Promoting Creative Development: A View into Arts-Science Integrations

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Abstract

This qualitative study aims to explore how the creative development of primary-junior students is promoted through arts-science integrative strategies. The purpose of this study is to explore the rationale, strategies, benefits and challenges surrounding the integration of the visual art, dance and science curriculum to promote the development of student creativity. A comprehensive and succinct review of the literature surrounding this topic was used to guide this research. Three semi-structured interviews were conducted in the Greater Toronto Area with educators who implement various arts-science integrations in Primary-Junior classrooms. Based on the data collected, key themes emerged including: 1) It is important for teachers to have clear and consistent understandings about how creativity is defined, student perceptions and the development of creativity over time; 2) General teaching strategies which can be implemented to support creative development include: scaffolding, modeling, open-ended problem solving, collaboration, hooking the students and encouraging the opportunity for lived experiences; 3) Strategies used to address diversity in learners while supporting the development of creativity include: being cognizant of student interest and the knowledge and use of multiple intelligences; 4) Educators aim to foster the development of the creative person through arts-science integrations relative to the curriculum: problem solving, flexibility, self expression; and 5) When developing creativity through arts-science integrations, educators encourage first year teachers to: implement cross-curricular integrations, engage in self-reflection, to not be scared and to view learning as a process. These themes were amalgamated and summarized into a discussion of the findings. Ultimately, this study is intended for educators interested in fostering creativity through arts-science integrations in their own classrooms.

Key Words: creativity, the arts, science, arts-science integrations
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4. FINDINGS

Key Findings and Themes

Theme # 1) It is important for teachers to have clear and consistent understandings about a) the role of creativity in the classroom and how creativity is defined; b) student perceptions of art-science integrations as related to creativity and; c) the development of creativity over time.

Theme # 2) General teaching strategies which can be implement to support the development of creativity include: a) scaffolding; b) open-ended problem solving; c) collaboration; d) hooking the students to engage them full and; e) encouraging the opportunity for lived experiences.

Theme # 3) Strategies used to address diversity in learners while support the development of creativity include: a) being cognizant of student interests and; b) the knowledge and use of multiple intelligences.

Theme # 4) Educators aim to foster the development of the following components of the creative person through arts-science integrations relative to the curriculum: a) problem-solving; b) flexibility and; c) self-expression.

Conclusion

5. DISCUSSION

Reflection and Implications

List of Recommended Practices

Theme # 5) When developing creativity through arts-science integrations, educators encourage first year teachers to: a) implement cross-curricular integrations; b) engage in self reflection; c) to be confident and; d) to view learning as a process.
Promoting Creative Development: A View into Arts-Science Integrations

Chapter 1: INTRODUCTION

We have to go from what is essentially an industrial model of education, a manufacturing model, which is based on linearity and conformity and batching people. We have to move to a model that is based more on principles of agriculture. We have to recognize that human flourishing is not a mechanical process; it's an organic process. And you cannot predict the outcome of human development. All you can do, like a farmer, is create the conditions under which they will begin to flourish. – Ken Robinson, 2006a

The greatest scientists are artists as well. – Albert Einstein

Introduction to the Research Study

Society is a dynamic entity, requiring its members to adapt to an assortment of social, technological, economic and environmental innovations and developments. This statement especially holds true for the 21\textsuperscript{st} century (Trilling & Fadel, 2009). In this day and age, the complexities of our ever-changing environment have led scholars to label creativity as the defining personal asset of our time (Shaheen, 2010; Sheridan-Rabideau, 2010). I believe that the ability to be innovative, employ creative problem-solving skills and to foster a sense of self-expression, are all elements of creativity that need to be cultivated within the classroom. Consequently, I believe that in order for future generations to prosper in an information-based, technologically dominant culture, the educators of contemporary society will be required to develop a pedagogy that encompasses this vital need for creativity in the educational environment (Williams, 2002).

One could argue that the development of creativity within an educational context is deeply rooted in an arts-based pedagogical approach to teaching and learning. Rather than maintaining that arts education enhances student performance in all areas of the curriculum, the intrinsic significance and the interconnectedness that this approach has to science, math, literacy and all subjects alike should be noted. Using the arts as a basis for teaching provides the
students with a strong cognitive foundation to think creatively, enhancing one’s capability to draw meaningful conclusions and adeptness to flexibly transfer insight across the curriculum (Wilson, 1998). I argue that learning in, through and about the arts is central to learning in all aspects of the curriculum. With that being said, how can integrative arts strategies be used in the classroom to address areas of the curriculum predominantly known as “hard-science areas,” such as math and science?

While traditionally the fields of art and science, creativity and conceptuality tend to be isolated from one another, it is important to note that the boundaries between these once divergent areas of learning are now becoming blurred. It is recognized that through the aesthetic experiences in the arts, students’ conceptual understanding of the sciences can be enhanced while promoting the development of creativity (Ozdemir, 2012). Vital to this study at hand, it should be noted that creative thinking can be described as being analogous, just as an arts-science integrations are a “juxtaposition of disciplinary elements that reveals or generates connective ideas” (Marshall, 2005, p. 240; Hummel & Holyoak, 2002). In contemporary society, the development of creativity has become highly valued while the symbiotic relationship between the arts and science education has become increasingly prevalent. Thus, this study will investigate how creative development is fostered through arts-science integrations in primary-junior elementary classrooms.

**Purpose of the Study**

The purpose of this study is to examine the development of creativity, and the extent to which it can be fostered through arts-science integrations within primary and junior classrooms. The development of creativity is a psychological concept that has been studied for generations; however, there has been a recent surge in the research surrounding fostering creativity within the
classroom (as cited in Shaheen, 2010, p. 166). While creativity is a concept that was primarily associated with the arts, the Ontario Ministry of Education has now come to recognize creativity, and creative thinking as being essential to all areas of education. More specifically, the 2007 Ontario Ministry of Education Science Curriculum document, states that it has never “been more important for our students to be creative and critical thinkers” and places immense value on the interconnectedness of categories of knowledge, which includes the ability for the student to apply creative thinking skills when engaging in problem solving (p. 105). While the popularity of research on creativity in an educational context has surged over the last decade, it is imperative to note that there is a lack of solidarity pertaining to how creativity is defined and understood by educators and theorists alike (Clark, 2008; De Backer, Lombaerts, De Mette, Buffel & Elias, 2012; Sternberg, 2006). Moreover, this lack of consistency regarding the definition of creativity can also be attributed to the notion that the definition changes with time and is dependent on the cultural context in which it is used (Tillander, 2011). This study first and foremost, gives an overview of how creativity is understood and fostered within the context of elementary school classrooms in the Greater Toronto Area (GTA).

Although over one million creativity-related articles are currently published and present in the ERIC database, with 150,000 of the aforementioned articles thematically associated with scientific education, this particular study takes a unique approach to tackling a relatively long-established concept (Hadzigeorgiou, Fokialis & Kabouropoulou, 2012). The purpose of this qualitative research study is to explore the development of creativity and how it is impacted by arts-science integrations within the elementary school classroom. Current research does not succinctly address the interconnectedness of the arts and science curriculum, or the vitality of developing student creativity within the elementary school classroom. Particular attention will
be placed on the pedagogical practices that teachers implement to specifically foster creativity through various arts-science integrations.

Ultimately, studying how creative thinking processes are cultivated through the amalgamation of the arts; specifically visual art and dance, and science will emphasize the importance of substantively integrating The Ontario Ministry of Education’s curricular subject areas. Using substantive integration by connecting art with mainstream subjects such as science, establishes a pedagogical approach that promotes the way the mind works, encourages learning relative to flexibility and transference of ideas, and serves as a catalyst for creativity (Marshall, 2005). Moreover, this arts-science integrative approach to teaching and learning emphasizes how making meaningful connections through aesthetic experiences enrich students’ conceptual knowledge of science related content. Hopefully, this research cultivates an inspirational basis for both teachers and external educators alike, to implement arts-science integrations to teach curriculum content, as creative thinking is becoming a pivotal form of human capital in the 21st century (Webb & Rule, 2012).

Research Questions

The overall aim of this research project is to investigate how educators can foster the development of creativity through arts-science integrations in primary-junior classrooms. Specifically, how can visual art and dance be integrated with science curriculum to encourage creativity among students in grades Kindergarten to Grade six? Teachers hold implicit theories of what creativity is as their understanding of this complex concept is shaped by their personal experiences (Saracho, 2012). Therefore, participants were asked to define what they believe creativity to be as this shapes and guides the way they respond to the subsections of this research.
The main research question is: How can educators foster the development of creativity through arts-science integrations in primary-junior (PJ) classrooms?

Multiple sub-questions were used in order to establish a framework for defining creativity:

1) How do educators define creativity?
2) What specific strategies do educators use in PJ classrooms to promote creative development?
3) In what ways do educators aim to foster the development of the creative person?

This project aims to promote awareness surrounding the essentiality of teaching for creativity within the elementary school classroom and how this can be accomplished through arts-science integrations.

**Background of the Researcher**

I am a second year graduate student in the Primary/Junior division of the Master of Teaching Program at the Ontario Institute for Studies in Education at the University of Toronto. I have received an Honours Bachelor of Arts degree with a major in Sociology and a minor in Family Relations and Human Development from the University of Guelph. More specifically, my desire to bridge a conduit between the development of creativity and the educational setting is greatly attributed to my own experiences as a student and to the teachers who fostered and promoted creative exploration in all subject areas within their classrooms.

As a student, I was very involved in the arts; dance, drama and visual arts both within and outside the boundaries of the classroom. It was the outlet of art that motivated me to think outside the box, to dig for multiple solutions to a problem and to engage in an outlet of self-expression that has inspired me to pursue this area of interest in my own research. I was lucky enough that through my upbringing my parents had the financial stability to support my extracurricular endeavors. Consequently, I believe that because of being nurtured in an arts-based environment, my greatest asset to the educational community and society in general, both
as a student and as a professional, is my ability to think creatively. I am able to see the interconnectedness between art and all subject areas. Ultimately, my personal experiences have formulated my outlook on education and have led me to believe that the arts are a vehicle for self-expression, divergent thinking, and require a prominent place within education. The arts-based education I received as a student has instilled me with a unique skillset allowing me to see the world from a multifaceted perspective, enriched with imagination, individuality, appreciation for differences and inspiring innovations. These combining factors have unified to make the teacher I am today and will be tomorrow, a teacher who wholeheartedly teaches in, through and about the arts.

While I feel like I predominantly connect with the arts; visual art and dance, I was also a student who loved mathematics and science. I never truly recognized or appreciated the interconnectedness between these various facets of education until now. Curriculum areas such as science can benefit from arts integrations, as the aesthetic experience of creating and viewing art in my experience reinforced conceptual understanding of complex topics within the “hard-science” areas of learning. Furthermore, throughout my practicum and volunteering experience, I have been able to explore and recognize the success of arts-integrations within an educational context, learning first hand as I integrated dance within the mathematics curriculum to teach patterning and transformational geometry, and visual art to teach about plant adaptations. Ultimately, this experience was so meaningful to the students that their reaction has inspired me to further explore various arts-science integrative strategies that elementary school teachers and educators implement in areas of the curriculum, to foster creative thinking.
Overview

The following body of research is organized into five chapters. Chapter one presents an overview and introduction to the nature of this research study. It outlines the vitality of fostering creativity in the classroom, as it has recently become acknowledged as a fundamental skill that is required to prosper in a society that is dynamically changing, and it touches on the importance of using arts-science integrations to foster creativity within the classroom environment. The driving forces behind the researcher’s motivation to study this topic are also explored in this chapter. Chapter two serves as a comprehensive framework in which this study is built on as it has unified both literature from the past and present that addresses the concepts and issues raised by this paper. Chapter three outlines the methodology of this research project in a procedural manner, identifying the research participants, data collection instruments, steps to writing an analysis of the data, the ethical review procedures and the potential limitations of the study. Chapter four identifies the participants of this study, describes the data collected and the themes that emerged as it references the research questions. Chapter five delineates possible limitations of the study, conclusions, connections and recommendations for practice and further reading and studies. References and a list of appendixes are found at the end of this paper.
Chapter 2: LITERATURE REVIEW

Introduction

According to Ken Robinson (2010b), a leader in creativity and education believes “creativity now is as important in education as literacy, and we should treat it with the same status.” Furthermore, our formal education system is currently under scrutiny for creating conformists and for perpetuating stereotypes rather than supporting each student as being free, original and creative agents of change (Shaheen, 2010). I believe that the need for an educational reform can be attributed to the realm of creativity and it is a foundational prerequisite for student and human success in the 21st century and beyond. In this literature review, I will unpack the facets of creative development that are fundamental components of this research project including: the contribution creativity in a global scope, how creativity is defined and manifests itself, the role creativity plays within the educational context and how it can be perpetuated through arts-science integrations in the classroom.

Human Capital

A wide body of current research regards creativity as being the most critical asset and attribute of human capital in contemporary society (Saracho, 2012; Sheridan-Rabideau, 2010; Walberg, 1988). Moreover, Webb and Rule (2012) suggest that creativity; innovation and problem solving, is at the forefront of the necessary skills to possess in the 21st century. It is noted by multiple scholars that the youth of today must be prepared to thrive in a constantly evolving society. Thus, educators are assigned the task of developing a pedagogical approach that motivates youth to see themselves as creative agents of change, prepared to address societal issues at a local, international and global level (Sheridan-Rabideau, 2010). Furthering this notion, Parkhurst (1999) states that fostering creativity within an educational context prepares
youth to deal with ambiguous problems and equips them with the flexibility to constantly adapt to dynamic changes in a society where predictability is scarce. For Craft (1999), creativity is largely a “fundamental life skill” required in developing countries to foster creative thinking skills that will manifest in political, economic, cultural and social reform (Oral, 2006). Ultimately, consensus regarding the importance of cultivating creativity within the educational environment resonates across the literature.

