Walden University

College of Education

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John Krenik

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Walden University
2014

The Influence of Problem-Based Learning on Drawing Ability

by

John Krenik

MAE, University of Massachusetts, 1994

BS, Mankato State University, 1980

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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May 2014

Abstract

Abstract

Learning skill in visual arts has been positively associated with problem-based-learning (PBL). Although researchers theorize that PBL engages students to increase learning, many visual arts instructors continue to use skill-based learning (SBL) in their classrooms. The purpose of this study was to address the differences in Clark's Drawing Abilities Test (CDAT) scores between 7th grade visual art students taught through the framework of PBL (N = 26) and those taught through SBL (N = 55). The study was guided by the conceptual framework of PBL. The method of inquiry was a quasi-experimental design with a nonequivalent external control group design and pretest-posttest. Clark reported reliability and validity measures from previous studies, and scoring validity was obtained by enlisting experts at CDAT Publishers to assess content.. Data analysis from a t test revealed that a decrease in posttest scores among the PBL group, possibly due to resentful demoralization, as students became discouraged from the emphasis on standardized testing during the study. Although the results were skewed, this study provides insights into the ways that teaching drawing promotes an understanding of visual art concepts of interest to students, parents, faculty, administration, institutions, and the visual art education profession. Positive social change includes promoting skill development in problem finding and problem solving, decision making, critical thinking, and using artistic expressive properties. This study also demonstrates the effect high stakes testing can have on some students.

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Dedication

This dissertation is dedicated to people of all ages who struggle with their drawing ability.

.

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I thank Dr. John Flohr, my academic mentor/advisor and committee chair, for his persistent help maintaining high quality of work throughout my PhD program and continuous coaxing toward successful academic achievement. I also thank Dr. Edward Graham, my qualitative methodologist on my dissertation committee, who worked diligently with me to help make the methodology for this dissertation most appropriate for its unique method of design. I thank Dr. Denise Dunn-Reynolds from URR who gave a fresh perspective on the study. I acknowledge and thank Dr. Gilbert Clark for his sincere and dedicated help, encouragement, and permission to use Clark's Drawing Ability Test. Most importantly, I wish to thank participating visual arts educators and their administrators for allowing me to use data.

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Chapter 1: Introduction to the Study

Introduction

The purpose of this study was to compare two different teaching strategies already in place in the curriculum by participating teachers in this study using Clark's Drawing Abilities Test (CDAT) (Clark, 2006). This study was a need because many public and private middle school visual art teachers in the United States are currently teaching students through skill-based learning (SBL) or problem-based learning (PBL) without knowing which teaching strategy is more effective. Implications for social change include providing insights into ways teaching strategies promote understanding of seventh grade visual arts concepts that may benefit students, teachers, and administration. Positive social change may include long-term changes in learners, faculty, institutions, and the visual art education profession. These insights include factors such as drawing skill, use of expressive art concepts, formal and sensory properties, technical and artistic properties, PBL, SBL, and how problem solving need to be considered in visual arts classes. Major sections of this chapter include the introduction, background, problem statement, purpose of the study, research question and hypotheses, the conceptual framework for the study, nature of the study, definitions, assumptions, scope and delimitations, limitations, significance of the study, and summary.

Background

Students taught through PBL in prior research were shown to possess several positive attributes. These include being better at integrating knowledge, being resourceful in addressing problems, and interpreting and evaluating more objectively than those taught traditionally (Semra, Ceren, & Omer, 2006). Students taught through PBL are self-regulating and retain ownership of their learning and scored higher on a biology test (Semra & Ceren, 2006), as well as, exhibiting increased achievement and retention levels (Liu, 2005; Ozgen & Pesen, 2008). Dochy, Segers, Bossche, and Gijbels (2003) argued students of PBL have better retention of declarative knowledge, although they remembered fewer facts, as well as greater knowledge application, both immediate and long lasting, which is a skill sought after in the workforce (Schmidt, Vermeulen, & van der Molen, 2009). SBL, in contrast, may increase drawing outcomes because of the repetitive, slow-paced, step-by-step learning, which students might be more inclined to remember. Loyens, Rikers, and Schmidt (2009) argued that PBL could fail to motivate students and cause them to doubt their learning potential. More detailed discussions of the literature review appear in Chapter 2.

