professional experiences as an art educator in a museum and in public schools.

ABSTRACT

The purpose of this M.A. Art Education project is to explore the reasoning, methods and justification for integrated art curricula in K-12 education, drawn from the belief that art is essential and inseparable from academics. In Idaho, the need for art teaching resources is especially great, as present funding circumstances and educational mandates have shifted away from the arts. Teachers do not always have access to resources and high-quality curricular materials. They do not always feel that they possess the knowledge, skills or confidence to successfully implement art lessons within their classrooms. The rationale and methods used to develop a curricular resource for K-12 teachers in Idaho entitled "STEM+Visual Art" are explained in this paper, alongside research-based advocacy for art education.

The history of recent educational policies and their effects on the marginalization of art education in the public school system have coincided with the emergence of science, math, and technological education through the STEM movement. STEM, an acronym for science, technology, engineering, and math, is currently being emphasized in schools as a way to engage students in experiential, project-based learning to better prepare them with 21st century skills for career and economic purposes. The argument for art as an integral process for preparing students as innovative and creative thinkers, as well as the ways in which art overlaps with STEM subjects, is presented. The philosophy for integrated curricula that promotes art as a viable, valuable subject of its own merit is

discussed and debated. Further, an inquiry-based strategy for teaching art integrated content is defined and examined.

The STEM+Visual Art curricular resource includes content derived from the study of these topics, including a philosophy for integrated curricula, catalogue of artist examples, lesson plans, and teaching resources. The research methodology involved critical feedback from teachers to shape the content and design of the resource. Further, pilot lessons were used to effectively evaluate whether the intended purposes of the lesson were clearly communicated by both the teacher and author. The outcomes of this process showed that teachers are willing to take time to plan and teach art lessons when resources are made available. The results emphasize the importance and need for art integrated resources such as this M.A. project. Last, recommendations for improvements and further study related to this topic are suggested.

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As an educator currently working in all grade levels and subject areas, I commonly teach students in areas of science and math. These subjects have become increasingly noted for their importance in the development of a highly skilled American workforce and are an integral part of 21st century education. Schools nationwide are adopting curriculum to support these subjects, known by the acronym “STEM,” which stands for science, technology, engineering and math.

Recently, the concept of an integrated curriculum with STEM subjects and the arts is gaining ground. Most frequently, this initiative is labeled with the updated acronym "STEAM," incorporating the "arts" as one of the primary components in science, technology, engineering and math education. The STEAM initiative is documented by research from the Rhode Island School of Design (RISD), whose website collects case studies that promote inclusive STEM and art curriculum. According to RISD (2012):

> Innovation still seems tightly coupled with Science, Technology, Engineering, and Math – the STEM subjects. Art and design are poised to transform our economy in the 21st century like science and technology did in the last century. We need to add art and design to turn STEM into STEAM.

Art educators are well aware of the emphasis in science and math over other subjects such as art in the public school system. They are also aware of the value that the arts lend to these subjects, enhancing and increasing student creativity, critical thinking

skills and awareness of the visual culture in which we live. Finding common ground between art and other subjects has always been of great importance for art educators to support the legitimacy of art in students' education, and is perhaps more essential now than ever before.

Need for Project

Art is meaningful, relevant and impactful in students' lives. Art is also an enjoyable part of students' education. From a field trip to an art museum to view works of art by historic or contemporary artists, to the creation of illustrations that accompany class projects, art is a memorable and important part of a child's education. Students are surrounded by a multitude of visual imagery in everyday life, from advertisements to electronic media such as iPads and smartphones. In light of this, students will need the ability to process and discern the messages they are receiving from the constant barrage of visual stimuli. Yet as art drives our increasingly visual culture and society, it is being downplayed in education, and all too often is cut in favor of other subjects or due to budgetary constraints.

As "STEAM" is being emphasized by researchers and practitioners nationwide, educators are incorporating visual art into the STEM movement. Though educators, specialists and researchers are exploring this concept, there are few resources devoted to the inclusion of visual art in STEM subject areas in Idaho schools. Idaho's education curriculum stands to be enhanced and greatly enriched with the inclusion of high-quality lessons that integrate visual art with STEM subjects. STEM subjects continue to be promoted in the Idaho education system, yet there is little mention of the dearth of art

education for students. To advocate for the importance of art education, it stands to reason that the question of how teachers can best include art into their teaching of STEM subjects should be explored. A curricular resource for teachers that promotes effective strategies for teaching STEM subjects and visual art as a teaching tool may help to demonstrate the value of a high-quality, integrated art education for students.

At their essence, STEM subjects and visual art overlap in many areas and share several commonalities in how they are taught. For example, topics in science are often taught with a focus on experimentation and observation of phenomena in the world around us. Likewise, art teachers challenge students to express ideas that relate their experiences with our world and involve problem-solving with materials, techniques and design through the creation of works of art.

The philosophies behind a STEM curriculum are based upon the idea that these subjects are the best way to promote innovation in our society through education, looking at students as our future workforce. Science, technology, math and engineering will continue to be promoted as subjects that provide important skills for 21st century learning. Research from RISD (2012) and other sources argue that for truly innovative education, the inclusion of art may extend students' critical thinking skills and provide multiple lenses through which they explore our world. Yet according to Wynn and Harris (2012), teaching a STEM and art integrated curriculum is not "…a magic bullet for innovation." Rather, a focus on STEAM can be described as an opportunity for teachers to collaborate, learn and teach about the areas where art and STEM intersect (Wynn & Harris, 2012).