**Human Capital: Creativity in Arts Education.**

Literature suggests that the arts are at the crux of this pedagogical shift to fostering creativity within the educational context (Sheridan-Rabideau, 2010). In the wake of preparing youth to thrive within the future societal domain, arts education develops creative individuals who view the world through a unique lens, blurring the boundaries of national, racial and socioeconomic boundaries (Christensen & Kirkland, 2010; Sheridan-Rabideau, 2010). Sheridan-Rabideau (2010) suggests that it is the creative thinking manifest in arts-education that elicits entrepreneurial thinking. Furthermore, Christensen and Kirkland (2010) support this notion as they posit that art making is associated with higher order cognitive skills, allowing learners to develop a strong sense of self in relation to greater society. Additionally, De Backer et al. (2012), assert “artistic education can be considered a fertile area for the development of creativity, and is now a general learning goal within the current primary education curriculum” (Prummel 2006; Van Ransbeeck 1996). Ultimately, it is vital to consider that curriculum documents at a global scale explicitly reference the importance of creative thinking within an educational context as a curricular goal (Hadzigeorgiou et al., 2012).
Defining Creativity

Sternberg (2006a) argues that literature on creativity is limited, and often lacks conciseness. While scholars often disagree on what the definition of creativity entails, they do however agree that conceptualizations of creativity across the spectrum are variable and highly subjective. Lacking a sound definition of what creativity entails has many implications for studying this concept within classroom practices and the context of the educational system. The definition of creativity is subject to cultural and regional divergence, as westernized nations tend to perceive it as being innate intelligence and ability that is substantiated by a product or an effect (Schmidt, 2011). On the contrary, eastern views surrounding creativity see it as an act that an individual pursues in order to achieve personal fulfillment (Seo, Lee, & Kim, 2005). While a degree of confusion arises from psychological theorists attempting to define creativity, a recurring theme throughout the literature is the systematization of four distinct facets of creativity: a) the creative person; b) process; c) environment; and d) product (Battey & Furnham, 2006; Cheung, 2012; De Backer et al., 2012; Runco, 2004).

Creative person.

Craft (2000) describes the creative person as an individual who exhibits curiosity, asks questions, holds diverse interests, prefers a challenge, favours aesthetic experiences, is independent, has high energy, is motivated and is described as autonomous and intuitive. Differential psychologists pursue researching how people are different from each other based on a) cognition, general intelligence, and mental abilities, and b) dispositional; personality, motivation and values (Simonton, 2012). On the other hand, cognitive psychologists’ attention is placed on the mental processes utilized during creative thought (Simonton & Damian, in press). Moreover, Torrance (1962) and Trompenaars (2007) further this notion by defining
creativity as individuals who exhibit flexibility, fluency, originality and elaboration. Perhaps most importantly, Lin (2011) deems that creativity is an entity that can be developed in an individualized context, as he believes all humans possess the innate potential to be creative (Glaveanu, 2010).

**Domain changing/flexibility.**

*Flexibility* is the ability for one to transfer schema or develop concepts in alternative situations (Torrance, 1962; Trompenaars, 2007). Supporting this belief by coining a similar term for the concept, Csikszentmihalyi (1996) defines *domain-changing creativity* as “any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one” (p. 27). Milbrandt and Mildbrandt (2011) believe that domain-changing creativity is indicative of an extensive understanding of various skills or concepts in a field, therefore allowing for creative acts of domain-changing flexibility to be recognized. Furthermore, domain-changing creativity and flexibility are praised within the art classroom as a means of promoting intrinsic creativity and metacognition. For instance, scholars recognize that implementing activities that teach students about an artist and the context in which their work was created encourages students to draw comparisons and make connections between artwork from the present and from the past. Therefore this helps students resolve any visual problems they may have, assists the development of creative artistic habits of mind, prompts the understanding of skills and knowledge in a given content area (Hetland, Winner, Veenema, & Sheridan, 2007; Milbrandt & Milbrandt, 2011).

**Self expression.**

Torrance (1962) suggests that *originality* and the ability to create novel, exceptional or innovative ideas is definitive of one’s creativity. Furthermore, Milbrandt and Milbrandt (2011)
determine that a sense of self-expression helps individuals to become flexible and to adapt to change and to celebrate life. As early as the 1930’s scholars believed that educational practices in the classroom needed to foster self-expression through imagination and art as a vehicle for transforming society and producing autonomous individuals (Dewey, 1934; Milbrandt & Milbrandt, 2011).

**Creative problem solving.**

Creative problem solving and elaboration go hand in hand. Elaboration is defined as one’s creative ability to develop, build upon or complete ideas (Torrance, Ball, & Safter, 1992). Furthering this notion, creative problem solving is described by Parnes (1988) as being the generation of “multiple solutions that are neither right nor wrong, but may be more or less successful depending on the context and solution criteria” (as cited in Milbrandt & Milbrandt, 2011, p. 12). Possessing the ability to manipulate the question at hand to generate a diverse multitude of responses, demonstrates one’s ability to think divergently and bring forth unique responses (Milbrandt & Milbrandt, 2011). One could argue that creative problem solving has a definitive place in the educational system that extends far past the boundaries of an arts classroom.

**A summary understanding of creativity.**

As implicit theories hold, my personal understanding of creativity has been almost entirely influenced by my past experiences. However, after immersing myself in the literature, I have developed a more comprehensive definition of what creativity entails. I believe that being creative means engaging in the process of divergent thinking, considering multiple possible answers to a question and being able to express oneself in many different contexts. Creativity is a process that is highly influenced by ones external environment; the places and people they
surround themselves with. I believe that creativity can be developed in every student as each human being innately possesses creative potential. Furthermore, I believe that each student’s “creativity quotient” is different from his or her peers’. Perhaps most importantly, I believe that education serves a highly influential role in cultivating creative students who can think abstractly, maintain a sense of wonder and imagination and actively solve problems as they arise.

The dire need for educators within the educational environment is more apparent than ever, as scholars such as Ken Robinson (2006b) assert “We are educating people out of their creative capacities.”

**Creative process.**

Torrance (1966) describes the creative process when he states that creativity is: a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results. (p. 6)

The creative process is described as being an area in need of continual focus in the elementary school classroom. Learning theorists view creativity as a constructive process, vital to the development of creative aptitude (Houtz & Krug, 1995; Moran, 1990). Moreover, developmental psychologists focus on how creativity evolves and is reshaped across the lifespan (Simonton, 2012). Perhaps of most interest, Sternberg (2006b) notes that “Creativity is often obvious in young children, but it may be harder to find in older children and adults because their creative potential has been suppressed by a society that encourages intellectual conformity” (p. 93). Although previous research suggests a decrement in creativity with age, recent studies advocate that this notion no longer holds consistent especially with regards to the presence of creativity in the field of science (Simonton, 2012; Stroebe, 2010). While there is an evident disparity throughout literature regarding how the developmental psychology of creativity is
understood, this concept is consistently viewed as being a process of development over the majority of the literature.

**Creative environment.**

As previously mentioned, the educational system has been appointed to develop creative citizens who will thrive and adapt to the ever-changing nature of current society. Cheung (2012) stresses that a student’s learning environment is paramount to shaping creativity. Furthermore, research notes that environmental designs that include easy access to resources and a space to work independently, cultivate creativity (Cropley, 2001; Odena, 2001). Additionally, conducive creative environments are ones that promote autonomy, provide sufficient resources and time, encourage innovation, set realistic expectations, encourage imaginative play and allow students free choice of activities (Cheung, 2012; Prentice, 2000). Research also suggests that fostering creativity in the classroom through the arts engages students and people in a new way of seeing, prompting the formation of social bonds and strengthening community cohesion within the classroom (Milbrandt & Milbrandt, 2012). Given that the classroom plays an integral institutional role in shaping and developing creativity, educators should facilitate ingenuity in the vein of reinventing one’s practices daily to create a classroom environment that is conducive to a creative learning space.

**Creative product.**

Producing a creative product is defined as “any human act that gives rise to something new…whether what is created is a physical object or some mental or emotional construct that lives within the person who created it and is known only to him” (Vygotsky, 1967 and 2004, p. 7). Cheung (2012) notes that originality is a defining characteristic of a creative product. Furthermore, it is central to consider the developmental level of the student or creator of the
product, in comparison to larger norms; a child’s work may not be considered original and unique (Cheung, 2012). From an educator’s perspective, this is an extremely vital piece of information, as creative products are considered original if it is something that is original to the producer. What might not be viewed as a creative product to some, is seen as being creative by others and most importantly by the maker.

Explicit and implicit definitions of creativity.

With that being said, creativity is a highly subjective term. Explicit theories of creativity are definitions and conceptions of creativity that are formulated through systematic research and held by scientists, theorists and researchers (Saracho, 2012; Trompenaars, 2007). Conversely, implicit theories are thoughts, ideas, and understandings about the nature of creativity, stemming from personal experiences and beliefs (Saracho, 2012). Teachers and educators often hold implicit definitions of creativity as their beliefs about how to foster and assess creativity within the classroom originate from their own personal beliefs (Saracho, 2012). This information is a considerable implication for the current research, as the participants of this study will all be teachers who hold their own implicit views on what constitutes creativity.

Creativity & Child Development in an Educational Context

As previously mentioned, creativity is a poorly systematized and potentially under-researched topic. This fact especially holds true in areas of childhood development and education. Williams (2002) argues that the importance of creativity is paramount and should be nurtured in young children, especially in the educational context. While some individuals possess the natural innate ability to be creative in certain domains, creative skills can be learned and improved (de Bono 1992; Prummel 2006). Therefore, scholars such as Clarke (2003) argue that creativity is integral to education and should be embedded in every student’s school
experiences, as it has the potential to be a catalyst for improving student learning and increasing school-wide standards (Steers, 2009). Furthering this notion, Torrance (1962; 1976) stresses that guidance is the key to supporting young students’ creative thinking abilities and thus fostering the development of their personality, mental health, educational achievement and social competence (Freund & Holling, 2008). Regardless of the fact that policymakers have indicated the importance of assimilating creativity into the educational system, there is an unequivocal disparity between the transmissions of policies into practice (Craft & Jeffrey 2008; Kaufman & Sternberg 2007; Steers 2009). Although once suggested that teachers’ classroom practices were influenced by their beliefs and implicit theories of creativity, teaching behaviour is not always found to be consistent with the educators’ beliefs (Cheung, 2012). Moreover, while creativity is regarded as being a fundamental component to consider in both curricula and practice, research indicates that the bulk of primary school teachers do not specifically implement strategies within their classroom to cultivate the development of student creativity (Schacter, Thum, & Zifkin, 2006). Webb and Rule (2012), posit that while teachers are cognizant of the importance of fostering children’s creativity within the classroom, many are often unequipped and unsure of how to nurture it.

**Science and Creativity**

There is a widespread perception held by the public that science is a conceptual domain that is isolated from creativity (Schmidt, 2011). Moreover, various studies suggest that student and communal attitudes toward the success in scientific endeavors circulate around rote-learning, rigid and dogmatic thinking (Barak & Shachar, 2008; Barton, Tan, & Rivet, 2008; Kessels, Rau, & Hannover, 2006; Latu & Young, 2004; Lunn & Noble, 2008; Timms, Courtney, & Anderson, 2006). However, creativity manifests itself into all areas of life and is a concept that is
pronounced in all areas of the Ontario Curriculum; science, math, language arts and social studies (Craft & Jeffrey, 2008; Prummel, 2006; Schmidt, 2011). Scholars are recently suggesting that it makes sense to ensure creative thinking is a curricular goal, therefore science is a field that will make a significant contribution to this achieving this aspiration (Hadzigeorgiou et al., 2012). Thus, through developing inventions, concepts and theories, problem finding and solving, hypothesis formation and modeling, creativity is being explored in the scientific domain (Hadzigeorgiou et al., 2012).

**Teaching creative science.**

The extent to which students receive opportunities for creative thinking, whether independently or in a collaborative context, is dependent on how the science teacher runs his/her program. Furthermore, research supports the notion that scientific creativity manifests itself in experiences that are unique and meaningful to the student or scientist (Hadzigeorgiou et al., 2012). Schmidt (2011) suggests that there are four basic teaching styles outlined by developmental theorists that stimulate creative development:

1) *a pedagogical approach*, where teaching and learning are seen as processes of giving and receiving information and the emphasis is on subject-centered methods of instruction;
2) *a behavioural approach*, which is based on the idea that learning is achieved by establishing associations between stimuli and responses and teaching methods focus on quantifiable outcomes of instruction;
3) *a cognitive approach*, which emphasizes internal processes such as insight and perception and teaching methods centre on the provision of experiences that will generate, or facilitate, insight and perception in the student and;
4) *a developmental approach*, which addresses learning as a fundamental human need and teaching strategies vary from student to student, with the emphasis on personal growth (Schmidt, 2011, p. 436; Stredl & Rothwell, 1987).

Furthermore, within these teaching styles, Hadzigeorgiou et al. (2012) intimates that the following suggestions are vital to incorporate in activities targeted at fostering creativity within the science classroom. First, students should know and understand science content knowledge.
Next, divergent thinking and imagination are both skills that should be encouraged in the scientific community environment of the classroom. Third, visual-spatial components; imagery and visualization should be incorporated into science lessons. Additionally, aesthetic experiences and supporting the concept of “wonder” within the classroom needs to be nurtured to facilitate student engagement and intrinsic motivation (Hadzigeorgiou, 2005). Next, opportunities for students to be able to transfer their knowledge to predict future events; temporal distance, and to think globally about events and people; spatial distance, should be stimulated during science learning periods. Lastly, the culture of scientific inquiry and the classroom culture should be used as a basis to promote social interactions in a social setting while using one’s imagination to think creatively and divergently.