Problem-solving is an important learning factor of PBL. Methods of problem-solving through the visual arts that have been researched are hierarchical modeling of creative artists' problem-solving behaviors (Kozbelt, 2008); investigations of the process of drawing from memory by comparing student outcomes of two countries, France and Brazil, (Coutinho, Ferreira, Darras, & Miranda, 2008), and how 214 fourth and fifth grade students resolved math problems with the assistance of creating drawings (Edens & Potter, 2008). Both PBL and SBL may increase drawing ability of students. In this study, I intended to determine the extent to which both teaching strategies already in use in the schools influenced artistic outcomes for seventh grade students. I compared these two teaching strategies and attempted to determine whether there is an influence of PBL on student drawing outcomes. A study of this type has not been conducted with middle school students and this study addressed this gap in the literature. Outcomes of this study may have positive effects on increasing drawing ability.

There was a need for this study because it attempts to promote positive social change by providing insight into strategies that create greater drawing ability and critical learning of visual art concepts. Positive social change may include long-term changes in learners, faculty, institutions, and the visual art education profession. Currently, teachers do not know which teaching strategy increases drawing ability for students, and this study provides some answers. The positive social change is insights into ways teaching strategies promote understanding of seventh grade visual arts concepts, which may benefit students, teachers, and administration. In addition, factors such as drawing skill, use of expressive art concepts, formal and sensory properties, technical and artistic properties, PBL, SBL, and problem solving should be considered in visual art classes.

Problem Statement

The problem was the effectiveness of PBL in middle school visual art is lacking in research, especially so in comparative studies with traditional SBL (Collard et al., 2009). This study attempts to fill that gap by comparing the learning outcomes of PBL with SBL as they relate to improving students' drawing ability. This comparative study reveals differences in teaching methods as they relate to student outcomes of drawing ability.

Currently, the problem is that the visual arts educators teach without knowing whether SBL or PBL is best for increasing artistic ability of students. Teachers are experimenting with both skill- and problem-based curricula or teaching one or the other without knowing which teaching strategy increased artistic ability for their students (Lam

& Kember, 2004). Teachers are in disagreement about teaching through PBL and SBL (Marshall, 2008). This problem created a gap in the literature in visual arts education specifically for seventh grade visual arts education students.

This problem influences visual art education because, without a clear, effective strategy in place, students are re-taught concepts, which takes away time for learning. There are many possible factors contributing to this problem, among them are: (a) lack of research in the area of drawing ability as it relates to PBL and SBL and (b) lack of knowledge about PBL on the part of skill-based teachers. This study contributed to the body of knowledge needed to address this problem by addressing both PBL and traditional SBL as it relates to improving drawing ability.

Outcomes of research drive PBL. Despite research by visual art educators, it is not known whether PBL or SBL increases drawing ability levels, because of the few empirical studies of conceptions of teaching visual art (Lam & Kember, 2004). The intent of this study was to investigate this gap in the literature. A study of this type has been conducted with middle school students, making re-testing of a specific problem-based curriculum difficult. If a similar study had been conducted, this study could be repeated to test the problem-based hypothesis. This problem has negatively impacted visual art students because a higher quality of learning may be present for Grade 7 visual arts students (Beach, 2007; Boud, 1985; Cerezo, 2004; Eilouti, 2007; Smith, 2008). A possible cause of this problem was a lack of research (Beach, 2007; Boud, 1985; Cerezo, 2004; Eilouti, 2007; Kozbelt, 2002; Kozbelt & Seeley, 2007; Lam & Keber, 2004; Smith, 2008). A study that investigated whether differences between these two teaching strategies increased drawing ability, by testing the influence of PBL on student drawing ability, could remedy the situation. Results may also reveal the catalyst for increasing drawing ability.