Currently, Idaho does not typically employ art specialists at the elementary level in public schools (Idaho Commission on the Arts & Idaho State Department of Education, 2010). Art education is often left to teachers and parent volunteers who do not always have adequate resources and knowledge to incorporate a truly high-quality art education. A lack of qualified art educators in Idaho schools, few resources related to the teaching of visual arts for teachers in other subject areas, and the current educational emphasis on subjects in the STEM curriculum, have led to the importance of developing a curricular resource for teachers at all levels focused on the inclusion of visual art in STEM subjects.

This project will investigate the research and development of a curricular resource for utilization by Idaho teachers across K-12 grade levels in response to the following questions:

- Why incorporate visual art with STEM-based instruction? What learning outcomes does the integration of STEM and visual art yield for students?
- What would a STEM curriculum with the inclusion of visual art look like in Idaho schools?
- How can Idaho teachers implement and assess lessons that incorporate concepts from both STEM and visual art to enhance student understanding of these subjects?

Design of Project

The goal of this project will be to provide a curricular resource for Idaho educators from grades K-12 to integrate visual art into teaching of STEM subjects. This resource will advocate for the inclusion of visual art in STEM curricula, and use an inquiry-based

approach towards the teaching of these subjects. In addition, this resource will present strategies for non-art teachers and art teachers alike to confidently and successfully teach lessons that integrate learning about artists, artwork and art-making methods in the exploration of science, technology, engineering and math topics. The STEM+Visual Art curricular resource will be composed of the following sections:

- Philosophy of an Inquiry-Based STEM+Visual Art Curriculum
- Catalogue of Images
- Lesson Plans and Assessments
- Additional Resources
- References

The methodology used to develop this project includes critical research of other STEM and visual art resources nationally and locally, an examination of the history of STEM and visual art education in Idaho, and a look at the work of visual artists whose work incorporates themes tied to STEM subjects. Here I have examined literature that discusses the merits and limitations of teaching art along with STEM subjects for the purpose of developing best approaches and practices for teaching an integrated art curriculum. The process also involved consultation with teachers to determine what subjects and projects would best work within their teaching contexts.

In addition, I explored inquiry-based approaches to teaching art and STEM subjects as a method of pedagogy. Besides a focus on specific subjects, STEM education is designed for students to engage in discourse and discussion through active, experiential learning activities (Idaho State Department of Education, 2012). Inquiry can be defined as "generating and answering pertinent questions in a dialogic manner" (Villeneuve &

Love, 2007). Using this definition, inquiry can be understood as a method of developing and asking questions that will cause not only response, but an interactive dialogue that engages students. Learning is fostered through social interaction, mentoring, and collaboration among peers, as facilitated by the teacher (Villeneuve & Love, 2007). Armstrong (1986a) contends that inquiry in art is a process of "visual analysis", and in this process, "questions by art teachers prolong specific, detailed information-gathering." Students can collect and recall the information they have learned to produce reflective thinking (Armstrong, 1986a). When prompted by questions from the teacher, students may build aesthetic vocabulary and knowledge. This method of instruction supports the type of learning that is associated with STEM, as students "…learn by shaping arguments and solving problems in the course of a continuous process of asking questions, experimenting, designing, creating, and gathering compelling supporting evidence" (Idaho State Department of Education, 2012).

Using the aforementioned research as well as information about current educational policies and STEM initiatives in Idaho schools, I developed a comprehensive curricular resource designed for use by teachers at all grade levels. The curricular resource is designed for ease of use, with clear language, explanation of terms and vocabulary and a clean layout. The lessons were developed to encourage teachers to adapt them for their own use and collaborate with other teachers, community resources and art specialists. Additionally, the resource promotes integration of technology and other resources for learning.

Lesson plans were developed according to specified grade levels, with concepts that are broad enough for teachers to adapt them for their particular students. The grade levels

are divided into K-3rd grades, 4th – 6th grades, middle/junior high school, and high school levels. Each grade area contains two lessons focused on the STEM subjects: science, technology, engineering and math. The lessons incorporate exploration of artists, works of art or art-making processes as part of the lesson content, with the goal of student-produced artwork through individual or collaborative processes.

Assessment and clear examples of standards are equally important in the development of content rich lessons, as educators in public schools face increasing accountability for student achievement. Each lesson within this curricular resource features learning goals and clear objectives for student achievement, as well as models for assessment. Methods for assessment may include observations, scoring rubrics, and questions designed for teachers to evaluate students' understanding of concepts presented in each lesson. In addition, all of the lessons in the curricular resource are developed to meet Idaho State Education Standards and Common Core State Standards.

This project is meant to demonstrate how inclusion of visual arts can enhance and enrich STEM-based instruction. As a curricular resource, this will position art education as a viable way for students to explore mathematical and scientific concepts while developing and expressing their creativity through artistic media. In addition, this project promotes and advocates for the value of visual art as an inclusive part of education for all students. Further study in how this curricular resource can achieve this end are suggested, as well as some discussion of the potential limitations to this project and suggestions for further research.

Scope and Limitations of Project

This project may be thought of as a "springboard" for further study and design of resources related to STEM and visual art education. In other words, while the project will aim to present useful ideas and techniques for Idaho teachers to implement, it is not so large that is will present enough information for a full year of study. Rather, the goal will be for teachers to use these lessons as inspiration to design their own lessons for future use, proceeding with confidence and understanding of how these subjects can enhance student learning. In addition, it is important to recognize and understand that each classroom and teacher has different needs and methods for achieving learning. The lessons will be designed to present information in a broad enough context for flexible use by teachers, but may need further differentiation to meet the individual needs of a classroom.

CHAPTER TWO: LITERATURE REVIEW

Introduction

This literature review examines the state of educational policy related to art education at the national and local level, as well as describes the origins of the STEM education movement for the purpose of understanding the issues and challenges for implementing an integrated art and STEM curriculum in Idaho. The literature reviewed consists of research on the topic of integrated art and STEM subject lessons as they relate to learning, and details the arguments and challenges for their inclusion in K-12 education. Information is also presented regarding inquiry-based pedagogy, as well as the rationale and methods for assessing student learning from integrated curricula.