**Art and Creativity**

As previously mentioned, creativity in arts education plays a vital role in shaping the students of today to be active, creative, citizens of tomorrow who will inevitably play a role in shaping the future. The aforementioned delineates the vitality of encompassing creativity into educational policy and daily practice on a consistent basis, and with the recent shift to focus on metacognitive, volitional and motorial development within the educational system, The Arts have gained a more acclaimed position in education than previously sustained (De Backer et al., 2012). It must be noted that scholars regard dance, music and art-making as natural, creative learning processes that satisfy our innate desire to learn through the means of integration, organization and self-expression (Burrill, 2011). Open-ended art activities prompt the development of *divergent thinking*, as it requires students to take multiple perspectives to approach the subject matter (Prummel, 2006). Additionally, when students are required to overcome art-related challenges, *creative problem solving* is elicited when they consider various
strategies and responses to the task at hand, contributing to the establishment of an effective learning environment for students (Parker, 2005). The domain of art-education is also prided for facilitating independence and personal self-expression, both achievable when educators refrain from providing students with examples they are required to duplicate and instead provide opportunity for students to exercise their own personal impressions of the given experience (De Backer et al., 2012). Smith-Autard (2002) has developed a framework in which creativity is believed to thrive under the balanced conditions of subjectivity and feelings, and training and objectivity. The task of providing equilibrium within the classroom between expression and form, process and product, subjective and objective, creativity and knowledge, and thoughts and feelings, is achievable through the implementation of arts-science integrations (Smith-Autard, 2002).

**Art-Integrations: Potential Outcomes**

As defined by the Kennedy Center ArtsEdge Education, arts integrations is “an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both” (Silverstein & Layne, 2010). Outcomes such as self-expression, active engagement, enhanced creative problem-solving processes are attributed to the process of integrating subjects; math, science and social studies with The Arts; music, art and dance (Scripp, 2000). According to the literature, students socially benefit from arts-integrations in terms of improved academic success, improved self-concept and a stronger grasp of multicultural perspectives (Deasy, 2002; Scripp, 2000). While a large number of educators view the task of planning and implementing arts-integrations within their classrooms as a daunting undertaking, arts-integrations yield highly effective
The Art-Science Connection: Art-Science Integrations

Literature suggests that providing a sense of “wholeness” to your students can be achieved by integrating scientific theory with works of art (Hadzigeorgiou et al., 2012). While Pugh and Girod (2007) posit that science educators fail to recognize the artful and aesthetic experience science provides because they are blindsided by the prioritization of meeting standards and proficiency testing, the notion of aestheticism and its relation to scientific exploration is a relatively common theme found throughout the literature (Root-Bernstein, 2002; McAllister, 1996, 1997). Furthermore, both artists and scientists share a like appreciation of imagination, inspiration and rely on mental imagery and analogies to explore artistic and scientific creativity (Hadzigeorgiou et al., 2012). Additionally, aestheticism of scientific knowledge and scientific inquiry; asking questions, problem solving, designing and conducting investigations, formulating hypotheses and explanations, and fostering imagination are all outlets of scientific creativity that can be achieved through an arts-science integrative approach (Hadzigeorgiou et al., 2012). Sheridan-Rabideau (2010) argues that the arts are the conduit for teaching creativity in the classroom. He argues that repositioning creativity by teaching it through the arts, other subject areas, specifically math and science, will help students foster a better sense of cross-curricular flexibility (Sheridan-Rabideau, 2010). Some scholars note that while art is a great integrative tool and way of approaching the sciences through the stimulation of learning and developing scientific creativity; divergent and imaginative thinking, participation in an art activity alone may not prompt the students to use their creative imaginations; problem solving and inquiry (Ashley, 2011; Hadzigeorgiou et al., 2012; Merten, 2011). For example, students making a collage to illustrate the water cycle can assist them when attempting to learn
science content however, it doesn’t foster the development of scientific creativity and divergent thinking (Hadzigeorgiou et al., 2012). However, Sheridan-Rabideau (2010), argues that the arts are at the hub of teaching the youth of tomorrow to understand the human condition and to be a positive contribution to future society. Furthermore, Jackson (1998) defends the art-science curriculum connections by stating that:

The arts do more than provide us with fleeting moments of elation and delight. They expand our horizons. They contribute meaning and value to future experience. They modify our ways of perceiving the world, thus leaving us and the world itself irrevocably changed. (p. 33)

Jackson summarizes the symbiotic connection between creativity and art and science. Through aesthetic and transformative experiences in the arts, students are better able to view the world in novel and unusual ways, to generate multiple conclusions or hypotheses and to make meaningful connections (Hadzigeorgiou et al., 2012; Jackson, 1998). Thus, the compatibility of arts and science leave these two concepts inextricably tied to the promotion of creativity and warrants the aesthetic productiveness it potentially has in the classroom environment.

**Conclusion**

While the concept of creativity lacks an unequivocal definition, its role in shaping our students to be 21st century learners is unambiguous. The literature regarding creativity makes it evident that creativity is a concept that can be broken down into multiple subsections: the creative person, the creative process, the creative environment and the creative product. The aforementioned subsections of creativity are all vital to the study at hand, as educators may consciously or unconsciously foster the development of creativity by focusing on these areas. Furthermore, the implications for aiming to lessen the gap between research and practice regarding the implementation of teaching for creativity in the
classroom are endless. A common misconception is that creative development is solely triggered by participating in arts-based activities. However, opportunities for creativity occur in all areas of the curriculum. Both art and science pose as outlets that offer students unique aesthetic experiences that involve them in the learning. Perhaps, most importantly is the distinct connection between The Arts and Science, and the aptitude for such integrations to harness and encourage the creative potential of students within the educational system.

This research study, which involves face-to-face interviews with three experienced educators, addresses how these educators define creativity, the strategies they use to foster creative development, and ultimately how arts-science integrations can be implemented within the classroom to trigger creative development. It must be noted that these participants will be guided by their own implicit definitions of creativity, stemming from their past experiences, values and personal beliefs. By considering how educators define and implement various strategies to develop creativity among their students, hopefully we will better be able to understand how creativity can be fostered through arts-science integrations at the primary-junior level.
Chapter 3: METHODOLOGY

Procedure

Guided by the criterion determined by the Masters of Teaching Program at the Ontario Institute of Studies in Education (OISE) at the University of Toronto (UT), this particular body of research takes a qualitative approach to collecting data. The objective of this study is to investigate how creative development is fostered through various arts-integrations that are actualized within elementary school classrooms. Specifically, this research sets out to bring light to the arts (visual art and dance)-science integrative techniques and strategies teachers’ use within their classrooms to elicit the development of creativity amongst their students of the elementary grade level.

First and foremost, a succinct, thorough and extensive review of the literature was completed surrounding the topics of creativity in the classroom environment, arts-science integrative education and specifically the relationship that the development of creativity has to visual art/art-science integrations in the elementary school classroom. The literature: scholarly journals and peer reviewed articles, were then succinctly organized and amalgamated based on predominant findings, themes and concepts to unite the information surrounding this specific topic area. Once completed, the literature review established a unified and firm foundation for my research.

Next, semi-structured, interviews were conducted with three educators in the Greater Toronto Area in Ontario, Canada. These educators’ views, insights and beliefs about creativity and how it should be fostered within an educational context were explored. Interviewees were selected based on their educational practices within the classroom and how well they relate to the study at hand (see specific criteria in the section called Participants). My interview participants
included teachers and educators with whom I have come in contact with through my practicum experiences or those who have been recommended by colleagues and other professors. The semi-structured interviews were approximately an hour in duration. Two of the interviews were conducted face-to-face however, given the circumstances; one interview was conducted over the telephone. The interviews were guided by a set of 13 predetermined interview questions (Appendix A) that were provided to the two interviewees in hardcopy during the interviews and were emailed to the participant interviewed over the telephone, moments before the interview took place. All three interviews were recorded, transcribed and then printed out. Themes were noted and filed as they manifested themselves in the transcriptions. The data was analyzed using a critical lens, and the conclusions and key findings were summarized and presented thematically based on commonalities and variations as they emerged within the interviews.

**Instruments of Data Collection:**

As previously mentioned, informal interviews were conducted in a one-on-one, face-to-face or over the telephone manner. A prescribed set of interview questions were asked during the interviews to make sure all aspects of the research had been covered however, ample room was provided for the interviewees to clarify and explain their responses (see Appendix A). Therefore, this type of qualitative research design followed the standardized open-ended interview framework as outlined by Turner (2010).

Although the participants were asked identical questions, they were given ample opportunity to express their viewpoints, beliefs, practices and experiences as all questions require an open-ended response (Turner, 2010). An example of such a question would be: In your own words, how would you define creativity? Moreover, some questions required supplementary information; such as the interviewee giving an anecdotal account of their own experiences. For
instance, one of the research questions was: “Could you give me an example of an arts-science integrative activity you did with your students that you are the most proud of? Explain why this was such a meaningful activity for you.” Thus, this question allowed me to ask probing questions, in order to gather responses that were full of depth and breadth. Participants were also given an opportunity at the end of the interview to provide any other insights they might have had on the relative topic that wasn’t previously mentioned.

**Participants**

The underlying goal of my research was to explore the role that arts-based approaches to teaching science has on the development of creativity in elementary school classrooms. Thus, the selected participants of this current study were to be teachers or educators that presently teach or have taught any of the primary or junior grades (Kindergarten to grade six). I decided to focus on this specific age group because:

Primary education is seen as: ...a critical stage in children’s development – it shapes them for life. As well as giving them the essential tools for learning, primary education is about children experiencing the joy of discovery, solving problems, being creative in writing, art, music, developing their self-confidence as learners and maturing socially and emotionally. (as cited in Shaheen, 2010, p. 167).

Furthermore, some scholars regard young children as individuals who possess the innate, creative desire to learn (Burrill, 2011). Additionally, it was a prerequisite that the participants of this study foster an arts-science integrative approach to teaching within their primary-junior classrooms. Specifically, interviewees were familiar with or have had experience with integrating arts-science integrations to teach curriculum content. As mentioned previously the research participants consisted of two arts-educators and one teacher from a public elementary school located in the Greater Toronto Area. Interviews were held in comfortable environments such as the classroom and a local café, to ensure that the participants were comfortable and able
to share honest experiences and were offering open and truthful answers (as cited in Turner, 2010, p. 757).

With a combined 51 years of teaching related experience, the three consenting participants in this research are to be identified throughout this research using the pseudonyms Anna, Melissa and Charles. Anna, a visual arts educator, working for a multitude of organizations, has worked within the educational industry for 18 years teaching both elementary and high school students. As an arts educator, Anna travels to schools in both rural and urban areas throughout Ontario to provide integrated visual art programming through mediums such as paint, clay and pencil just to name a few. Anna provided extensive insight regarding creative thinking and the interconnectedness of the arts and science. She also delineated the role that environmental education plays within the context of arts-science integrations.

Melissa, a dance educator who has been teaching for 18 years, 12 of which have been within the school system, spoke in great detail about the interconnectedness of movement, creativity and arts-science integrations. As a dance educator, Melissa implements a kinesthetic approach to teaching, using dance and movement to teach Science curriculum concepts. Melissa also travels to various schools, implementing workshops that interlace the dance and science curriculum for learners of the elementary levels (Kindergarten to grade eight). Her natural ability to foster student creativity manifests through the passion she emits for the arts, and the innovative lesson designs she creates and implements within various elementary school classrooms throughout Ontario.

Charles is an elementary school teacher who currently teaches in a grade four classroom, in the GTA. With 15 years of experience teaching in mainstream classroom, Charles provided a wealth of information regarding the importance of integrating The Arts within the classroom
through all areas of the curriculum. His dedication to educating 21st century students is evident and the conduit between 21st century teaching and learning is deeply rooted in his ability to foster the development of student creativity through the arts-science integrations he facilitates in his classroom.

**Data Collection and Analysis**

Following the collection of data through three informal interviews, the data was transcribed. Each of the interviews was recorded on a Mac OS X Version 10.9.1, using a computer program called *Garage Band*. The audio files were saved to the aforementioned laptop, so that they could be replayed as a point of reference during the research process. Following the culmination of the interviews, the audio file for each interview was imported to a program called *Express Scribe*, where I was able to slow down the playback rate, making the process of transcription relatively seamless. Transcriptions of the interviews were recorded in the program *Microsoft Office Word* and saved to the computer. During the process of analysis the transcripts of the interview data were printed out as hardcopies, read, and re-read multiple times. These transcriptions were underlined using a colour coding system to distinguish any commonalities, recurring themes, and differences in the participants’ responses. While re-reading the interview data in the form of transcriptions, notes were constantly made in the margins of each interview regarding commonalities and differences in the responses. The data was then reorganized into a table format based on underlying themes, meaningful quotes and important insights, using *Microsoft Office Word*. Thus, when formulating a cohesive data analysis, the information was all in one place and explicitly displayed in a comprehensible manner allowing for a succinct and straightforward analysis of the data.
**Ethical Review Procedures**

The ethical review approval procedures for the Master of Teaching Program at the Ontario Institute for Studies in Education were adhered to during the duration of this research study.

Interview participants were required to read and sign the letter of consent before the interviews could be administered (see Appendix B). The letter of consent provided for each of the participants outlined the purpose and goals of the study, the content that was to be covered in the interview questions and the participants’ rights as stated within the confidentiality agreement. The aforementioned was reviewed with each participant prior to the interview, as well as after the completion of the interview. Participants were reminded that these interviews were going to be digitally recorded; yet, if respondents were opposed to this method of data collection, alternative arrangements would have been made and answers could have been scribed by hand. In addition, participants were reminded that they possess the right to refrain from answering any questions throughout the interview process that they feel uncomfortable answering. Participants were also given an opportunity to ask any questions before proceeding with the interview. The participants were also reminded that they were able to revise any of their answers prior to publication, and that they had the right to opt out of the study at any given time. The participants were also provided with a final copy of the research paper upon completion. Furthermore, participants were reminded that questions were encouraged and welcomed during the entirety of the interview process. All measures were taken to ensure that participants were comfortable and at ease when responding to the interview questions to assure honest and open participation. Participants were required to sign two copies of the letter giving consent for them to participate.
in the study. The original copy remained with the participant as the personal copy, and the researcher retained the other copy.