PBL has many research-based outcomes. PBL outcomes have been sought by teachers (Eilouti, 2007). Strategies of PBL that have been researched are conditions used to solve a problem (Eisner, 1997), student-designed curriculum (Atkinson, 2008), critical thinking (Green, 2006; Lampert, 2006; Sloan, 2010), problem-finding (Atkinson, 2008; Delisle, 1997; Rostan, 2005; Suwa, 2003), problem-solving (Kozbelt, 2008; Lampert, 2006; Leshnoff, 1995; Sloan, 2010), ill-structured problems (Maker, Jo, & Muammar, 2008), meaning-making (Walker, 2004), self-questioning (Wilson & Smetana, 2009), and use of mood boards (Garner& McDonagh-Philp, 2001). Literature on methods used to problem-solve in visual arts education are discussed in Chapter 2.

PBL has many other quality outcomes teachers seek. Students taught through PBL are better at integrating knowledge being resourceful at addressing problems, evaluating objectively than those taught traditionally (Semra, Ceren, & Omer, 2006). Students taught through PBL are self-regulating, take ownership of their learning, and one study revealed students scored higher on a biology test (Semra & Ceren, 2006). In addition, they demonstrate increased academic achievement and retention levels (Ozgen & Pesen, 2008). Dochy, Segers, Bossche, and Gijbels (2003) argued PBL students have better retention of declarative knowledge, although they remembered fewer facts, students possessed greater knowledge application, both immediate and long lasting, which is a skill valued in the workforce (Schmidt, Vermeulen, & van der Molen, 2009). In contrast, SLB may increase drawing outcomes because of the repetitive, slow-paced, step-by-step learning, resulting in students retaining more information. On the other hand, Loyens, Rikers, and Schmidt (2009) argued that PBL could possibly fail to motivate students and cause them to not realize their learning potential.

Limited investigative research on outcomes of PBL have greatly affected topics of independent student learning. Teachers desire independent development, collaborative opportunities (Hardie, 2007), PBL (Massey & Burnard, 2006), and student centered learning (Sayer, Wilson, & Challis, 2006). Purposively vague problems require critical thinking (DeYoung, Flanders, & Peterson, 2008), which PBL provides. These ambiguouse problems help students make connections (Eisner, 2002). There was a need for further research in PBL middle school art, especially in comparative studies with traditional SBL. This study attempts to fill that gap by comparing drawing ability outcomes of PBL with traditional SBL.

Both PBL and SBL may increase drawing ability. However, this study intends to determine which teaching strategy increased drawing ability for seventh grade students. The purpose of this study compares the two teaching strategies, PBL, and SBL to determine which approach enhances seventh grade drawing ability more.

Purpose of the Study

The purpose of this quantitative study was to determine the extent to which PBL and SBL produce differential results in the measurement of drawing ability levels for visual arts students. Specifically, the purpose of this study was to determine the extent of differences in drawing ability levels between PBL and SBL among seventh grade visual arts students through quantitative measures. The conceptual framework for PBL led to the research question and quantitative study approach appropriate for this study. The independent variable was teaching strategies, and the dependent variable was drawing ability.

The findings of this study may reveal short and long term drawing ability effects of PBL on the student, which in turn will strengthen the institution and the profession. Since there was no current research on the topic, this comparative study closed a gap in the existing body of research. The research question and hypotheses were designed to address this gap.

Research Question and Hypotheses

Research Question

To what extent are there differences, if any, in scores on CDAT between seventh grade visual arts students taught through PBL and those taught through SBL?

Null Hypotheses

$H_0$1: There will be no statistically significant difference in CDAT assessment posttest scores between students who have been taught through PBL and those taught through SBL.

$H_0$2: There will be no statistically significant difference in CDAT assessment scores (pretest –posttest = difference) between students who have been taught through PBL and those taught through SBL.

Alternative Hypotheses

H_A1 : The scores on CDAT posttest assessment will be higher in students that have been taught through PBL than those taught through SBL.

H_A2 : There will be statistically significant difference on CDAT assessment scores between (pretest –posttest = difference) students who have been taught through PBL and those taught through SBL.

Detailed discussions on the nature of the study, research questions, and hypothesis appear in Chapter 3.