Recent Educational Policies and Visual Art

The recent policies in education have greatly affected the place of visual art in public education, and provide a starting point for discussion. Reports and policies pertaining to education, from *A Nation at Risk* (1983) to *No Child Left Behind* (2002), spur calls to action, and lay out varying arguments for school reform. Despite changing messages, these legislative initiatives remain consistent in providing a perpetual public conversation about the question of what schools should actually teach. While art education benefited from more attention and better funding in the 1970's and 1980's, the

education landscape has experienced many changes that have left the current state of art education in a tenuous position in many school districts. The aforementioned *No Child Left Behind Act of 2001* (NCLB) may have been one of the most impactful pieces of legislation to affect public education within the last few decades, and certainly one of the most widely known. Due to NCLB, overall funding for schools is now hinged on their ability to meet "Adequate Yearly Progress," or AYP, determined by the results of standardized testing in reading and math.

Perhaps a significant success of the law, as seen by art education advocates, was the inclusion of art as one of the designated "core" academic subjects. However, not all core subjects are created equal, it seems, as the limited focus on reading, math, and science in standardized, high-stakes testing has consequently resulted in leaving other subjects behind. The subject of decreased instructional time devoted to the arts and other subjects not formally tested under NCLB has been echoed numerous times in articles that discuss the effects of NCLB on art education. Circle (2005) cites that the pressure placed on school districts to achieve AYP has left programs such as the arts, which are "…viewed as peripheral by administrators", greatly curtailed, or cut altogether.

Chapman (2004) discusses the effects of NCLB legislation on art education in detail. NCLB was intended to close achievement gaps between students, and increase proficiency and test scores (Chapman, 2004). The unintended consequences of NCLB have resulted in a downshift in spending and emphasis on subjects that are untested as part of AYP, which includes the arts. Chapman (p. 12, 2004) does discuss other aspects of NLCB that had implications for art education:

> The law also authorized arts education activities in research; model school-based arts education programs; development of statewide tests; in-service programs; and unspecified collaborations among federal agencies, arts and arts education associations.

To this date, many of these initiatives do not seem evident in most public schools. Part of this reason may be that funding was never provided to ensure that these activities occurred (Chapman, 2004). NCLB also placed emphasis on art integration in curriculum, though Chapman (2004) asserts that this further designates art as not part of the regular "core" curriculum, despite the recognition of art as a core subject as written in the law.

After NCLB changed the landscape of education, a new curricular emphasis known as "STEM" was explored and further shifted art down the ladder of learning priorities. The acronym "STEM," again, stands for science, technology, engineering, and math. Wynn and Harris (2012) cite the origins of STEM education as a mandate from Congress that recognized the need for innovation in America, seen as being behind the curve in the international community. In 2011, President Obama announced the reauthorization of the COMPETES act, which among other items, provided funding for STEM education (Wynn & Harris, 2012). The basis for the STEM movement is outlined in a 2010 Report to the President entitled "Prepare and Inspire: K-12 Education in Science, Technology, Engineering and Math (STEM) for America's Future." This report was developed by a team known as the President's Council of Advisors on Science and Technology, or PCAST. As an advisory group, PCAST is comprised of the nation's leading scientists and engineers appointed by the President to make national policy recommendations in their areas of expertise (Prepare and Inspire: K-12 Education in

Science, Technology, Engineering and Math [STEM] for America's Future, 2010). Their report (2010) details the reasoning behind the STEM emphasis in public education, citing the need to prepare and inspire students with STEM education to fulfill a need for U.S. leadership in a competitive, global market to solve challenges in areas such as health, energy, and environmental sustainability. The PCAST report concludes with five recommendations concerning STEM education:

> (1) improve Federal coordination and leadership on STEM education; (2) support the state-led movement to ensure that the Nation adopts a common baseline for what students learn in STEM; (3) cultivate, recruit, and reward STEM teachers that prepare and inspire students; (4) create STEM-related experiences that excite and interest students of all backgrounds; and (5) support states and school districts in their efforts to transform schools into vibrant STEM learning environments (Prepare and Inspire: K-12 Education in Science, Technology, Engineering and Math [STEM] for America's Future, 2010).

These recommendations can be seen at the national and local level in schools with the advancement of STEM related resources and professional development opportunities for teachers.

Along with the STEM movement in recent years, all school subjects stand to be greatly affected by the upcoming Common Core State Standards (CCSS). Idaho, along with 44 other states, has adopted the CCSS from a federal education initiative designed to improve and implement consistent standards for Math and English Language Arts (ELA). According to the Common Core State Standards Initiative website (2012), the standards were developed to be relevant for the "real world" skills students will need for college

and careers, with the ultimate goal of providing a successful workforce for the global economy. The aforementioned PCAST report on STEM Education (2010), cite the origins of CCSS, correlating them with a need for consistent and rigorous standards in STEM education, and mentioning the possibility of future Common Core standards enacted for science education. CCSS and STEM can be tied together as educational strategies at the national and local levels for increased quality of standards, assessment and accountability measures.

Despite a de-emphasis in viewing art as a vital part of curriculum, researchers are continuing to report positive outcomes for student learning when art is incorporated. A report from a Johns Hopkins University summit (2009) shed light on the relationship between art and neuroscience, citing the importance of creative education for students' cognitive abilities. Just as STEM has been directly related to the workforce, the arts are looked at from a macroeconomic, national perspective, stating that art education promotes collaboration, creativity, and learning across multiple disciplines (Hardiman, Magsamen, McKhann & Eilber, 2009). The Johns Hopkins report (2009) provides some hope that an opportunity to secure the place of art in schools, along with appropriate funding, may someday surface in legislation, as well as provide ample evidence that supports the cognitive benefits of art for students.