Participants were notified that the recordings, transcriptions and data collected from the interviews were stored in a private, folder on the researcher’s personal computer. Additionally, participants were reminded of their anonymity within this research study as the researcher intended to use pseudonyms to reference the individuals in order to protect their identity. The researcher and the researcher’s supervisor reviewed all information collected from participants, with consent from the participants.

Limitations

Although every effort was made to ensure validity and reliability throughout the research, there were some unavoidable limitations to this particular study. Such limitations included a selective literature review and ambiguous definition of creativity, the sample size of participants, interview questions and researcher bias.

Literature on this specific subject matter is relatively non-existent therefore motivating the researcher to pursue studying the development of creativity through an arts-based approach to teaching science. Additionally, this literature was selected based on currency and the relevancy to the topic at hand; creativity and science, creativity and arts-based education, an arts-based approach to science education. Ultimately, the literature chosen may not represent a fully comprehensive lens surrounding creativity in an arts-based science classroom.

As previously mentioned, while there is a considerable amount of literature available pertaining to the development of creativity within an educational context, there is no set or consistent definition of what creativity is. Thus, a lack of clarity when it comes to defining creativity is at the forefront of potential limitations. Furthermore, teachers hold implicit views;
shaped by their personal experiences and intrinsic beliefs, as to what creativity is. This shortage in stability across interviews caused some difficulty when it came to analyzing the set of data. Although creativity is a daunting subject area to research, it leaves a broad area for exploration, which outweighs the possible limitations.

Secondly, this research study had a relatively small sample size. Thus, the findings present in the study to a degree, lack generalizability. This notion is furthered by the westernized ideals about creativity held by the participants who are all teaching in Canada, a developed country. Research suggests as developing countries seem to neglect the notion of creativity, developed countries base much of the educational philosophy and goals on the promotion of creativity; creative problem solving, self-expression and creative thinking (Shaheen, 2010). While, the insights provided by these teachers were suitable for the context of this study, on a global scale the data would be, in a sense, biased.

The interview questions posed in this study were also a potential source for limitations. While the research questions were designed specifically to align with the goals of the study, this places constraints on the breadth of the topic. By narrowing down the subject matter to specifically focus on an arts-based approach to teaching science, curriculum areas such as math and social studies are neglected.

The final limitation of this study is the way in which the data was analyzed and interpreted by the researcher. As each individual possesses different values, beliefs, biases, assumptions and experiences, an unavoidable subjective standpoint will be used to analyze the data. Although chances for elaboration, clarification and explanations were given, due to the time restrictions on each interview, respondents may have been able to effectively articulate their viewpoint. Furthermore, the researcher approached this study with a firm foundation in the arts,
science and math, holding an underlying belief that all subject areas cultivate creativity in some way, shape or form. This partiality to an arts-based approach to education is solely used to explore this topic as a key research proponent of interest, and is not meant to compromise the integrity of this paper by any means.
Chapter 4: FINDINGS

Introduction

In this chapter the findings that have emerged from the data collected, during my three interviews with educators practicing within the GTA, will be analyzed and interpreted. Prior to conducting these interviews, a succinct and comprehensive review of the literature regarding the role education plays in shaping the creative development of students through arts-science integrations, was completed. The educators interviewed all demonstrated an unwavering commitment to fostering student development in their homerooms, and various classrooms around the GTA where they have taught. Further to this, their willingness to speak about their authentic experiences, specifically the instances in which they utilized arts-science integrations; visual arts, dance and science, to foster the development of creativity within their classrooms, speaks volumes about their commitment to supporting the development of 21st century students. Precautionary steps were taken in order to ensure the anonymity of the participants, as the names of the participants have changed and their associated institutions have been left unnamed.

Key Themes and Findings

The purpose of this research was to answer the question regarding how educators use arts-science integrations to foster the development of creativity in primary-junior classrooms, and the specific strategies educators use to promote creative development, as well as to how arts-science integrations contribute to the development of the creative person. Following the careful analysis of my interview transcriptions, five key findings, and multiple sub themes emerged based on my interpretation of the unique experiences, beliefs, values and advice provided by each of my research participants. The five central themes identified will be discussed further in the following chapter. These predominant themes are:
1) It is important for teachers to have clear and consistent understandings about a) the role of creativity in the classroom and how creativity is defined; b) student perceptions of arts-science integrations as related to creativity and; c) the development of creativity over time.

2) General teaching strategies which can be implemented to support the development of creativity include: a) scaffolding; b) open-ended problem solving; c) collaboration; d) hooking the students to engage them fully and; e) encouraging the opportunity for lived experiences.

3) Strategies used to address diversity in learners while supporting the development of creativity include: a) being cognizant of student interests and; b) the knowledge and use of multiple intelligences.

4) The educators’ aim to foster the development of the following components of the creative person, through arts-science integrations relative to the curriculum: a) problem-solving; b) flexibility and; c) self-expression.

5) When developing creativity through arts-science integrations, educators encourage first year teachers to: a) implement cross-curricular integrations; b) engage in self-reflection; c) view learning as a process and; d) not be afraid.

It is important for teachers to have clear and consistent understandings about the role of creativity in the classroom and how creativity is defined.

It was evident across all three interviews that educators regard creativity as maintaining a significant and increasingly important foundational role within the educational sector, an ideology that has been echoed throughout the aforementioned literature, including the Ontario Ministry of Education Curriculum documents (Clarke, 2003; Williams, 2002). In establishing a foundation for which making sense of the participants’ responses was attainable within the
context of this study, it was imperative to understand how Anna, Melissa and Charles defined creativity. Given that it is their underlying understanding of creativity that serves as a touchstone for the rest of their responses. While consistency prevails with regards to the role creativity plays in the classroom, the way in which educators define creativity is subject to a slight degree of variance, which can be attributed to individual interpretations, under the confines of what Saracho (2012) deems as an implicit definition; thoughts, ideas and understandings about creativity that are rooted in personal experiences and beliefs. However, it must be noted that although all three participants are unique to their own personal histories, the manner in which they all perpetuate their understanding toward how creativity is defined substantiated many similarities.

In Anna’s account of creativity, she sheds light toward implicit theories of creativity by recognizing that the understanding of creativity is in some sense, unique to every individual and different for everyone. For Anna,

Creativity is actually an everyday moment. It’s staying humble to time and understanding a process whether you are engaged in gardening or engaged in cooking, really paying attention to how one takes it in on a sensory level. What is it doing and what are the connections that activity is making to other components of your life? And that is going to be different for everyone, and that is creativity (Field Notes, 2013).

Interestingly enough, Anna recognizes the flexible nature of creativity and how it occurs across all facets of life, replicating the understandings of domain changing flexibility as she emphasizes the power of being able to make connections between vastly different dimensions of one’s life (Milbrandt & Milbrandt, 2011). This is especially important at a curricular level as creativity manifests itself in all areas of the curriculum, and is not solely limited to the arts (Craft & Jeffrey, 2008; Prummel, 2006; Schmidt, 2011). Anna further insinuates that in being an everyday activity, creativity is something that is experienced by all humans. Supporting this
notion is Glaveanu (2010) who intimates that “every person has a creative potential; this potential can be developed and is not purely innate; and creativity is specific to everyday life and not ‘reserved’ exclusively for artists or scientists” (p. 149).

Moreover, Charles’ definition of creativity makes reference to the construction of a creative product “human act that gives rise to something new” (Vygotsky, 1967, 2004, p. 7). Charles believes that “Creativity is making something out of nothing…Everybody has a creative way of [making] something out of nothing” (Field Notes, 2013). It also must be noted that he solidifies the recurring theme that every individual has the potential to harness creativity. Interestingly enough, Melissa’s perception of creativity corresponds to this ideology that creativity is in some sense hardwired into human nature, as she believes, “Creativity is something that exists within all living beings and it’s just there. It’s always, there within us as human beings” (Field Notes, 2013). Melissa’s implicit definition of what creativity entails bears many similarities to both Anna and Charles, and to Lin’s (2011) understanding of creativity; an entity that can be cultivated in all human beings as creativity is an innate human characteristic.

Furthermore, throughout the discussion of creativity and how it can be implicitly defined, both Charles and Melissa address the concept that students are solely “regurgitating” information, rather than being the creators of information. They both stress the vitality of engaging students in the learning process by involving them as creators of knowledge. According to Melissa, “I think if kids are creating, rather than just memorizing and regurgitating…then they are learning” (Field Notes, 2013). Through such aesthetic experiences that promote the development of creativity in the arts, Ozdemir (2012) delineates that students’ conceptual understanding of content matter, specifically in the sciences can be enhanced significantly. Instead of promoting rote memorizing of concepts, when students are creating,
they become invested in the subject matter and learning happens involuntarily. Charles further extends this notion by accentuating the imperative role that creative problem solving and divergent thinking has in the process of constructing a creative product. Charles states that when,

You have them create something 3D, they have to problem solve. They’ve got to think outside the box and I think the arts encourage kids to think outside the box, rather than being told to regurgitate something, they create something (Field Notes, 2013).

The aforementioned quote reinforces the idea that engaging in the creative process to bring about the formation of a creative product, the learned becomes embedded within the exercise. The notion that the students become creators is twofold. They are creating a final product in the process of becoming co-creators of their learning. Learning theorists delineate that creativity is a constructive process that wholeheartedly contributes to the creative aptitude of the learner (Houtz & Krug, 1995; Moran, 1990).

In summation, it is evident that creativity is regarded as being a key component to foster within the educational system and although each participant holds an implicit definition of what creativity entails, there are many overlapping conceptions about how creativity is understood by educators. It is clear that creativity is held to be an innate trait, with the potential to be cultivated in all individuals. Further to this, it is apparent that educators regard creativity as being individually specific, as a process that gives way to an original product, and as possessing the ability to think divergently, to make connections and to problem solve.

It is important for teachers to have clear and consistent understandings about student perceptions of art-science integrations as related to creativity.

Creating an environment where students feel safe and open to learning is at the forefront of providing students with a meaningful educational experience where they become invested in their own learning. Although the premise of implementing arts-integrations within the classroom
can seem daunting, May (2012) notes that arts-integrations are key to facilitating student engagement. A commonality between all three interviews was that all participants reflected on the positive student reactions that were generated from implementing arts-science integrations in their classrooms. Anna explains that, “The expectation is that the learning is going to happen automatically because they are having fun, because art is usually delegated to being a fun activity” (Field Notes, 2013). Anna’s response is a clear depiction of the way she perceives her students to respond to the integration of science and art into her programming. Students perceive art as being a fun and safe activity, where the learning comes automatically because of the students’ openness to the learning. Furthermore, Hadzigeorgiou et al. (2005), claim that when exposing students to aesthetic experiences achievable through arts-integrations, if a sense of wonder is stimulated, student engagement is then amplified. Charles furthers this notion by suggesting that art is an entity that creates a space where his students feel safe and open to step outside their comfort zone.

When you produce it that way, in a safe way, art allows them to put down their guard, and all of a sudden science becomes fun. It’s not as technical, I mean they are going to have to learn technical terms eventually, but once they don’t have a fear of science, the learning happens more quickly, and they learn better (Field Notes, 2013).

Charles insinuates that art is a discipline that students enjoy, and when paired with science is a subject that offers a safe conduit to an area of the curriculum many students may have once been hesitant towards. When introducing concepts to students in a safe and aesthetic manner, student engagement increases and curiosity is triggered.

As previously mentioned, all three participants shared the same underlying perception regarding positive student response to the integration of arts and science to prompt creative development. Melissa’s take on students’ perceptions really solidifies the ideology of students’ maintaining positive perceptions towards arts-science integrations. According to Melissa,
I think anytime...kids are away from their desks and learning with their whole bodies, they’re just excited. They seem really engaged...I think they really want to move, you know?... Kids just don’t want to really be stuck to a desk. It’s like a whole body learning experience. And it’s great that they get to do group work, and they get to be creative and work with each other. So, I think it is exciting for them (Field Notes, 2013).

Melissa vividly reiterates the integral role the arts play in fastening students to a meaningful full-body experience, as dance serves as the kinesthetic conduit between creative development and understanding science content. The perception of high student engagement and excitement toward group work is another component of Melissa’s response that needs to be highlighted. According to Matt (2003), by providing opportunities for collaboration in dance-science classes, students are held progressively accountable and are compelled by their environment to become more productively engaged.

In culmination, it is critical that we consider the notion that all participants indicate that they perceive their students as responding to arts-science integrations for the purpose of developing creativity in their classrooms, in a positive and exciting manner. Educators perceive their students as regarding art as a safe space, which becomes a catalyst for learning because students are more open to risk taking and letting their guard down, ultimately increasing student engagement. Infusing curriculum areas such as science with the arts offers students a safe, collaborative and kinesthetic opportunity to experience authentic learning.

It is important for teachers to have clear and consistent understandings about the development of creativity over time.

After further analysis of the interview responses, the data displayed suggests that some educators may believe that the development of creativity resides with the passage of time. Many longitudinal studies administered by developmental psychologists aim to delineate the relationship with aging and the substantiation of creativity (Simonton, 2012). Although previous research may suggest that creativity decreases with age, a recent surge in evidence supports that
this notion may no longer be consistent, especially in the field of science (Stroebe, 2010).

Contrarily, Charles’ believes that,

> At our schools we kind of produce kids... We manufacture these kids “like here this is the information you need to get.” I don’t know if we are necessarily teaching them to be independent thinkers, and I think creativity does that (Field Notes, 2013).

Charles insinuates that creativity fosters independent thinking, and a need for divergence that will inspire imagination, fastening students to a commitment to life-long learning. Charles suggests that the emphasis in present education is for educators to be disseminators of information rather than providing students with foundational skills that will emanate into the production of 21st century students. Further to this, Sir Ken Robinson (2006b) states that “I believe this passionately: that we don’t grow into creativity, we grow out of it. Or rather, we get educated out if it.” Educators need to do more than just distribute information; they need to instill a love for learning that opens students to the reality of imagination and ultimately, creativity. According to Melissa,

> I think it just opens the door to their imaginations because you know art is all about imagination and creativity. Those are places where kids live. They live there. I think that as adults our hearts die. What is that line from the breakfast club where she’s like “I don’t want to grow up, I don’t want to be an adult. Your heart dies.”...But kids are still so attached to like what’s really real and important. Which is just like being happy and creating and just living life, and the joy of learning. As adults we just get so bogged down with real life (Field Notes, 2013).