Conceptual Framework

PBL was concieved to generate positive learning outcomes. The conceptual basis for this study was the teaching strategy of PBL originating from a student desiring to solve a problem (Boud & Feletti, 1997). Boude and Feletti (1997) defined PBL as "an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning" (p. 15). When real-life situations are pared with ill-defined problems, student motivation is increased. Teachers adjust their pedagogy according to learning needs of students presented in their field of teaching using this definition to guide their problem-based curriculum (Boud & Feletti, 1997). Students increase learning from the independent self-directed learning that PBL provides (Boud & Feletti, 1997). An increse in learning outcomes lead to real world connections.

These real world connections lead to deepen student understanding of concepts. PBL was developed by Boud (1985) to study the "most effective training for future professionals who needed to access knowledge across the range of disciplines and in realistic settings" (Boud, as cited in Eilouti, 2007, p. 199). PBL was developed to mimic real-world situations found in the work place. This strategy simulates real life situations through independent problem solving to deepen understanding of topics encountered in the work place or throughout life (Eilouti, 2007).

The origins of PBL remain applicable in contemporary teaching. PBL originated in the medical field by Howard Barrows at McMaster University in Hamilton, Ontario, Canada in 1980 and was later adapted and used at Harvard's Medical school because it was discovered that students increased learning from independent studies and simulated real life self-directed learning, which PBL provided (Boud & Feletti, 1997; Delisle, 1997). After experimenting with PBL at McMaster, Barrows discovered:

> Students who were taught through PBL became 'self directed learners' with the desire to know and learn, the ability to formulate their needs as learners, and the ability to select and use the best available resources to satisfy these needs. (Delisle, 1997, p. 3)

PBL fosters independent learning as well as increased motivation and critical thinking. Barrows and Tamblyn (1980) describe PBL as working towards solving a problem. The problem is purposely ill-defined to drive curiosity. Boud and Feletti (1997) redefined PBL as "an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning" (p. 15). Mimicking real-world problems increases curiosity and motivation to learn.

There are several components of PBL. Components of a problem-based curriculum include cumulative learning, integrated learning, progressive learning, and consistency in learning (Engel, 1997). PBL competences applicable for middle school students in this study, include: "adapting to and participating in change; dealing with problems, making reasoned decisions in unfamiliar situations; reasoning critically and creatively; identifying own strengths and weaknesses and undertaking appropriate remediation, eg (sic) through continuing, self-directed learning" (Engel, 1997, p. 19). Visual art curricula are ever changing yet require reasoning skills conducive to independent learning. PBL supports self-organization through questioning, progressive learning through a self-selected sequence, and learning for comprehension rather than rote recall of facts (Engel, 1997). This deepened understanding of concepts has many advantages.

Advantages for framing learning through PBL inculude; students seeking advice, increased retention, and gaining expertise in creating art. The strongest argument for using PBL as a teaching strategy, is that knowledge in context results in longer retention (Swanson, Case, & Vleuten, 1997). The goal of expertise in the arts may lead to retention through the nature of PBL. "Problem-based learning does not deny expertise; rather it is a way of gaining a vitally important form of expertise" (Margetson, 1997, p. 43). Students seek expert information and advice to help problem-solve. PBL is about transfer of knowledge (Norman, 1997) and retention (Swanson, Case, & Vleuten, 1997). Reasons for framing learning through PBL are longer retention rates, easily retrieved information, application in context, relevance, cumulative learning, progressive development, resourcefulness, critical reasoning, and identification of personal strengths and weaknesses (Engel, 1997).

According to Boud and Feletti (1997), guiding principles behind PBL are:

- PBL is a way of constructing and teaching courses using problems as the stimulus and focus for student activity.

- It is a way of conceiving the curriculum as being centered upon key problems in professional practice.
- Problem-based courses start with problems rather than with exposition of disciplinary knowledge.
- They move students towards the acquisition of knowledge and skills through a staged sequence of problems presented in context, together with associated learning materials and support from teachers (Boud & Feletti, 1997, p. 2).

Using PBL in the curriculum with a focus on real-world problems drives student learning toward content and progressive understanding, as well as, comprehension of big ideas.