State of Visual Art and STEM Education in Idaho

In 2010, a joint project between the Idaho Commission on the Arts and the Idaho State Department of Education entitled "A Report on the Status of Arts Education in Idaho" produced some results that may have been surprising for art education advocates.

The report found that art education funding from various sources such as the state, district, PTO/PTA organizations, and the Idaho Commission on the Arts, were typically spent on art materials, field trips and assemblies (Idaho Commission on the Arts & Idaho State Department of Education, 2010). The least amount of the funding was spent on collaborative learning time, curricular development for art and hiring of art specialists (Idaho Commission on the Arts & Idaho State Department of Education, 2010). These findings suggest that there are significant challenges for the development of a high-quality art programs in schools, and the ability for teachers to have access to adequate resources and time to implement an art integrated curriculum.

In contrast to the lack of resources dedicated to the development of high quality art programs in Idaho schools, there is a more noticeable effort by the Idaho State Department of Education to promote STEM education. This initiative uses the acronym "i-STEM" for Idaho Science, Technology, Engineering and Mathematics, and is described as a coordinated state-wide effort amongst the Idaho State Department of Education, educators, business and industry leaders in these fields, to promote the education of STEM subjects (Idaho State Department of Education, 2012). The mission and objectives of i-STEM according to the Idaho State Department of Education website (2012) is to develop resources and professional development for educators to implement stronger teaching of STEM subjects. STEM education emphasizes inquiry-based, problem-solving and project-based ways of learning about topics that are denoted by i-STEM as directly linked to the needs of Idaho's industries (Idaho State Department of Education, 2012). Similar to the development of STEM at the national level, the Idaho

effort connects these subjects with a stronger workforce and the needs of a global economy.

The i-STEM initiative shows a clear distinction between the ways in which art and STEM subjects are regarded and supported in Idaho education. The i-STEM website (2012) lists multiple events for professional development for educators, dozens of lesson plans designed for STEM, opportunities for individuals and businesses to donate funding and materials to support STEM education, and many other resources. Contrasting with the array of resources for i-STEM, the Humanities area of the Idaho State Department of Education website (2012) offers some curricular resources for art and articles that support arts education, but the limited amount of information dedicated to these subjects is nowhere near the level of the i-STEM movement. This void offers opportunities for art educators to create further resources for art education, and explore the skills and types of learning that the arts and STEM have in common.

Aligning Art and STEM with State Standards

Idaho Content Standards are used by Idaho school districts to establish a level of academic achievement necessary for students to graduate from Idaho's public schools (Idaho State Department of Education, 2013). Visual art falls under the category of "Humanities" in Idaho's Content Standards. While humanities credits are required, the visual arts themselves are not. Realistically, a student could attend public school in Idaho for 12 years or more and never set foot inside a visual art classroom. Due to the manner in which art is classified as a sub-heading, students can elect to spend their credits taking

music, dance, or other subject credits to fulfill the Humanities requirement (Idaho State Department of Education, 2013).

Conversely, science education in Idaho has a set of state content standards that are generally divided into areas, depending upon grade level, of biology, earth science, physical science and the nature of science consisting of forming hypotheses, analyses and investigations and other scientific skill-based concepts. Math education in Idaho likewise has a set of standards that are divided by grade level, and focus on topics such as numbers and operations, probability, algebra, geometry and at the secondary level, more advanced concepts such as calculus.

Technology and engineering education are not addressed in a straightforward manner with separate standards like those for art, math and science. Engineering and technology education in K-12 schools do not have individual state content standards, but are woven into standards for other subject areas. Therefore, it may be more useful for teachers to consider the basic proponents involved in many engineering processes, such as problem solving and design, and incorporate these aspects into lessons (Bequette, J. & Bequette, M.B., 2012). Likewise, technology does not have an individual set of state content standards and is also not traditionally taught as a stand-alone subject, but many Idaho schools are working to implement technology into classrooms across the state, from SMART boards and document cameras to computer stations for students. Additionally, teachers can incorporate web-based instructional resources, media content from the internet and other sources into lessons. If educators purposefully and skillfully incorporate technological resources into lessons, they may help students gain competency in their usage.

Learning from an Art Integrated Curriculum

The integration of art into other subject areas is not a new concept. For many years, educators working at various levels nationwide have made a case for integrated curricula by successfully demonstrating how learning is possible through units, lessons, courses and programs designed to integrate of art into the traditional subjects of math, science, language arts, and social studies. For the purposes of this literature review and project, the term "art integration" can be defined as an approach to teaching art in which students construct and demonstrate understanding of a topic through an art form (The Kennedy Center, 2013). The purposes of teaching with art integration are further clarified in the following statement by The Kennedy Center (2013): "Students meet dual learning objectives when they engage in the creative process to explore connections between an art form and another subject area to gain greater understanding in both." This definition clearly highlights the importance of gaining equal understanding of themes, ideas, and topics in both disciplines, rather than simply utilizing art as a vehicle for gaining greater skills within mathematics or science.

Wynn and Harris (2012) argue that teachers must be the first to organize and implement STEM and art integrated curricula, proving that these methods can yield effective results for learning, before policy makers will move forward. In addition, Wynn and Harris (2012) also argue that when science and math are taught through quantitative methods alone, they lose their ability to apply to real-world situations. Yet there are challenges to implementing an integrated curriculum. As Riley (2012) notes, integration requires planning, collaboration, research and practical application by educators, and

teaching integrated lessons aligned with visual art standards can seem daunting for teachers who are not confident in facilitating lessons with art content.