In providing students with arts-integrative opportunities, Melissa suggests that by opening the door to imagination and creativity, no restraint is placed upon students reaching their optimal potential. Perhaps most importantly, Melissa alludes to the concept that children’s hearts live in worlds that are rich in imagination and creativity, while implying that as adults this is essentially nonexistent. Furthermore, Melissa’s ability to make connections between her related beliefs with reference to creative development to the script of The Breakfast Club must be noted. Ironically,
this displays domain changing flexibility and exemplifies her creativity as an individual to make cross-textual connections.

In sum, it is evident that it is important for educators to maintain consistent understandings about the role creativity plays in the classroom and how it defines, student perceptions of art-science integrations as related to creativity and the development of creativity over time. Educators perceive creativity as maintaining a crucial role in student development, and define creativity as being an innate human trait that is unique to each student. When providing students with arts-science integrative opportunities, educators perceive their students as being excited and therefore engaged. Perhaps most importantly, educators perceive the development of creativity as being fundamental to creating lifelong learners and recognize that over a span of time, students’ sense of wonder in a sense “dies.” The implications this has for education is vital, and as future educators it is essential we understand potential strategies we can implement in order to harness creative potential amongst our students.

**General teaching strategies, which can be implemented to support the development of creativity, includes scaffolding.**

It is somewhat alarming to comprehend that while creativity is becoming continuously regarded as a fundamental skill in today’s society, the conscious stimulation and focused development of creativity within schools is limited (Bamford, 2007; Robinson, 2006b; Schacter, Thum & Zifkin, 2006). It should also be noted that according to Kaufman and Sternberg (2007), teachers and educators play a fundamental role in encouraging their pupils to think and act creatively, and to encourage creative behaviour when it arises. Furthermore, the literature delineates that teachers’ may interpret how to integrate creative education in vastly different manners (Steers, 2009). However, the data collected from the three interviews suggest that the strategies Anna, Melissa and Charles implement within the classroom are relatively synonymous.
In some capacity, all three participants allude to utilizing *scaffolding* as a strategy to support arts-science integrations to facilitate creativity. According to O’Donnell (2013), scaffolding is: “the social guidance, support, and assistance a teacher provides to students so that they can gain skill and understanding” (p. 54). Further to this, Petrowski (2005) delineates three fundamental principals to creating a learning environment that is conducive to the development of creativity. According to Petrowski (2005), one of these founding pillars “supporting any attempt to create.” When Anna recalls the arts-science integrative project she was the most proud of, she alludes to using scaffolding to support the students she was working with to reach the culminating task; creating birds out of clay.

We examined the photographs of actual bird nests. We looked at birds’ wings and the structure of the hollow bones. We looked at maps of migrations. We created drawings on those maps, cooperatively drawing the parts of birds. So, for children as young as grade two that is pretty fundamental for them to understand all of those parts. Then we actually built. The culminating task was for them to build their own bird, but from doing all the prior activity; they were not so interested in the decorative aspect, but really understanding form (Field Notes, 2013).

Manifest in the aforementioned quote is Anna’s ability to provide effective scaffolding to the students she was working with by gaging the status of the zone of proximal development. Pugh and Girod (2007) support this technique by delineating that educators can chronologically develop a series of activities to support students in engaging in aesthetic, transformative arts-science experiences. By chunking the information provided to the students, Anna provides support by essentially building the students’ stamina and understanding of the science concepts until they get to culminating task. Special attention needs to be paid to the notion that Anna even mentions that the students “were not so interested in the decorative aspect [of the birds], but really understanding form” (Field Notes, 2013). Thus, after building and supporting the
students’ knowledge regarding the anatomy, habitat and various adaptations, the students were finally equipped with the knowledge to create a unique piece.

Similarly, Melissa speaks of her experience using scaffolding prior to a lesson commencing. Melissa explains,

Well, I work with the children and build a dance vocabulary first. So, I don’t just come in and expect everyone to feel comfortable with, or know how to use, their bodies to express themselves and their ideas, and communicate what they are trying to say with their bodies… I like to do a lot of warm up activities first (Field Notes, 2013).

The abovementioned exemplifies how scaffolding can be used to introduce topics before the bulk of the lesson commences. Furthermore, O’Donnell (2013) supports this notion by stating that many students face challenges and struggle to know where to begin in a new lesson. Teacher’s can help support this difficulty by setting up the learning activity, defining the learning goal and modeling. Melissa sets up the learning activity by co-creating a dance vocabulary with her students to heighten student comfort with the various concepts.

Similarly, Charles also implements scaffolding as a technique to develop creativity amongst his students. Charles explicitly states his step-by-step process of providing scaffolding to his students and justifies his reason why.

Scaffolding…You have to show them a little something. Give them a little something like “here’s an example of something” and they can go off with it… Then all of a sudden their creativity starts to flow and when you foster that, you have to give them a little something. I think that when they get older, you don’t have to give as much, but you just have to [provide] step-by-step scaffolding. You’ve got to stop, meet with them. “Okay, now do this next step,” and all of a sudden you will start to see the creativity that comes out of them (Field Notes, 2013).

While, there is not an abundance of literature that names scaffolding as a key strategy to implement in the classroom to foster the development of creativity, all three participants have implicitly or explicitly described scaffolding as a strategy that they rely on. Charles’ response makes reference to O’Donnell’s (2013) of providing support in the range of what the learner can
do while also providing exemplars for the students’ as a model of what is expected. The notion of modeling for your students is a facet of scaffolding and the upcoming general strategy of discussion.

**General teaching strategies, which can be implemented to support the development of creativity, includes modeling.**

An educator holds a very influential role in society, and is in many ways a role model and mentor for our future. As Pugh and Girod (2007) suggest, students initially experience content matter through the lens of their teacher based on how they perceive and perpetuate the subject matter. Therefore, it should come as no surprise that research suggests that if an educator teaches in a creative way, the likelihood of stimulating creative behaviour in their pupils is heightened (Jeffrey & Craft, 2004). However, De Backer et al. (2012) recognizes that the aforementioned approach is rarely occurring throughout artistic education. Interestingly enough, the educators interviewed for the purpose of this paper, all mention using *modeling*, as a strategy to facilitate the creative development of their students through arts-science integrations.

Modeling is a strategy when the educator provides visual or tangible examples or a step-by-step demonstration of the process the students will take in order to be successful. For example, Anna states, “I think modeling [that] those [arts-science integrative] activities…are joint. If you have strong instances where those are connected, it becomes part of the students’ vocabulary to then want to express that” (Field Notes, 2013). Anna touches on the importance of modeling the relatively ambiguous connection between the arts and science to demonstrate the interconnectedness of the two subjects. Thus, becoming part of the students’ repertoire in recognizing inter-subject flexibility.

Melissa implicitly references the use of modeling to her students during the process of scaffolding to assist in the process of reinforcing student independence. While teaching a lesson
on simple machines, Melissa speaks of a whole group learning experience that integrates music, dance and science. She states that,

> We start with the chant and I have a simple movement for each of the simple machines. So wedge, it splits…so I will have a splitting movement with that chant…A lever lifts. So then I have the arms going down and then up (Field Notes, 2013).

In this instance, Melissa is providing an example of scaffolding by modeling the pairing of a kinesthetic movement to a simple machines concept. By providing potential exemplars of the movements to the students, she is preparing them for the upcoming task requiring an autonomy and interpersonal vigor in order to be successful.

Charles’ account of modeling is unique and provides an important lens for consideration. He delineates the importance of modeling a passion and genuine interest in the content that he is teaching.

> I guess at the junior level, actually in the elementary level if the teacher has a love for something, and particularly in grade 4, they even jump on it even more…I find that because I have a love for it, it transits with them (Field Notes, 2013).

Charles believes that because he models a love for art-science integrations, students mirror the same passion. Although Kehr (1986) and Newby (1991) imply that modeling a passion for the content matter is not frequent, Pugh and Girod (2007) persistently emphasize the vitality of having educators who model a passion for aesthetic experiences through the arts and science.

In sum, whether it is modeling the interconnectedness of arts and science, modeling the learning activity or modeling a passion for the content matter, this strategy is recognized throughout the three interviews as being a catalyst for creative development.

**General teaching strategies, which can be implemented to support the development of creativity, includes open-ended problem solving.**

When educators plan for students to engage in opportunities where multiple answers can be generated, they are eliciting problem solving, encouraging self-expression and promoting
divergent thinking. Cropley (2001) asserts that teachers who foster creativity are the individuals who promote flexibility, are accepting of alternative answers and stimulate self-expression of student ideas. Coincidently, all three participants regarded implementing open-ended problem solving as an impetus for creativity. Anna delineates the importance of allowing students the opportunity for open-ended problem solving because she asserts that,

I think that sometimes that when we pigeon hole a subject to its frame or parameters especially a young student doesn’t know how to experience success without being in that box. So, if you take them out of the box and they are doing a science related activity through the arts and they have success, there’s that eureka moment. “Actually now I think I am interested in how those clouds look if I paint them,” and I start to name them because I am looking at them (Field Notes, 2013).

In this instance Anna is intimating that open-ended problem solving stimulates a sense of wonder and curiosity amongst students. Instead of “pigeon holing” a subject to the principle of “one correct answer,” allowing the opportunity for risk-taking, making mistakes and considering several different answers is paving the road for creative development (De Backer, 2012; Field Notes, 2013). Anna further states that within each visual arts project she generates and implements in the classroom, she makes the conscious steer away from “making many activities where everything has to be cookie cutter and looking the same” (Field Notes, 2013).

Coincidently, Charles holds the same belief and states “you promote creativity by not putting boundaries on things. I think when you start to put boundaries on things that’s when you start to lose kids” (Field Notes, 2013). By allowing the open-endedness for responses, Charles fosters creativity by setting criterion, yet not placing parameters around the assignment responses.

Charles further exemplifies how he gets his students’ “creative juices flowing” through open-ended problem solving by describing the daily sketching process his students participate in (Field Notes, 2013).
I give them an idea to think about or work around… Something as simple as “draw me a tare/tear” so whatever their interpretation of that might be. Come up with different ideas. Let them hear something and draw what they feel (Field Notes, 2013).

Further to this, Melissa outlines how open-ended problem solving has had a favorable impact in the classrooms where she implements dance-science integrative activities. In this anecdotal account, Melissa recalls presentation aspects of the simple machines dance activity the students worked collaboratively to use kinesthetic movements to represent a wedge, level, inclined plane, wheel and axle, pulley, wheel and rope.

So [the students] get a chance to be an audience member. And then, that is a great time to teach them about observation, about how important it is, and to also respect other peoples ideas. The kids are really entertained by how other groups have represented the motions and it’s fun (Field Notes, 2013).

By allowing the students an opportunity to transition between the role of the presenter and the role of an audience member, Melissa allows her students to engage in the open-endedness of the assignment to see how other students express their original ideas of the same content matter. In Melissa’s account, students become engaged and interested in the way that others have represented the simple machines and a sense of collaborative creativity is achieved.

**General teaching strategies, which can be implemented to support the development of creativity, includes collaboration.**

The idea of collaboration within an educational setting as manifested in the data collected is three fold. First, students’ creative potential is stimulated at a *student-student* level. Having students interact, engage in teamwork and problem solving in a collaborative context is a strategy in which all interview participants noted implementing within their classroom experiences. An intriguing realization is that recent studies have evidence that indicate that creativity increases when individuals work in groups that are distinctly diverse; gender, ethnicity, experiences and age (Nemeth & Nemeth-Brown, 2003; Simonton, 2012). Charles recognizes the
meaningful impact that working collaboratively on creative arts-science integrative assignments has on his students,

It’s that relationship you forge with other classmates that is really important because when it is all said and done, it’s who [they were] with. They won’t remember every lesson, they might remember what they did and they’ll walk away with some positive message out of that (Field Notes, 2013).

In this instance, Charles really emphasizes the power that collaborative work has on recalling a lesson. He highlights that team-work is strengthened by building relationships with classmates, and learning from each other more than what they would learn from a lesson. In the example provided by Charles, he outlines how students engaged in collaborative problem solving to create a life size, three dimensional, papier-mâché shark. On the other hand, Anna has students collaboratively drawing parts of birds together as a precursor activity to their cumulative project, and Melissa has her students create dances in groups that demonstrate different simple machines and how they work.

Melissa further notes that once she has provided her students with scaffolding and enough background information on the subject matter,

I break them up into groups and I say “create a splitting dance.” So they have to work together. I use group work, creative group work quite often, and the kids as young as grade two are really good at working together (Field Notes, 2013).

The notion of having the students work together to problem solve, triggering divergent thinking to decipher what movements would best represent a “splitting” movement, is powerful. Furthermore, Melissa indicates that “students as young as grade two really benefit from the implementation of this strategy (Field Notes, 2013).

Next, the avenue of collaboration extends far past solely using the notion of collaboration at a student level, and careful consideration needs to be paid to how the creative development of educators may be supported by this strategy. Anna and Melissa are both arts educators and
community partners who pair with schools and collaborate with the teachers to implement lessons and projects into the classroom based on specific curricular expectations. Thus, the cooperation between art educators-teachers composes the second type of collaboration within this research. Current literature suggests that inviting artists and art educators into the classroom broadens the host teachers’ practices, fosters a climate that is conducive to the development to creativity and inspires the host teacher to implement artistic creativeness into their daily teaching regimes as well (De Backer et al., 2012). When working with an Arts-organization out of the GTA, Melissa describes the collaborative process both she and the host teacher would engage in before she would visit their class,

They would send an artist in to speak to a classroom teacher in a 1-on-1 meeting and we would decide on what curriculum expectations that I would take to create my lesson plan and use dance – which is my art form, as a vehicle through which the information and curriculum requirements are delivered to the students So therefore we…developed sort of a rough idea [about] what I was going to teach in the class together (Field Notes, 2013).