Basic components of PBL applicable to student learning are universal. PBL has no specific set of rules or regulations to follow; however, the following are generally agreed upon characteristics: use of stimulus material, simulated real life situations, critical thinking, cooperative learning with a knowledgeable tutor, students identifying their own learning needs, reapplication of new knowledge to the problem, and self-assessment (Boud & Feletti, 1997). All of these characteristics were used in the PBL strategy in this study except cooperative learning, because the nature of most visual art experiences lean toward the independent spectrum.

Many educational benefits of implementing a PBL curriculum include:

- PBL supports brain-based learning in that students learn well when knowledge is in context in real life situations (Boud & Feletti, 1997; Jenson, 2008).
- It is more important to know how to use knowledge than to know information (Boud & Feletti, 1997).

- It is specific to each discipline (Boud & Feletti, 1997).
- It is ever changing yet keeps pace with the present (Boud & Feletti, 1997).
- It is adaptable for both small and large institutions (Boud & Feletti, 1997).

PBL is an approach to learning composed of critical reasoning (Engle, 1997). Historically, students have been taught simultaneously in a step by step format, which may present a lack of overall understanding of concepts for many students. Teachers seek multilayered, multidisciplinary learning and teaching approaches that PBL provides (Boud 1985, Eilouti 2007). Some PBL methods used are independent development, collaborative opportunities (Hardie, 2007), and "teaching with your mouth shut" (Finkel, 2000, p. 9) so that students can find their own steps and sequence.

The proposed problems that students work with can be designed for various curricular needs. The proposed problem may be selected to cover predetermined content concepts or techniques, to guide students through certain steps, to direct student interest or importance, to typefy a professional situation (Ross, 1997). The problem may take the form of "an event (or trigger); a descriptive statement; or a set of questions" (Ross, 1997, p. 31). An event might be one such as September 11, 2001, a descriptive statement might be lyrics from a rap song, or a set of questions on a topic might be developed by students or the teacher. In PBL, students usually work in groups with a tutor (Boud & Feletti, 1997; Engel, 1997; Ross, 1997), or in groups without a tutor, or as individual problem-solvers (Ross, 1997). In traditional learning, the goal is to quantify content, whereas in PBL, the goal is to qualify problem-solving (Margetson, 1997). Further explanation of the connection between PBL strategies and this study are discussed in a detailed analysis in Chapter 2.

This study approach was developed from the concept of PBL. The conceptual framework of PBL was compared to what most visual arts teachers use as a teaching strategy, SBL. These two teaching strategies needed to be compared and measured for increased drawing ability. The most appropriate measurement I found for this approach was CDAT. The research question; to what extent are there differences (if any) in scores on CDAT between seventh grade visual-art students taught through PBL and those taught through SBL is what drove this research approach. A research design suited to the study approach, research question, and participant sample was sought after. A nonrandom quantitative quasi-experimental pretest-posttest external control group design was a suitable design for the situation in my study because it helped deal with a maturation internal validity problem.

The data from CDAT yeilds continuous values agreeable with ordinary least square methods. A *t* test and ANOVA was used to analyze data. Because ANOVA is sensitive to the distribution of data, outliers may be unsuitable for ANOVA. Furthermore, an ANOVA may not achieve normality while transforming data, and it may be necessary to back up data analysis with a *t* test that tolerates departures from normality.

Nature of the Study

This quantitative study used a quasi-experimental design with a nonequivalent control group pretest-posttest design (Campbell & Stanley, 1963; Shadish, Cook, & Campbell, 2002) to investigate the difference between two teaching strategies, PBL and SBL, in relation to teaching drawing ability. The instrument used for testing was CDAT

(Clark, 1984). The quantitative study investigated comparison of an experimental group to a control group using different strategies already in place without asking teachers to change curriculum. The dependent variable is CDAT, and the independent variable is the teaching strategies.