However, STEM and art integrated curricula may have significant benefits for students of both disciplines. For example, artists can enhance their skills by learning about the methods in which scientists and mathematicians think and test theories, while the latter can better visualize and execute their ideas by using an artistic frame of reference (Wynn & Harris, 2012). Wynn and Harris (2012) further describe this concept by stating, "…employing artistic sensibilities in STEM practices is more an affinity of shared values than an appropriation." The capacity to think of ideas and test them might be best thought of as "learning to envision," a skill that students in visual arts classes learn to use that goes beyond observation (Hetland, Winner, Veenema & Sheridan, 2007). Observation and envisioning can be thought of as "…ends of the same continuum," according to Hetland et al. (2007). For artists, the relationship can be seen in ways that artists work from images and express them in another medium, a translation between idea and representation, or envisioning (Hetland et al., 2007). This process begins with images that are observed in reality or drawn from imagination that was derived from observing the world (Hetland, et al., 2007). Within the continuum discussed by Hetland et al. (2007), the concept is planned and developed through its execution as a work of art. A comparison can be made between the envisioning described by Hetland et al. (2007) and the process in which scientists develop and test hypotheses, later used to draw conclusions. Again, the similarities in thinking processes between art, science, and math demonstrate evidence for how the subjects can be intertwined to boost students' capacities in these shared skills.

The other two areas of STEM, technology and engineering, are less represented in school curriculum, but have connections to students and visual art. Prensky argues that students, and indeed many educators, can be considered native speakers of technological communication, thoroughly familiar and representative of the various methods and ways in which society interacts through social networks, text messages, digital correspondence and other technologies (as cited in Cress, 2013, p. 40). Digital profiles on social networking sites such as Facebook serve as ways for today's youth to construct their identities, replacing in-person interactions with online presence, but still mirroring their needs for socialization and human connection (Cress, 2013). In addition, the growing popularity of collaborative image and information sharing sites, such as Pinterest and Instagram, emphasize how students may be sharing content and ideas with little deference for copyright concerns or original authorship. Students will need to learn to navigate the information-rich environment of the internet and use digital tools responsibly, thus showing a need for educators to balance lessons with media content.

Worth noting is an assertion that one of the challenges for art education lies within the lack of research as to what art actually teaches (Hetland et al., 2007). Though students generate works of art and learn technique for creating works from multiple forms of media, the skills and ways of thinking that are developed in art classes have not always been fully realized, expressed, measured, and adequately researched. Therefore, the arguments by art advocates may have less weight behind them, at least when compared at the surface level to the tangible "real-world" skills that science and math are said to produce.

Eisner (2002) produced examples of lessons the arts teach, many of which should be familiar to those with firsthand experience teaching and learning about art. They include the ways in which art teaches multiple perspectives and solutions to problems, and go beyond the limits of language (Eisner, 2002). The arts provide experiences unlike other subjects, allowing students to appreciate subtlety, and discover a range and variety of feelings through visual expression (Eisner, 2002). The lessons stated by Eisner (2002) celebrate art for the impact they have on student learning, differentiating skills gained from art as unique among subjects.

Hetland et al. (2007) cite that many art education proponents link high test scores with participation in art classes, yet their research found there was no conclusive evidence that art classes caused rising scores. In their assertions, Hetland et al. (2007) argue that using instrumental claims for art education are inherently doomed to fail, and that the "arts will quickly lose ground if academic improvement does not result." They also posit that art is demeaned when it is justified solely through its secondary value to enhance other academic subjects (Hetland et al., 2007). Chapman (2004) echoes this concern, stating that proponents of art education should be wary of justifying art's place in schools as an instrument for boosting test scores. Angier (2012) describes a similar outcome that occurs when acronyms such as STEM are introduced. Angier (2012) touches on this concept of art being taught in conjunction with other subjects to justify its place, calling the effect of acronyms such as STEM, "rampant me too-ism." These statements serve as further reasons for art educators to articulate the skills students gain though art and evaluate the actual learning and ways of thinking that are produced.

Inquiry-Based Pedagogy

New understandings of how students learn have recognized the value of inquiry-based and constructivist perspectives drawn from Dewey, Bruner, Piaget, and Vgotsky. Dewey (1938a) was an advocate for experiential learning and inquiry-based instruction. According to Crippen and Archambault (2012), inquiry-based instruction is a natural outcome of STEM education and lends itself to the concept of teaching students to think like scientists. Crippen and Archambault (2012) posit inquiry based pedagogy as "an opportunity to enact STEM as a multidisciplinary construct addressing timely and critical issues" (p. 158). An examination of inquiry-based educational philosophies shows how these instructional methods are closely aligned with the objectives of STEM education, and blend seamlessly with the inquiry methods of instruction that are already used in art education.

In response to inquiry methods, students "construct" their own meanings based on the questions they answer and discuss about particular works of art. This method of engaging with works of art can promote creativity and critical thinking skills. In addition, Bruner (1960) posits inquiry as a way for students to solve problems. Essentially, the premise of this instructional model holds that teachers will facilitate open ended discussions in the classroom where students will exchange observations and opinions about works of art, compare and contrast different works of art, and provide reflection (Lampert, 2006). As suggested by Adejumo (2002), talking about art allows students to examine their ideas amongst peers and teachers in an open setting. Students can also, through this process, develop social skills and acquire verbal presentation and listening skills. When using

inquiry methods in art education, a distinct opportunity exists for students to unite and work together (Siegesmund, 1998), creating opportunities for collaboration.

Using inquiry methods, the educator is not a mere presence to pose questions that allow students to roam freely with their thoughts in the classroom, or to comply by responding with basic "yes" or no" verbal responses. Without teacher intervention during this process, it should be noted that students may just seek the correct answer to a problem, rather than working to explore and consider various and contrasting viewpoints (Lampert, 2006). By asking open-ended questions and suggesting complex issues, teachers can steer their students towards providing thoughtful response and conversation rather than one word answers (Lampert, 2006). Such open ended questions can consist of, "What do you see?", "What do you think this element is about?" and following up with "Why do you think this?" It is important that teachers do not merely pose a basic query. Teachers can follow student answers by inquiring why the student feels this way, what their reasoning is, or by asking any question that demands that the student provide a more detailed and expressive answer than a one word or one sentence response.