Melissa outlines the highly collaborative process carried out between her and the host teacher before the commencement of her dance lesson. It must be noted that although having a chance to plan with the host teacher before entering the classroom is ideal, this is not always the case. At times, Melissa works independently and only briefly gets to talk to the host teacher about the curriculum expectations they require her to address.

The last collaborative paradigm apparent throughout the research study is school-school teamwork or the pairing of classes from different schools. Anna recounts her experience implementing an arts-science integrative activity by teaming up two schools in vastly differing areas. In this instance, Anna paired partnering schools, one in the city; an urban environment, and one in a more rural environment.
I paired 2 schools…where students had a chance to understand the science of birds and
habitat but at the same time it became a metaphor for human migration and movement of
people, to things like different countries, and the city (Field Notes, 2013).

During the process of this project, these two partnering classrooms got to learn from each other
and the areas that their schools were in. The pronounced interconnectedness and uniquely
collaborative nature of this assignment really speaks volumes about the potential that teamwork
can have as a stimulus for creative development. Furthermore, a wide body of research suggests
that when artists and art-educators work alongside teachers, they bring novel and revolutionary
experiences to teaching that far surpass the conventional expectation arts-education maintains
(Anckaert 2007; Elias & Duquenne 2002; Robinson 1999). When taking Anna’s unique
approach to collaboration at the artist-teacher, school-school level, this statement holds to be
ture.

The multiple dimensions of collaborative and creative learning that have taken place
amidst the data in this research study delineates the potential that team work has in the field of
creative development. Further to this, it is apparent that the collaborative potential in fostering
creativity far surpasses being confined to the parameters of student-student learning and occurs
at the artist-teacher and school-school level as well.

**General teaching strategies, which can be implemented to support the development of
creativity, includes encouraging the opportunity for lived experiences.**

Perhaps most interestingly is the notion that across all three interviews, the participants
gave detailed and moving accounts of how they fostered the development of creativity in their
classrooms through providing their students with lived experiences. These lived experiences are
those in which students are in some sense able to physically embody both the art and science
content matter to better understand it. By adding a kinesthetic component to the learning,
students become the subject matter, therefore deepening the learning. For instance, Anna
encourages students to engage in lived experiences within the aforementioned bird project to supplement the facet of habitats. Anna states “We were looking at nests, varying nests. And then we started to pretend in a sense we were building nests” (Field Notes, 2013).

The notion of building a nest and creating something while pretending to be a bird is mirrored by Melissa during her structures lesson. In this instance, Melissa has her students physically become the structure by using their bodies. Melissa states that,

I believe that they have to make structures. What teachers usually do is get construction blocks and bendy straws and get them to build structures. But, what I do is get them to use their bodies… to build…. Every structure has a combination of tension and compression…It’s as simple as two people facing each other, they can raise their hands, their palms up to face each other and push against each other – palm to palm and there’s definitely compression there but there is also tension in their arms. So, if they are leaning towards each other they’re building a structure with their bodies (Field Notes, 2013).

By having the students physically become structures through partner work, students’ become part of the lived experience of building a structure. While there is limited literature regarding the benefits of having students digest the learning through lived experiences, literature notes aestheticism as being an important means of achieving scientific creativity through arts-science integrations (Hadzigeorgiou et al., 2012).

Furthermore, Charles solidifies the importance of stimulating creative development through providing students with lived experiences by recounting his experience of teaching habitats and life systems through art to his grade four class.

We’re in a process of changing our room into an ecosystem. Right now we have the sharks up and then we’ve looked at the pyramid. We’re going to put, what would the next level, and the next level [be]? Then there will be more of the small fish and we will look at the plant life that is there at the bottom… So they are kind of living into that, so that they are part of it. Where do they fit in there (Field Notes, 2013)?

By changing his room into an ecosystem, Charles’ students are “living” amongst the ocean’s ecosystem with the life-size, papier-mâché sharks installed to the ceiling of the
classroom and the intent of including small fish and the ocean’s vegetation into the classroom. Charles alludes to the notion that students will make the global connection by understanding “where…they fit in” amongst this food chain and ecosystem (Field Notes, 2013). Later on in the interview, Charles speaks of how he integrates the role that humans have played within social media portrayal of sharks and the popularity of shark fin soup in some areas of the world (Field Notes, 2013). Lastly, Charles further seeks to verify that students have the opportunity to have lived experiences with the subject matter by taking his students to the aquarium, where they can “make that connection” between when they “talk[ed] about fins, and they can actually really look at the fins and see how they move” (Field Notes, 2013). Charles really hopes to build that lived experience by helping students make connections to the process of building the shark, living amongst ocean’s ecosystem to actually seeing all of that in the most authentic manner as possible, at the aquarium.

Lived experience play an exponentially powerful role in the students’ lives and connections to the subject matter. Allowing an opportunity for students to, in some sense, “become” the content or embody and imitate the subject matter, validates the learning to a considerable degree.

**General teaching strategies, which can be implemented to support the development of creativity, includes hooking the students to engage them fully.**

Scholars suggest that student engagement is one of the most reliable predictors when it comes to learning and student development (Carini, Kuh & Klein, 2006). With that being said, the popularity in using a *hook* to engage students fully throughout the present data is increasingly important. A hook is a technique that is used to “fasten” a student to the upcoming learning by sparking their interest to the subject matter to better engage them. All three participants
recognized that hooking students at the beginning of the arts-science integrative lesson was a strategy they used to open their students to the content matter at hand.

Charles notes that the “first thing you do with teaching, is you’ve got to hook the kids” (Field Notes, 2013). Thus, reiterating the ever-important role that the teacher or educator plays in connecting students to the learning experience in order to maintain authenticity. Anna furthers this notion by emphasizing that she “makes sure that the individuals’ openness to creativity is somehow fastened by [her]. In doing so, she notes that she tries to give “them some sort of activity that opens them to the learning so that they get [comfortable], and that might even be called a hook in a sense” (Field Notes, 2013).

Further to this, Melissa touches on the need for creativity to be stimulated, a commonality among all three interviews. She believes that “[creativity] just lies dormant until you light a spark. Something or someone, it needs to be ignited” (Field Notes, 2013). While educators play a significant role in igniting student engagement, the subject matter also needs to be tailored to the student population and interest in the classroom. Charles echoes this ideology by stating “You have to find out what hooks them, and when you find out what hooks them, you have to find a way for the kid to just become addicted to something” (Field Notes, 2013).

Hooking students to engage them fully in the learning is a technique that resonates across all three interviews. The facilitator serves an imperative role in fastening student engagement. Ultimately, hooking your students is dependent on their interests, learning styles and the content matter at hand and thus the diversity of learners within the classroom should have a significant influence on teacher directives. With that being said, educators need to consider the diversity amongst their learners when planning how to hook their students to the learning goals at hand.

**Strategies used to address diversity in learners while supporting the development of creativity, includes being cognizant of student interests.**
As teachers, keeping our students interested in learning is something that is of the utmost importance. Scholars note that educators may foster their students’ creative potential by pursuing something that students will enjoy and therefore trigger their intrinsic motivation (as cited in Horng, Hong, ChanLin, Chang & Chu, 2005, p. 355). While aiming to develop student creativity, Melissa exemplifies this notion by suggesting to “See what certain students are into as far as The Arts go, and then guide the exercise around that art form” (Field Notes, 2013). Once you have a grasp on what your students’ interests are, guide your planning and lesson delivery around that. Melissa suggests,

So if…everybody is into music, maybe we can find a piece of music that we could create a rap to, that we can learn our science lessons, rules or theories that we have to learn and memorize. …Find out what the kids are into and go in that direction, because every group is different (Field Notes, 2013).

Melissa touches on the importance of recognizing differences between groups of learning and differences within groups of learners. By using student interests to gage future instruction, educators aim to capture the students’ curiosity and sense of wonder. Additionally, literature supports this by suggesting, “creativity may not only require motivation, but generate it” (as cited in Horng, Hong, ChanLin, Chang & Chu, 2005, p. 355).

Charles also bases his instruction off his students’ interests, age and developmental level. By going beyond solely understanding student interest to consider the developmental stage his students are at Charles demonstrates his commitment to fostering creativity through understanding diversity in learners. He states,

Find what interests them. For example this year, I said well I will hook them with the media and the sharks. At this age when you are 9 or 10 years old, you become realists and non-fiction is really important to them. So, sharks [are] intriguing because [they’re] monsters. They’re the oldest animal that has been on the planet. So they have expressed interest to me so I have decided to do this unit with them (Field Notes, 2013).
This is a perfect example of playing off of what is relevant to your students. In such a media dominated culture, students are constantly being exposed to information. Without the ability to think creatively in a context that is so relevant, are we really setting up our students to become 21st century citizens? The combination of relevance and students’ interest based on expressed preferences, age and developmental level to reach students’ needs to be considered when implementing strategies to promote creative development.

Strategies used to address diversity in learners while supporting the development of creativity includes the knowledge and use of multiple intelligences.

Building off of the aforementioned data, taking into consideration the various and unique learning styles of the students in your class is essential to promote success and learning achievement. With that being said, Howard Gardner’s (1994) theory of multiple intelligences is founded around the premise that “people are different and have different minds,” and is a theory that encourages educators to “build on strengths [as] there are many ways to achieve self-esteem and to accomplish something meaningful in school and the world beyond” (p. 580). Gardner (2007) “argues that if educators apply multiple intelligence theory to the design of their learning environments, the ability to engage students, dissolve misconceptions and build firmer and more flexible understandings is increased” (as cited in Clarke & Cripps, 2012, p. 114). Further to this, Clarke and Cripps (2012) suggest that students procure a more thorough understanding of their own creative processes when they are engaged in activities that stimulate their multiple intelligences. The eight multiple intelligences outlined by Gardner are: verbal/linguistic intelligence, logical/mathematical intelligence, visual/spatial intelligence, bodily/kinesthetic intelligence, musical/rhythmic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalist intelligence. Anna recognizes the importance of multiple intelligences by stating “I am a facilitator to understand what the teachers needs are but at the same time understand the
same kind of style learning that the children have” (Field Notes, 2013). In this statement, Anna intimates the importance of considering the students in your class and the ways in which they learned. As previously mentioned, all of the participants engage their students in interpersonal development in the sense that collaboration is seamlessly integrated throughout their experiences.

For Melissa, the dance educator, moving in her dance-science lessons is imperative to meeting the needs of the kinesthetic learners in the classroom, and in doing so, she states that they “really thrive.” Further to this, Melissa also integrates music into her lessons for the musical learners in her group. She asserts, “Using music to teach is so amazing. Just creating a rap, because they are going to remember a rap, they are not going to remember a list of things. But they will remember a musical chant” (Field Notes, 2013).

Furthermore, when Charles is asked to recount the arts-science integrative activity that he is the most proud of he recalls the shark papier-mâché assignment. His reasoning for choosing this project is that “it touches on everything and every kid gets a chance to either do hands on, they do an oral part, they can do the presentation part, they can do the writing part” (Field Notes, 2013). He further notes how this assignment required art; papier-mâché and painting the shark, math; problem solving of the sharks dimensions, language; media stereotypes, geography; where the shark lives, science; the ecosystem of a shark, biology of what sharks eat and physics in how the shark uses its fins to move. This all-encompassing project really incorporates all of the multiple intelligences and in a sense secures the engagement of learners who are verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, intrapersonal, interpersonal and naturalistic learners.
With the vast diversity of students amongst each classroom, it is imperative to take into consideration the learning styles of the students in your class. By targeting students’ multiple intelligences, the creative development of each learner can be fostered and enhanced.

**Educators aim to foster the development of problem solving in the creative person through arts-science integrations relative to the curriculum.**

Creative individuals are those who display curiosity, ask questions, enjoy aesthetic experiences, are autonomous and motivated (Craft, 2000). Moreover, other scholars regard creative people as those who exhibit flexibility, fluency, originality and elaboration (Torrance, 1962; Trompenaars, 2007). It is also imperative to note that the participants of this study tend to agree with Lin (2011) that creative individuals can be developed, as all humans possess the innate potential to be creative. Throughout the three interviews conducted for this research project, all of the participants implicitly and explicitly note fostering the growth of the creative individual by cultivating the development of problem solving, flexibility and self-expression.

Creative problem solving goes hand in hand with the strategy of promoting teaching that accepts open-ended responses. Creative problem solving is the ability for an individual to generate multiple, unique solutions based on the criteria of the problem (Milbrandt & Milbrandt, 2011; Parnes, 1988). Both Melissa and Charles recognize the importance of fostering creative-problem solving and the links it has to divergent thinking.

Melissa explains that in fostering divergent thinking, she “doesn’t explain ‘show this’ or ‘show that.’ I give them the idea of the movement and they just got with it. It’s amazing what kids come up with” (Field Notes, 2013). By providing just the right amount of scaffolding, Melissa elicits problem solving by placing the onus on the students to carry out the rest of the problem independently. By recognizing when the students’ are in the zone of proximal development, Melissa gives opportunity for autonomy when facilitating creative problem
solving. When asked about “what skills she hopes to develop or enhance in your students through fostering creativity” (Appendix A), Melissa responded,

Well definitely cooperation skills, problem solving because I like to do the group work with the kids. I like them to create their own work. Thinking outside of the box. There’s always like a typical movement that you think can describe something. Just go beyond that. Dig beneath the surface to see meaning, beyond the obvious (Field Notes, 2013).

“Thinking outside the box” is essentially divergent thinking. When Melissa encourages her students to dig beneath the surface and beyond the obvious, she is motivating them to bring forth unique responses.

Charles adds on to this by stating “the role of creativity is huge… If you’re not creative, you’re going to have people thinking linearly and not outside the box and I think that’s important because creativity fosters thinking outside the box” (Field Notes, 2013). In this instance, linear thinking or convergent thinking is the “one-right answer” frame of thinking. Charles regards creative problem solving as being a personal asset that will be virtuous in the future. He states,

Life is like a blank canvas. Artists are survivors. They create something beautiful out of nothing. When those people who put one foot in front of the other and plan their life linearly, what happens when things don’t go as they planned it to? So if they are able to create something, that skill is really, really important. So I think artists are survivors. We need those survivors in the science field because of the [environmental] challenges we have up front (Field Notes, 2013).