The effect size was a determining factor in this study. The effect size is what could be expected to be the difference in the means between the control and experimental groups indicating the relationships and strength of conclusions in group differences (Coe, 2002; Creswell, 2009), and in this study it was the difference in the means between the two teaching strategies. The effect size is a power analysis run to determine the smallest sample to use to find out the power needed for the sample size. The effect size was calculated from G*Power 3.1.2. with central and noncentral distributions, test family set at *t* test, statistical test set at *correlation: Point biserial model*, type of power analysis: *A priori: Compute required sample size – given* α*, power and effect size d* 0.40, α *err prob* 0.05, Power (1-β *err prob*) 0.85, sample size group 1 = 20, sample size group 2 = 20, total sample size = 40 (Faul, Erdfelder, Buchner, & Lang, 2009). What effect size and statistical test information mean here is a *t* test is the statistical test being used to tell the difference between two teaching strategies. The sample size in the proposal was 40 visual art students. The actual sample size for the study was 81. The effect size was 0.40, with the error of probobility being 0.05, so I needed a sample size of 20 for each group to yield a power of 0.85 or 85%.

A quasi-experimental nonequivalent design was used because it was the best match for this investigation. The population consisted of 144 seventh grade students. Data analysis consisted of a two-way ANOVA repeated measures, with power set at 0.85

to determine if there are any interactions beween the two teaching strategies and drawing ability. A *t* test was used as it was not possible to transform data to achieve normality because *t* tests will tolerate depatures from normality, which was the case in this study. The target sample is 40 students from both classes out of a total population of 144. Some of the students and/or parents may not consent to the study, in G*Power calculations, a sample of 40 is conservative (Faul, Erdfelder, Buchner, & Lang, 2009). Reliability and validity measures were validated on CDAT. Clark (1989) correlated the CDAT with Childrens Embedded Figures Test (CEFT) (Karp & Konstadt, 1963). This will be described in detail in Chapter 3.

Non-survey quantitative data consist of pretest-posttest assessment using CDAT. Data collection took place in the art rooms by art teachers. Data collection was a paper and pencil assessment administered and was collected by art teacher(s) from the school(s) who also coded the tests to protect privacy rights. Quarter assessment grades were also available to compare to the level of agreement with CDAT. A more detailed explanation of the quantitative procedure is discussed in Chapter 3.

Institution Review Board (IRB) considerations were followed in several ways. The descriptions of research participants including an extra section relevant to working with children was approved by Walden's IRB. Community research stakeholders and partners involved in participants or data collection and data use agreements as well as a plan for sharing results will be submitted for approval to IRB. Potential risks and benefits of study participation, data integrity and confidentiality, informed consent, final checklist, and electronic signatures will also be approved by Walden's IRB.

Definitions

Artistic abilities: "The capacity to express himself in a creative medium, training and development of this talent or the acquisition of technical skill to express what he has to say effectively" (Munsterberg & Mussen, 1953, p. 457).

Clark's Drawing Abilities Test: "A new instrument designed for visual arts education research and as a screening and identification test for use in gifted/talented education programs for artistically talented students" (Clark, 1989, p. 191).

Drawing skill: "Two such components, which might be referred to as "representational accuracy" and "artistic-aesthetic value" (Hermelin & O'Connor, 1990, p. 218).

Expressive properties: "mood, originality" (Clark, 1989, p. 100).

Formal qualities: Intellecutally expressive art concept qualities of pattern, contrast, rhythm, movement, balance, emphasis, and unity (Clark, 1989, p. 100; National Board of Professional Teaching Standards, 1997).

Ill-structured problem: A problem requiring students to research, think through information that is known, seek additional information, interpret prexisting knowledge, and understand there may be a number of solutions (Delisle, 1997).

Pictoral drawings: "Include expressive and extraneous elements not necessary for problem solution, with no schematic elements" (Edens & Potter, 2008, p. 186).

Problem-based curricula: "PBL organizes curriculum around this holistic problem, enabling student learning in relevant and connected ways" (Gerdes, 2014).

Problem-Based Learning: "PBL is an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning" (Boude & Feletti, 1997, p. 15).

Problem finding: A divergent act, and artwork created by a problem finding artist exhibit more thoughtfulness and originality (Csikszentmihalyi, 1965, as cited in Sawyer, 2006).

Problem-Oriented curricula: "Problem-oriented curricula are ones where problems are used as selection criteria for content (and method)" (Ross, 1997, p. 29).

Problem solving: A convergent act and artwork created by a problem solving artist exibit great craftsmanship (Csikszentmihalyi, 1965, as cited in Sawyer, 2006).