Methods of Assessment

Effective methods for assessment are integral for understanding what students actually learn in any subject area. Today, school districts nationwide have asked teachers to ensure curricular materials are aligned with state and national standards, including art teachers who previously had worked within the framework of the National Standards for the Arts (Stewart & Walker, 2005). Standards for learning have served to reinforce a need for assessment and art educators have adapted materials to assess student learning

through observation, participation, portfolios, projects and even traditional tests (Stewart & Walker, 2005). The benefits of assessment are numerous, and can empower educators as well as students (Huffman, 1998, Stewart & Walker, 2005). Stewart and Walker (2005) describe the importance of engaging students in the assessment process, stating that "educators recognize that with the assistance of knowledgeable adults, students need to be reflective learners, articulating what they know, what they want to learn, and how they might engage in learning" (p. 13). Further, well-defined assessments that document student learning can empower art educators. Armstrong (1994b) affirms that while teachers can espouse the value of art education as a vital part of formal education, documented learning through assessment provides the evidence by which art programs can become truly accepted and valued by school administrators and the public.

Assessments in art are often performance-based, or the reported results of knowledge and processes as manifested within artwork (Beattie, 1997). Performance assessment strategies can include portfolios, journals, group discussions, exhibitions (Beattie, 1997) and other types of activities. Art lessons that are integrated with other subject matter may be assessed using similar performance strategies or a combination of several types. Beattie (1997) asserts that educators should carefully create assessments for integrated lessons that measure discipline content, discipline processes, at least one cognitive process, or complex thinking, and one metacognitive process, or reflective thinking. By defining such measurements for evaluation, a teacher can ensure that integrated lessons reach a level of substance that goes beyond shallow exploration or activities created solely for entertainment purposes (Beattie, 1997).

For integrated lessons, rubrics may be the most viable measure of learning as they can allow for flexibility and choice on the part of school districts, school administrators and teachers. In regard to integrated lesson plans, rubric-based assessments can offer a method to determine the skills and content knowledge gained from multiple subjects. According to Beattie (1997), these types of performances often promote learning that extends to applications outside the classroom, and encourage creative, open-ended responses.

Currently, Idaho school districts and other states that have adopted CCSS are redefining best practices for assessing and evaluating student learning. The additional goals of the CCSS for student learning are two-fold: to provide consistent objectives for student learning, and also a clear understanding of what students should learn for teachers and parents to provide support (Common Core State Standards [CCSS], 2012). In order to provide a useful, objective and complete method of assessment, it seems logical to assume that any curricular assessment should be aligned with Idaho State Content Standards for the appropriate subject areas, as well as CCSS.

Resources are being developed for school districts and teachers to align curriculum with CCSS, as well as to assess students' learning under the new standards. The Smarter Balanced Assessment Consortium (SBAC) offers summative, interim and formative assessments that will be utilized with CCSS (Smarter Balanced Assessment Consortium [SBAC], 2012). SBAC (2012) emphasizes learning processes that students undergo when they explore concepts, asking how they generate answers, over what is the answer. This dovetails with integrated lesson concepts, in which open-ended, exploratory learning of themes across multiple subjects and project-based styles of learning, are accentuated.

Discussion

Content and teaching methods are continually discussed and debated amongst educational scholars and practitioners. Of particular importance amongst scholarly debaters has been the concept of preparing students with 21st century skills for future careers. The emergences of STEM initiatives were derived from the perceived relationship between mastery of certain educational subjects and the economy, and have further expanded the discussion. Yet, art educators can be empowered to join the conversation. Educators can participate in the research and furthering of effective teaching approaches, while remembering to advocate for the merit of visual art on its own, as contended by Chapman (2004) and Hetland et al. (2007).

The students of today are poised to become tomorrow's leaders and will also represent the next generation of potential arts supporters. The demands of an increasingly global society and economy will need to be met with innovative thinking. Yet students are not always encouraged to participate in arts activities that would nurture, develop, and provide an outlet for their creativity. With little to no connection to artists and artwork, there may be fewer reasons for tomorrow's communities to participate in preserving and supporting the inclusion of art in education, public programs, and organizations. Human societies have long benefited from the presence of art as a mode of expression. Perhaps tellingly, the last of the lessons the arts teach as identified by Eisner (2002) states, "The arts' position in the school curriculum symbolizes to the young what adults believe is important." The understanding that artistic expression often develops from education in the arts is crucial.

According to the literature, art programs in Idaho and nationwide are being under-developed or diminished in favor of other subjects, such as math and science (Chapman, 2004, Idaho Commission on the Arts & Idaho State Department of Education, 2010). Sources of education funding aren't necessarily allocated towards the development of high-quality art programs or resources (Idaho Commission on the Arts & Idaho State Department of Education, 2010). Policymakers, administrators, teachers and parents don't always see the value of art programs, nor have a basis for understanding the ways in which this subject intersects with other disciplines (Armstrong, 1994b, Hetland et al., 2007). Proponents of art education will need to approach the public with effective and inspiring educational programs that demonstrate how art fits into their lives.

CHAPTER THREE: METHODOLOGY

Introduction

The following chapter discusses the research methods used in the organization and development of this project. The purpose of research was to explore how integrated art and STEM lessons can be implemented in classes across grade levels, as well as address how teachers view the problem of a lack of resources dedicated to teaching art. The information gathered from the research process was used to develop a curricular resource for Idaho educators. An overview of the methodology and a summary of findings from the research are presented and discussed.