Charles further emphasizes the importance of creative problem-solving at the global level. When asked what skills he hopes to develop or enhance in your students through fostering creativity” (Appendix A), Charles stated, “Think[ing] for themselves, that’s the obvious. Eventually down the road, how are they going to [be able to] survive on their own? The world is everchanging” (Field Notes, 2013). In this sense, Charles delineates the need for autonomy as being imperative for problem solving in the future. The world is everchanging and requires that society be flexible in a sense to dynamically evolve with it.
Educators aim to foster the development of flexibility in the creative person through arts-science integrations relative to the curriculum.

Throughout all three interviews, Anna, Melissa and Charles all engage in developing students’ domain changing flexibility. In another sense, the participants encourage their students to see the interconnectedness to the world around them. Flexibility is regarded as the ability for one to transfer schema or develop concepts in alternative situations (Trompenaars, 2007; Torrance, 1962). Alternatively, domain-changing creativity is an individual’s ability to transfer “any act, idea, or product” from an existing domain to a new one (Csikszentmihalyi, 1996, p. 27). One could argue that domain-changing creativity and flexibility is apparent in the realm of arts-science integrations. Being able to transfer an understanding of science knowledge to the realm of the arts is essentially transferring ideas from one domain to another. Ultimately, all three participants allude to consciously developing domain-changing flexibility amongst their students. Andrea mentions that,

A child might be fully engaged in something, and then they really want to…say “hey that reminds me of…is that right,” and you go “yeah that is bang on,” or “how did you come up with that?” That’s exactly what you’re hoping, just as adults do it in conversation. It forays into something. You want children to see those connections all by themselves (Field Notes, 2013).

Andrea mentions the importance of children being able to “make connections” between domains autonomously. Further to this, her answer exemplifies how she wants students to ask questions, to be curious and to still have a sense of wonder that can be fostered through the enrichment of creative development.

Interestingly enough, Charles mirrors this belief and provides an example of how he read his students a story and asked them to illustrate it. He had his students go back and redraw the story from a different viewpoint; from a “third persons perspective,” “put yourself in the painting,” “[draw] what it would feel like if you were being chased by … a pack of wolves,” or
“[draw] from the viewpoint that you are the wolves chasing” (Field Notes, 2013). By doing exercises like the aforementioned, Charles demonstrates how he encourages his students to transfer their knowledge of the content being discussed and consider it from multiple perspectives. Further to this, Charles supplements the development of creativity amongst his students by encouraging students to make connections between the content matter and other domains of their life.

Then kids start saying “oh wait”, “ok this reminds me when this happens with a dog”, “this reminds me of when it was this day.” Then all of a sudden their creativity starts to flow and when you foster that, you have to give them a little something (Field Notes, 2013).

In this sense, Charles nurtures his students’ ability to apply their knowledge to alternative situations and content matter, while also making connections to other texts and previous life experiences. Most significantly, he notes that such activities stimulate flexible and ultimately triggering the “flow” of creativity.

Melissa describes the process in which she elicits domain-changing creativity and flexibility. Melissa states that she “may give them a word, or a feeling or a concept, that I will explain or they will already know. Then I will throw on some music and have them create movement to reflect that idea” (Field Notes, 2013). In this sense, students are required to take their current knowledge of the word, and in an alternative domain come up with an appropriate and kinesthetic movement that is representative of that word. Melissa solidifies the potential links that the arts and science have in terms of fostering domain-changing creativity and flexibility by explaining,

Science…is my favourite subject to teach with dance. It’s just so great, because everything in science, when it all boils down to it, you can find movement in everything, because right down to a molecular level there is movement going on…It’s so cool because you can translate that into dance (Field Notes, 2013).
By emphasizing the interconnectedness between two vastly different subject areas of the curriculum, Melissa draws insight toward how cross-curricular integrations in some sense are all encompassing directives of domain changing creativity. By stating that each science concept harnesses the potential to be the conduit for a kinesthetic and dance related component, she unmistakably leaves the domain of science and the arts to be inextricably tied as a catalyst for understanding flexibility and domain changing creativity.

**Educators aim to foster the development of self-expression in the creative person through arts-science integrations relative to the curriculum.**

The arts are fundamentally considered as a vehicle for self-expression and thus a main proponent of creative development. For decades, scholars have regarded the arts as a means of transforming society and producing autonomous individuals, achievable through the cultivation of self-expression and imagination within an educational context (Dewey, 1934; Milbrandt & Milbrandt, 2011).

A recurring theme throughout the data is the educator’s aim in fostering the development of self-expression through art-science integrations. All three participants regarded the arts as being a rudimentary communicative tool, a language in which students are able to express themselves. Anna refers to art and science as being a “language” (Field Notes, 2013). Charles, echoes this belief but also touches on the importance of integrating the arts within the classroom. He states, “I think when we look at the arts, I don’t think people value as much as they should be. It’s the oldest form of communication” (Field Notes, 2013). Additionally, Melissa believes “What’s beautiful about dance is that dance is a language. You can choose to communicate ideas and concepts just like any other language. It’s a powerful learning tool, as well as it’s a powerful teaching tool as well” (Field Notes, 2013).

The notion of regarding the arts as a communicative tool and a conduit of self-expression
is vital to this study at hand in the sense that it provides a foundational understanding of how significant of a role the arts play in authentic teaching and learning strategies to promote creativity. Interestingly enough, Anna was the only educator in this study who linked the importance of fostering creativity in developing 21st century students prepared to thrive in an everchanging environment. She states, “Hopefully if creativity has been fostered, they’ll have the autonomy later in life to be expressive and opinionated and make changes as needed instead of following the crowd” (Field Notes, 2013). In possessing the autonomy, to express their original and innovative ideas, Anna suggests that this procures the leadership we will need in a future society.

**Conclusion**

Throughout the last chapter, it was illustrated that each participant has constructed a highly implicit understanding of creativity and the ways in which it can be fostered in a classroom environment through arts-science integrative activities. However, despite the fact that each participant is unique to their own personal histories and experiences, many similar themes emerged regarding the beliefs, perceptions, roles and strategies that can be implemented within a classroom regime to promote the creative development of students. Interlacing the literature throughout the chapter supported the themes that emerged from the date collection process. Ultimately, the expertise that these participants have offered has been invaluable and have wholeheartedly contributed to both my personal and professional development in the realm of education by adding to and refining my understanding of the development of creativity through arts-science integrations.
It should also be noted that the fifth and final theme will be discussed in the next chapter as advice for future teachers on how to implement arts-science integrations into their programming to support the creative development of their students.

In support of the previously mentioned findings, a visual representation has been created in order to illustrate how each theme contributes to the process of fostering creativity in the classroom. The cyclical nature of this diagram delineates that cultivating creativity is in many ways influenced by the implicit beliefs one holds and how they are subject to change as educators engage in professional development. The way in which educators approach teaching creativity through arts-science integrations is entirely reliant on the understanding they have regarding this concept and how that influences the development of creativity (Theme 1). Based on the educators’ understanding of creativity, they implement various general teaching strategies to foster their students’ development of creativity (Theme 2). It must be noted that in this stage, educators will also consider and address the unique and diverse needs of their learners by implementing localized strategies to do so (Theme 3). Once the application of strategies has taken place, students will have been exposed to programming that specifically targets the development of the creative person. Through this specific programming, educators aim to foster the development of problem solving, flexibility and self-expression, all dimensions of the creative person (Theme 4). Lastly, it is recommended that first year teachers and all educators in general always engage in professional development and learning in order to better understand creativity and the role that it maintains in an educational setting (Theme 5). Thus, any additional knowledge that educators may acquire regarding supporting creative development through arts-science integrations will therefore influence their understanding of creativity and will guide their future practices within the classroom. Thus, the feedback loop begins again.
Theme 1: It is important for teachers to have clear and consistent understandings about:
   a) the role of creativity and how creativity is defined;
   b) student perceptions and;
   c) the development of creativity over time.

Theme 2: General teaching strategies, which can be implemented to support the development of creativity, include:
   a) scaffolding;
   b) modeling;
   c) open-ended problem solving;
   d) collaboration;
   e) encouraging the opportunity for lived experiences and;
   f) hooking the students to engage them fully.

Theme 3: Strategies used to address diversity in learners while supporting the development of creativity include:
   a) being cognizant of student interests and;
   b) the knowledge and use of multiple intelligences.

Theme 4: Educators aim to foster the development of the following components of the creative person through arts-science integrations relative to the curriculum:
   1) problem-solving;
   2) flexibility and;
   3) self-expression.

Theme 5: When developing creativity through arts-science integrations, educators encourage first year teachers to:
   a) implement cross-curricular integrations;
   b) engage in self-reflection;
   c) to view learning as a process and;
   d) to not be afraid.

END GOAL
Chapter 5: DISCUSSION

In this final chapter, I will reflect on how completing this project has enriched my understanding as an educator and how this journey has supplemented my growth as a researcher. This chapter will also outline the implications from the key findings and the recommendations from educators who intend to foster arts-science integrations in their classroom (Theme 5). Lastly, this chapter will discuss the limitations of the study while at the same time recommending areas in which future research has the potential to ensue.

Reflections and Implications

As the process of this research is coming to an end, I have embraced the opportunity to reflect on both my personal growth, professional growth and growth as a researcher. Prior to engaging this study, I regarded creativity as an essential component to education that must be intentionally fostered within the context of the classroom. This notion was affirmed by the literature collected and echoed by the responses of the participants. However, after delving into the literature and speaking with Anna, Melissa and Charles, it is now more evident than ever that creativity should maintain a permanent position in all classrooms. I embarked on the process of this research to better understand the ways in which educators’ foster creativity through arts-science integrations. It became clear through this process that developing creativity amongst your students is almost cyclical in nature, a recurring feedback loop in which teacher beliefs maintain influence over his/her teaching practices regarding creativity and is impacted by professional development opportunities.

This research study has further emphasized that my belief in the arts and making creativity an everyday experience as worthy of exploration. Further to this, the integrations of arts and science as a cross-curricular connective practice poses as a catalyst for the development
of creativity in itself as two vastly different domains require students to understand flexibility, problem solving and self-expression under the context of both subject areas. This new perspective on cross-curricular integrations has encouraged me to consider implementing them on a more regular basis, being more in tuned to the needs, learning styles and interests of students as well. With that being said, it should also be noted that the participants perceived their students as thoroughly enjoying learning content through arts-science thus, increasing their engagement and investment in the learning process. Moreover, the educators in this study allude that creativity and a zest for learning regresses with time and this belief was mirrored in some literature and contested by scholars in others. This was a key learning for me in the sense that I have come to recognize that our job as educators far surpasses the role of solely teaching content matter and truly boils down to our ability to inspire our students, cultivate a commitment for lifelong learning and triggering their creative potential to thrive. Ultimately, while I held some assumptions regarding the importance of fostering creativity in the classrooms, the findings that arose from the data far surpass the surface value of fostering creativity and are deeply rooted in instilling a love for learning that will last a lifetime.

In most instances, the themes that were uncovered from the data collected held for the most part, many similarities between that of the compiled literature. While the role creativity plays in the educational environment is imperative, for many individuals the question becomes centralized around the “how.” For me, this was the underlying motivation for this interview. How can I cultivate creative students within the classroom? Thus, bringing me back to the purpose of this study to uncover the ways in which educators can foster the development of creativity through arts-science integrations. While most educators mention implementing scaffolding, modeling, open-ended problem solving, collaboration, hooking the students to
engage them fully and encouraging the opportunity for lived experiences, the participants further spotlight prioritizing diversity in students by implementing strategies that target the interests and learning styles of the students. The most important understanding I have gathered from the discussions held with the participants is that *creative teaching leads to creative learning.* Whether the participants realized it or not, their commitment to developing creative students emanated from anecdotal exemplars they provided in the interviews and provided evidence of creativity in the approaches they took to intentionally fostering creativity amongst their students. This notion is supported Jeffrey and Craft (2004) who suggest that “teaching in a creative way leads more easily to creative behaviour in pupils” (as cited in De Backer et al., 2012, p. 55). In this sense, the onus is very much placed on educators and their teaching practices to thoroughly plan and assess with creativity in mind, in turn modeling and nurturing that potential in their students.

Educators aim to integrate arts-science activities as they intend to foster elements of the creative person including self-expression, domain changing creativity and flexibility and problem solving. As I reviewed these findings, I couldn’t help but notice the other areas of the curriculum that would benefit from a student who can fluently engage in self-expression, is able to “think outside” the box to problem solve and is able to generate multiple solutions by making connections through engaging in flexible thinking. More importantly, I also recognized the implications this has in a global context. Through such experiences, it is the intent to create students who will one day be creative, autonomous leaders of tomorrow. As our planet gets passed down from generation to generation, Charles outlines the importance that arts-science integrations has to inspiring students to be the leading forces behind fixing environmental issues we have contributed to creating (Field Notes, 2013).
List of Recommended Practices

Left for discussion in the present chapter is Theme five, which concerns the advice my participants have for first year teachers just entering the profession of education. However, I would argue that the advice they provide is applicable and should be considered to all educators regardless of background experience in the profession. Across all three interviews the participants regarded: implementing cross curricular integrations, engaging in self-reflection, to not be afraid and to view learning as a process, as being advice for first year teachers who are looking to foster creativity through arts-science integrations in the classroom.