Problem solving curricula: "Problem-solving curricula are ones where students are given specific training (or development experiences) for solving problems" (Ross, 1997, p. 29).

Schematic drawings: "A drawing is considered primarily schematic if it resembles a diagram and spatial relations and proportions between objects are depicted" (Edens & Potter, 2008, p. 186).

Sensory qualities: Emotionally expressive art concept qualities of line, shape, color, texture, space, form, and value. (Clark, 1989, p. 100; National Board of Professional Teaching Standards, 1997).

Skills-based learning: Teaching through activities whee students learn the "how and why behind a variety of artistic techniquesr" (Dolamore, 2009, p.131).

Talent: "A special, natural ability or aptitude for expression in one or more art forms" (Clark, 1989 b, p. 193).

Technical properties: "Technique, correctness of solution" (Clark, 1989, p. 100).

Assumptions

I assumed respective school art teachers would administer and collect CDAT and code the pretests and posttests, as well as the teacher quarter grade report, to provide participant privacy, thereby reducing researcher bias. Additionally I assumed there would be willing participants who would respond to test questions honestly. These assumptions were vital to the success of the study.

Scope

Drawing ability is what many art educators strive for when teaching students art concepts. It is desirable to maintain or increase drawing ability levels while teaching long periods to avoid reteaching subject matter. Teachers are reteaching drawing skills and continuously investigating students drawing ability, not knowing which teaching strategy increases drawing ability. The comparison of teaching drawing ability through PBL and SBL revealed differences and similarities. PBL may determine effects of how a comprehensive, individually investigated topic of interest helped students increase drawing ability. SBL may determine how teacher-driven, step-by-step, follow-along lessons address drawing ability. Both groups of students took pretest and posttests (CDAT) at the same time as in a cohort, which is how I attempted to relieve the maturation problem in internal validity.

Delimitations

This study was restricted to seventh grade visual art students in two, district-based middle schools and did not investigate the long-term abilities of core subjects such as science, mathematics, and social studies. The variables are restricted to the creativity of problem-solving lessons and studio skills lessons, outcomes of CDAT. The delimitation issues of external validity in this study were geographic distance of the two middle schools, as well as student attitudes of these two schools being unlikely to change over a quarter of the school year.

Potential generalizability would be a problem in a research study such as this. The results of this study cannot be generalized to the greater population due to the small sample. If this study were to be conducted with an extremely large population diverse in geographic, socioeconomic and cultural perspectives repeated over time, the results could be generalized.

Limitations

Limitations of this study related to the design included internal and external validity, construct validity, and confounder variables. The design of this study is limited in validity and reliability because of the gap in research that produces the problem and need for this study and lack of tested criteria in PBL for seventh grade visual arts students. Models for investigation may inaccurately determine the true drawing ability of visual arts students when comparing drawing ability of PBL and SBL. This weakness is addressed by stating that limited research has been conducted on this topic, and any study on the topic will add to the body of knowledge.

Several sources of internal invalidity must be considered for this nonrandom, quantitative, quasi-experimental, nonequivalent, pretest-posttest external control group design. Statistical regression was not likely in the design of this study because the samples, control, and treatment were not selected in the extremes of a distribution. There would be a concern about regression towards the mean if samples deviated in an extreme manner from the two populations of seventh grade students in their respective schools. This design usually may have problems with internal validity in the interaction of selection and maturation. This particular study did not confront this problem because both seventh grade groups mature simultaneously which minimizes out this source of internal invalidity. Maturation was not a concern because both groups acted as cohorts and as such they both move, through cycles simultaneously, as well as having had similar compilations of race/ethnicity and socioeconomic status. With the external control group, results of greater accuracy might be expected than if both groups were within the same school.

Threats to external validity in this quasi-experimental design appeared minimal. The interaction of testing and treatment (PBL) was very unlikely because a person's attitudes are unlikely to change (Campbell & Stanley, 1963). The interaction of selection and treatment was unlikely because of lack of "freedom to sample widely" (p. 50) and randomized grouping (Campbell & Stanley, 1963). The threat to reactive arrangements was unlikely because there was less chance and reason to react because of the difference in teaching method and geographic distance (Campbell & Stanley, 1963). The threat to reactive assessment environments became the greatest threat to external validity. This quasi-experimental design was consistent with research designs needed to advance knowledge within the discipline of visual arts education. A discussion on sources of internal and external invalidity in greater detail occurs in Chapter 3.