Developing a Curricular Resource for Teachers

The research methodology used in this project may be best classified as a form of action research. According to May (1993), action research can be defined as the study and enhancement of one's own practice. This method of "teacher-as-researcher" allowed for additional collaborative inquiry with other teachers that held shared interests in finding ways to incorporate art lessons in their scope of teaching. The teachers also had shared concerns, recognizing the problem of art becoming marginalized in school curricula due to issues of inadequate funding, attention and time devoted to this subject. The logic behind using an action research methodology can perhaps be best summarized

by Dewey (1904b), as “Learning to teach well requires being conscientious students of our own practice” (as cited in May, 1993, p. 114).

The process of creating the STEM+Visual Art curricular resource also involved researching literature, as presented in the Literature Review, along with case studies, lesson plans and curricular resources from STEM and art disciplines, and articles, videos and other media about the work of contemporary artists which intersect with STEM subjects. Other sources of STEM and art integrated curricula were examined for the purpose of identifying common practices and formats. In addition, the development of concepts in the lesson plans involved a reflexive process, utilizing ideas that were based upon my own experiences as a student and teacher in art, math and science classes. Critical research into the models that had been established in other sources helped to blend techniques from other researchers, including best practices in content areas and inquiry-based instructional methods, with the author’s experiences and motivational goals for the project.

Ideally, the curricular resource was designed to be used by teachers across all subject areas, and especially those with little to no experience creating and teaching art. In order to create a resource that would truly be useful, easy to understand, and a rich assortment of suggestions and ideas that could be implemented with little to no prior art experience, I consulted with elementary and secondary teachers and used their feedback to revise and adjust all aspects of the project. This collaborative, active, research process was a key component in the project’s development.

Specifically, the research process used to develop the curricular resource involved both observations and critical feedback from teachers. A total of eight teachers

participated in the critical feedback and observation process. The teachers represented multiple areas of teaching, including a secondary math teacher, a secondary science teacher, general education teachers at the elementary level, and an art teacher at the secondary level. A rubric-based assessment was used to evaluate the effectiveness of the lessons from each teacher's standpoint. Observations of lessons were conducted whenever possible to directly compare how the lesson intentions and objectives were comprehended and implemented by classroom teachers. Teachers provided additional feedback and critique to further refine and shape the look, language and motivation for the curricular resource.

Critical Feedback

The development of this resource relied on the ability to assess how well it would work with practitioners in the field of education, who teach content across multiple subject areas, and have varying degrees of experience implementing art integrated lessons of any kind. Using content-specific feedback outside of the realm of visual art allowed me to gauge how the lessons were perceived from external perspectives. This helped to build and refine the manner in which the lessons were constructed and the scope of their content.

In some cases, the critical feedback given provided a useful lens to reexamine my own ideals and the practicality of certain elements in each lesson and the overall resource. For example, though I prefer to include authentic materials for creating artwork, a lack of funding for quality materials or technological abilities in the classroom led to the adaptation and enrichment section of the lessons. This section offers practical

suggestions that are mindful of teachers' limited supply budgets, but also do not compromise the lesson's quality. In other cases, the feedback demonstrated the genuine desire teachers had to learn methods for achieving more ambitious art-making projects in their classrooms, and also a willingness to experiment and utilize the lens and language of art within their individual teaching contexts. In turn, this critical feedback encouraged an ambitious scope for the curricular resource.

Pilot Lessons

During the development of the project, I asked teachers who provided feedback if they would be willing to teach a lesson and allow me to observe the process. During these pilot lessons, I used a rubric-based evaluation to gauge how effective teachers were in delivering the content using inquiry-based approaches, and whether teachers demonstrated understanding of the concepts from the lesson that I hoped to convey. Furthermore, teachers were observed and evaluated on how effectively they taught artistic concepts rather than scientific or mathematic content. Many of the teachers already had resources, professional development, training or experience teaching STEM subjects. However, the visual art piece of the lessons was less familiar for them.

In addition, follow-up questions were asked to assess teacher understanding and perspective about the lesson. Teachers were asked to respond to the following specific questions and statements: Which parts of the lesson did you feel were most successful and why? Do you feel that this experience increased your confidence in teaching art? Why or why not? Are there any parts of the lesson you would adapt or change if you taught this again? If so, please explain which parts you would change and why.

CHAPTER FOUR: SUMMARY

Findings

The critical feedback portion of the research yielded positive comments as well as suggestions that were not originally considered or included to strengthen lesson content or connections to standards. Many of the teachers who provided critical feedback included helpful suggestions and resources to strengthen the STEM content. For example, the usage of a NASA resource in the "Photographic Earth" was incorporated based upon the suggestion from a middle school science teacher. This teacher also suggested mentioning specific concepts from geometry and science within the lesson content. Additionally, teachers also had suggestions for specific concepts that tied directly to grade level curricula or state standards. One specific example was to incorporate student-generated examples of habitats in their local communities, tying directly to 5^{th} and 6^{th} grade standards. This suggestion was helpful in showing how lesson content can be adjusted to connect to additional standards.

Other teacher comments were related to the themes and questioning strategies listed in the lesson content. This included the following comment in relation to the "Photographic Earth" lesson plan for grades 6-9: "I love the way you used artists' artwork and technology in this lesson plan! This lesson has some great higher level questions looking at the importance and detail of art media and photographs (very

clever).” Further, comments from teachers also showed how the discussion or questions within the lessons could be adjusted to align with other instructional objectives in Idaho school districts. A first grade teacher suggested the addition of questions that helped students understand why they are learning about a certain topic, specifically, “Why do we need to know this?” This recommendation showed what some school districts and administrators might look for in lessons, and also may be helpful for students to understand the various purposes of each lesson. The first grade teacher also affirmed the importance of visual examples in each lesson to help young learners, stating that photographs or other visual examples “can really trigger understanding that helps them reach the next step on their own.” This comment not only provided support for visual elements within the lessons, but also assisted in creating a scaffold approach toward teaching concepts.