With regards to implementing cross-curricular integrations, Anna notes that it is important for first year teachers to remember that at the elementary teaching level, you don’t have to be a “specialist,” but need to be knowledgeable in a broader sense by finding your strength and recognizing “where you can integrate [the] arts…with science” (Field Notes, 2013). Melissa echoes this belief by emanating that “creativity should be in every lesson plan… in every exercise” (Field Notes, 2013). In achieving this, she recognizes “integrating some together at the same time” can combat the overwhelming nature of the “hundreds of curriculum requirements” (Field Notes, 2013). Melissa further supports her believe in using cross-curricular connections to support creativity by stating,

I think integration is really important because if kids aren’t really into science or math, they might just shut down. But once you’ve inspired them through the arts, it doesn’t really matter what they’re learning… Once that spark is lit, you sort of just open the door and you can step inside (Field Notes, 2013).

Further to this, Charles reiterates the safety in using arts-integrations within the class as your students may be more comfortable with one subject area, which will open them up to others subjects that may be more intimidating.
Use the arts because the arts are very human. There is a very human side to it, and teaching has a very human side to it. Integrate the technical side to it in a very safe way for them so they are very inspired (Field Notes, 2013).

Thus, by integrating the arts; a safe outlet with science; an area of the curriculum that is perceived as being more intimidating, cross-curricular integrations are suggested as being a way in which first year teachers and educators in general can be encouraged to introduce creativity to their students.

Secondly, these educators suggest engaging in self-reflective practices to better meet the needs of their students and to evaluate the success practices in which they have implemented, to cultivate creative development. Anna states “Make sure that you, yourself have sat down, deeply looking at not just the science but looking at…your experiences as a visual artist” (Field Notes, 2013). In this sense, building on ones prior experiences in the arts and science can gage the direction in which you intend to pursue to build on your students’ “creativity quotient.” Charles furthers this notion by stating that for teacher candidates just entering the profession, “you need to find something you are passionate about. If you are passionate about something… your kids will be passionate about that” (Field Notes, 2013). This all relays back to modeling a passion for the content matter. If you emote a passion for the content, your students will mirror that and their engagement in the learning will be impacted for the better. Reflect on personal interests and strengths that you can bring forth to your students to provide unique and authentic learning opportunities.

Charles sums up the importance of engaging in self-reflection for professional development by stating, “That’s why I think in teaching, you can’t do the same thing year after year, after year. It becomes, well you become boring and mundane. You don’t learn as a professional [either]” (Field Notes, 2013). Melissa compliments this ideology by suggesting,
“I’m learning and being a teacher. It’s a lifelong learning experience for you too. The second you stop learning as a teacher you are done. You can’t, you know, you’re not really inspired anymore and you get bored” (Field Notes, 2013). Again, in this instance the cyclical nature of Figure 4.0 is noted. The essence of being a lifelong learner is a never-ending process, and engaging in reflective practices; understanding your successes, challenges and changes, are essential to bettering ones’ ability to approach the teaching and learning of creativity with vigor and refinement.

Next, Anna and Melissa recommend that focusing on the process of developing creativity through arts-science integrations is more important than being driven to creating an end product. Anna suggests,

[Try] to be less focused on the end product and think about layers of experience so that you can even stage a project. So day one you will do such and such an activity and the next day we will take that same piece of paper and add onto it (Field Notes, 2013).

By viewing arts-science integrations as a process rather than a product, educators become more in tuned to allowing students to explore, risk take and express themselves by not having confinements placed on their learning. Moreover, Melissa supports this ideology by regarding her job as a teacher to inspire rather than provide information. She states, “The one thing I always say is, your job is not to teach students. That’s not your job. Your job is to inspire them to learn. That’s harder, I think. It is harder but it is more rewarding” (Field Notes, 2013).

Instead of placing focus on linearly teaching content or the “end product,” by aiming to nurture a love for learning you are inspiring your students to engage in a more comprehensive process of consuming information.

Lastly, and most importantly, the educators in this study encourage future teachers and practicing teachers alike not to be afraid of implementing arts-science integrations in support of
activity. The educators encourage being confident in creating an environment conducive to creativity and to believe in themselves and their ability to cultivate creativity while teaching the arts and science. Anna identifies urges educators to “Not be afraid of messes [and] not be afraid of creating a place where experimentation can happen” (Field Notes, 2013).

Melissa believes that educators are “intimidated by the arts” and advises first year teachers to not “be afraid of the arts” (Field Notes, 2013)! She recognizes that a lot of teachers don’t have an artistic background and that fostering creativity through visual arts, dance, drama or music may seem daunting; they have to keep in mind that “the kids are the artists” (Field Notes, 2013). On the other hand, Charles believes

I think you get more people turned off and are just scared toward science. I think the word “science” is a label that you put on something “this is an intense discipline,” it is an intense discipline… When you introduce the arts, it’s a very safe thing because all their life they are surrounded, they have been surrounding since kindergarten. When you produce it that way, in a safe way, art allows them to put down their guard, and all of a sudden science becomes fun (Field Notes, 2013).

In this instance Charles implicitly notes that for teachers and students alike, teaching and learning science, a discipline that is known for intensity, can be intimidating. However when pairing it with an outlet that is safe for students, the arts fastens their learning while opening them up to the potential of creative development as well.

Limitations

While I fully believe I provided considerable insight regarding fostering creativity through arts-science integration in the classroom, there are still limitations manifest in this project. As previously mentioned in Chapter three, the potential limitations of this study include a selective literature review and ambiguous definition of creativity, the sample size of participants, interview questions and researcher bias. Additionally, given the focus on visual arts as a means of fostering creative development, I feel as though this study could have been
supplemented by the inclusion of photographic evidence of the projects discussed by the participants. Given the parameters of the ethical procedure, I was unable to include photographic evidence of student work. Furthermore, due to the time scope of this project I would have liked to include more participants in the process of this research. However, I feel that within the confines of time, I have attained the goal of my research and hope I have done the participants and the content matter justice.

Further Study

Regardless of the fact that this study yielded multiple themes and sub-themes, the data revealed other dimensions worthy of further research. In all three interviews, the participants revealed that in implementing arts-science integrations, they would also amalgamate other areas of the curriculum as well. I wonder if educators use the same strategies as previously mentioned, to cultivate creativity in other areas of the curriculum. Are there strategies that are specific to certain subject areas? Or are these strategies consistent across all curriculum areas?

Additionally, the participants in this study reiterated the importance of providing students with a safe outlet in which they felt comfortable in approaching the content matter and learning activity. It would be interesting to look into the impact the physical environment of the classrooms/school could potentially have on fostering creativity amongst students. Are certain types of environments more conducive to cultivating creativity than others? Does the number of students in a class or the physical layout of the room affect the creative development of students in any way?

Lastly, I was almost surprised that not one of the participants mentioned engaging in any type of assessment to support the development and learning of creativity in the classroom. Scholars maintain that assessing the students is fundamental to designing grade and
developmentally appropriate tasks for their students to benefit from creatively. As Hunt and Paraskevopoulos (1980) affirm, “that there should be a match between the children’s assessment and their authentic performance for them to achieve optimal development (Runco & Gaynor, 1993). This makes me wonder about the ways in which assessment can be utilized to support creative development and the role that assessment as, for, and of learning would play in this dominion.

Conclusion

I wholeheartedly believe that my greatest asset as an educator, both professionally and personally is my ability to be creative in all aspects of life. I attribute much of my personal and professional success to the various arts focused and other educational experiences I have accumulated to this point in my journey. Thus, pursuing this research has been a particularly meaningful adventure for me. Although five themes emerged from the data, the most important insight gained from this research is the increasingly important impact that educators have on fostering creativity in the classroom. Ultimately, the way in which educators define and perceive creativity will guide their practices, strategies implemented and influence their students accordingly. As previously mentioned, creative teaching generates creative learning and behaviour amongst students (Jeffrey & Craft, 2004). In essence, educators need to be cognizant of the impact their beliefs, values, lessons and classroom behaviour may have on their students.

As Pugh and Girod (2007) assert,

Students first come to experience subject matter concepts through the eyes of their teacher. This puts a great burden on the teacher to portray subject matter in ways that captivate, motivate, and enervate students to give an honest effort in learning and seeing the world anew (p. 22).

Modeling a passion for imagination and wonder, teaching creative lessons, and knowing the students in your class are all ways in which the development of creativity can be harnessed in an
educational context. This further supports the notion that educators should always maintain a sense of wonder and motivation to better their practice through professional development opportunities, in order that they continuously perpetuate the dire commitment to lifelong learning.

Each theme that emerged from the data has provided invaluable guidance in regards to fostering creativity through arts-science integrations. Such themes have provided guidance in how I will approach the symbiotic process of teaching and learning creativity in my future classrooms. With the importance of creative development within an educational context becoming increasingly prominent, it is vital to understand that students perceive the integrations of art and science in their classroom with the purpose of developing creativity, as exciting. Educators are at the forefront of combatting Ken Robinson’s (2006b) belief “that we don’t grow into creativity, we grow out of it. Or rather, we get educated out if it,” and I strongly believe that instilling a sense of wonder and love for learning is at the foundation of this issues’ solution. Furthermore, educators need to be cognizant of their students’ diverse learning needs when implementing general strategies into the classroom. In aiming to develop creativity, educators place focus on cultivating autonomous individuals, those who can problem solve, think divergently; making connections between different domains and those who can express themselves in a manner in which their voices and beliefs are clearly articulated. Again, all educators’ beliefs regarding creativity influence their practices within the classroom, yet it must be noted that professional development opportunities should be harnessed in order for teachers to continue building on their own personal creativity repertoire, and thus the feedback loop begins again (Figure 4.0). Charles shared a belief that really resonated with me as an educator regarding
the vitality of fostering creativity through arts-science integrations in a global scope. He believes that,

What’s great about art is that…life is like a blank canvas. Artists are survivors. They create something beautiful out of nothing. When those people who kind of put one foot in front of the other and plan their life linearly, what happens when things don’t go as planned…? So if they are able to create something, that skill is really, really important. So I think artists are survivors. We need those survivors in the science field because of the challenges we have up front (Field Notes, 2013).

Educators maintain the task of developing a pedagogical approach that motivates the youth of today to see themselves as the creative agent of change, prepared to address the societal issues at a local, international and global level of tomorrow (Sheridan-Rabideau, 2010). I truly believe that the arts and sciences are the conduit between providing students with a meaningful educational experience in which creativity becomes the foundation from which we as educators and students can all flourish.
REFERENCES


Appendix A: Interview Questions
My name is Megan Clements and I am a Masters of Teaching student at the University of Toronto. Thank you for participating today. The data collected in this interview will contribute to my Masters of Teaching Research Paper, which is a requirement for completing my teaching degree. Any personal identifiers will be taken off the record for your confidentiality. The topic we are going to discuss today is the development of creativity through arts-science integrations. I’ll ask you about 10 questions and it will take about 30-40 minutes. I would like to record this interview so I will be able to quote you without any flaw. Do you have any questions before we begin?

Section 1: Participant Background Information
1. a) What grade do you teach, and what grades have you taught in the past? [What is your teaching experience?]
   b) How many years have you been teaching?
   c) Could you please describe what a typical day is like in your classroom?

Section 2: Integration of Arts in the Science Curriculum
2. How do you incorporate arts in your teaching practice?
3. Specifically, how do you incorporate arts in your science curriculum?
4. Could you give me an example of an arts-science integrated activity you did with your students of which you are the most proud?
   a) Explain why this was such a meaningful activity for you.
5. How do your students respond to the integration of the arts during their science classes? Give an example.
6. What are the student related outcomes of integrating arts into the science curriculum? [Discuss any challenges or benefits that you have observed].

Section 3: Creativity
7. In your own words, how would you define creativity?
8. Describe the role that creativity plays in the classroom.
9. How can creativity be fostered within an educational environment? [What are some of the specific strategies you use to promote creativity in your classroom?]
10. What types of skills do you hope to develop or enhance in your students through fostering creativity?

Section 4: Arts-Science Integrations & Creativity
11. How can PJ elementary educators use an arts-science integrated approach to foster the development of creativity amongst their students?
12. What advice do you have for teacher candidates coming into the teaching profession about developing creativity through arts-science integrations in the classroom?
13. Is there any other insight you would like to offer on the subject matter at hand?

That concludes our interview. Thank you very much for your time it is greatly appreciated.
Appendix B: Letter of Consent for Interview

Date: ___________________

Dear __________________,

I am a graduate student at OISE, University of Toronto, and am currently enrolled as a Master of Teaching candidate. I am studying the development of creativity through art-science integrations for the purposes of investigating an educational topic as a major assignment for our program. I think that your knowledge and experience will provide insights into this topic.

I am writing a report on this study as a requirement of the Master of Teaching Program. My course instructor who is providing support for the process this year is Dr. Susan Schwartz. My research supervisor is Dr. Jackie Eldridge. The purpose of this requirement is to allow us to become familiar with a variety of ways to do research. My data collection consists of a 40 minute interview that will be tape-recorded. I would be grateful if you would allow me to interview you at a place and time convenient to you. I can conduct the interview at your office or workplace, in a public place, or anywhere else that you might prefer.

The contents of this interview will be used for my assignment, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a conference or publication. I will not use your name or anything else that might identify you in my written work, oral presentations, or publications. This information remains confidential. The only people who will have access to my assignment work will be my research supervisor and my course instructor. You are free to change your mind at any time, and to withdraw even after you have consented to participate. You may decline to answer any specific questions. I will destroy the tape recording after the paper has been presented and/or published which may take up to five years after the data has been collected. There are no known risks or benefits to you for assisting in the project, and I will share with you a copy of my notes to ensure accuracy.

Please sign the attached form, if you agree to be interviewed. The second copy is for your records. Thank you very much for your help.

Yours sincerely,

Researcher name: Megan Clements

Phone number, email: ______________________________

Instructor’s Name: Dr. Susan Schwartz
Phone number: _________________ Email: _______________________


Research Supervisor’s Name: Dr. Jackie Eldridge
Phone #: ______________________ Email: _______________________

Consent Form

________________________________________________________________________

I acknowledge that the topic of this interview has been explained to me and that any questions
that I have asked have been answered to my satisfaction. I understand that I can withdraw at any
time without penalty.

I have read the letter provided to me by Megan Clements and agree to participate in an interview
for the purposes described.

Signature: ________________________________

Name (printed): ________________________________

Date: __________________________