According to observations from the pilot lessons, teachers were more confident introducing artistic concepts, and using art vocabulary, when clear examples and usage of such vocabulary were modeled in the lesson plans. In addition, it was observed during these lessons when teachers asked for examples of specific statements to generate student responses and encourage the brainstorming process. The examples gained from viewing types of questions and prompts added by teachers were added to the lesson plans.

Selected student works from one pilot lesson were documented for the purpose of understanding and reflecting on the instructional process, which had been derived from the procedures and content of the lessons. I found that the student works reflected creativity and unique, personal expressions of their ideas, gained from the lesson. For examples, Figures 1, 2, and 3 shows the initial concepts and final works of art designed

by students. The teacher had encouraged students to “think like architects, or engineers.” This statement prompted students to imagine what challenges they might face and encouraged them to change and revise their concepts as needed for their final sculptures. The particular teacher was masterful in her delivery of guided questions to engage students with the lesson content, and this was shown in the students’ initial concept sketches and final works of art (Figures 1, 2 and 3).

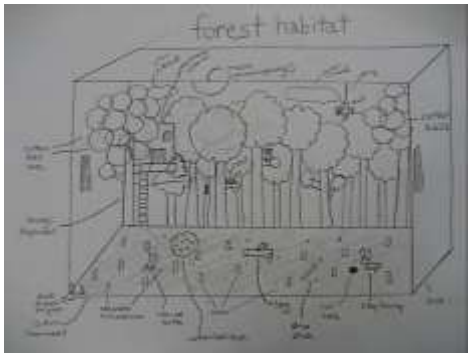

Figure 1. Habitat Sketch

(source: photograph by author)

Figure 2. Habitat Sketch and Sculpture

(source: photographs by author)

Figure 3. Habitat Sculpture

(source: photographs by author)

During the reflection process that followed pilot lessons, teachers shared positive comments in relation to their experiences teaching the art integrated lessons. According to one teacher, "Students were engaged and interested, which helped them to develop a better understanding of the content." In regard to whether this particular teacher would feel confident incorporating art lessons, the response was "Absolutely! I felt very successful during and after the lesson."

As noted in the aforementioned literature and research, time and resources for teaching art are not always available. However, the feedback from teachers served to highlight the importance of art resources for teaching purposes, such as this curricular resource. As stated from this elementary school teacher: "Without the lesson from this resource, I probably wouldn't have taken the time to teach an art lesson." The availability of curricular resources can provide ideas and inspiration for teaching, and as this teacher's statement indicates, may be the only motivation for teachers to take the time to implement art lessons in their classrooms. Overall, the outcomes of the research from both the critical feedback and pilot lessons yielded encouraging comments and teacher

support for art integrated teaching resources such as the STEM+Visual Art curricular resource.

Recommendations

The acronym STEM describes a movement in which policymakers, educators and members of the public are promoting the teaching of skill sets gained through the specific subject matter of science, technology, engineering, and math. In turn, this has encouraged advocates for inclusion of the arts alongside STEM. This purported "STEAM" movement is meant to incorporate the various disciplines under the arts, including music, drama, and dance. The STEM+Visual Art curricular resource solely focuses on the integration of visual art, but may inspire lessons that delve into other areas in the arts. Further exploration of how the arts can be fully integrated into curricula, across subjects and grade levels, is recommended.

Visual art remains a part of Idaho's curriculum and graduation requirements, yet art education is not always given full placement in school curriculum. While standardized testing and emphasis on STEM subjects appear to leave less time for subjects such as visual art, the development of this project and research findings show that art can be incorporated in meaningful ways through integrated teaching methods. However, more research and advocacy is needed to convince teachers of the full potential of art integration. Visual art, constantly in a tenuous position in school curriculum and funding, cannot be a peripheral part of the content, nor a vehicle for solely learning about STEM. Rather, the ability to learn about art, by discussion, observation, collaboration, and production, needs to be omnipresent when teaching with integrated art methods. Art

needs equal partnership and priority alongside STEM content to demonstrate shared skills between disciplines.

In addition, one of the issues that surfaced many times in the research process was the difficulty in implementing art integrated curricula due to time constraints. While deep exploration of artistic concepts and media require both time and attention from teachers, this may have the consequence of discouraging teachers from engaging students with art lessons. Integrated subject activities, such as the lessons in STEM+Visual Art, may allow for teaching to address multiple subject areas within a constricted amount of time. However, teachers will still need extra planning time and willing teaching partners to fully integrate subjects, particularly at the secondary level where disciplines are typically taught individually.

At first glance, the newly instated Common Core standards seem to continue the narrow focus on math and reading as seen in other recent educational mandates. However, an examination of CCSS provides some hope that students will be more effectively assessed on their knowledge based upon the mastery of larger concepts and themes that develop from multidisciplinary studies. Further study is highly recommended to explore the range of ways in which visual art and integrated curricula can be aligned with CCSS, due to the many shared skills between art and STEM addressed in this paper.

The research outcomes in the development of this project showed that teachers across grade levels and content areas are more likely to incorporate art lessons when they are given access to high-quality art teaching resources. Various types of resources may be developed in the future to support those needs, from professional development opportunities through webinars and workshops to instructional resources such as web-

based tools, media content, and lessons. Overall, the process of developing this curricular resource and gathering feedback from educators has further emphasized the need for art in students' lives, and highlighted the ways in which art is uniquely able to capture student interest, engagement, and allow for creative expression.

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APPENDIX A