Biases that could influence the outcomes of this study included the expectation of greater outcomes on CDAT results in problem-based or skill-based teaching. This bias was addressed with each art teacher having control of introducing students to the study, delivering the teaching strategy, administering the pretest and posttest, as well as coding the tests and teacher grading. This controls any influence on researcher bias within the CDAT outcomes.

Significance

Potential contributions of this study that advanced knowledge in the discipline were significant, varied, and numerous. The purpose of this study was to compare two different teaching strategies. These different teaching strategies are PBL and SBL in the visual arts. The goal was to provide guidance to art teachers so they can provide informed learning and social change in art education. It was not known the extent of which PBL or SBL in art education increased drawing ability for seventh grade students. This study attempted to close this gap in teaching as well as in literature.

This study attempted to promote positive social change by providing insight into ways in which teaching strategies benefit student learning; PBL and SBL. This difference is important because at the individual level, critical thinking may noticably increase (see pbln.imsa.edu for more information) and at the institutional level, PBL may institutionalize formally as preference in teaching strategy because of increase in the students' drawing abilities.

Critical thinking which PBL offers is transferable to other areas of student learning (Hetland & Winner, 2007). Commentators mention students in public education not developing problem solving, decision making, and critical thinking skills necessary to face challenges out of school in work and in life are generally provided in meaningful ways by the arts and PBL (Stevenson & Deasy, 2005). Research outcomes in visual arts education may encourage art educators to think clearly about teaching these 21st Century skills. At the same time, they may expand knowledge while providing more efficient means of teaching. Ultimately changing the field of art education may result in positive social change (Wilson, 1997). The visual arts and PBL provide a tremendous outlet of opportunity for positive social change.

A PBL teaching strategy influences many students. With a hands-on authentic approach, visual arts duplicates work place skills, and the practical approach PBL ascribes to in the visual arts is appealing to at risk students (Brophy, 1998; Davis, 2008; Sloan, 2008; Wilhelm & Wilhelm, 2010). The arts are a lifesaver for at risk students because the arts are the most important subject for most of this population who find a niche, their purposes and calling to succeed in art rather than other subject areas (Davis, 2008; Wilhelm & Wilhelm, 2010). “Art teachers are experts and unsung heroes in the education of challenged and challenging students” (Davis, 2008, p. 81). Visual arts teachers usually teach the entire population, or at least the population of lower performing and struggling students for which success in the arts is believed more likely (Brophy 1998, Sloan, 2008). Visual arts provide practical learning skills that go with a student into his or her career; the visual arts provide students with a voice, giving these students a will to succeed (Davis, 2008) in the workforce (Brophy, 1998; Sloan, 2008). The arts are basic and provide a point of connection through inquiry, interpretation, expression, and imagination in a way other subjects cannot (Davis, 2008), especially so through problem-finding (Atkinson, 2008; Delisle, 1997; Rostan, 2005; Suwa, 2003) and problem-solving (Kozbelt, 2008; Lampert, 2006; Leshnoff, 1995; Sloan, 2010). The nature of visual arts is particularly conducive to a PBL teaching strategy because the strategy challenges students with a problem to be solved, forces them to think of solutions and helps them weigh challenges, opportunities, and consequences.

PBL provides skills for problem-solving and discovering new information conducive for visual arts environments (Davis, 2008). The arts provide opportunities for students to create something new, tangible, and original, which are never right or wrong (Davis, 2008). The arts provide students opportunities to experience significance as agents of positive social change through powerful image making and metaphorical expressions in a way that they make a difference and realize possibilities through imagination (Davis, 2008) increasing their self-concept and confidence while solving problems. The arts foster tolerance of differences and encourage these differences (Stevenson & Deasy, 2005) opening students up to further possibilities of problem-solving. The arts provide students opportunities to choose whether or not to make changes happen through their own abilities, which provide for them a voice that may carry across other subjects (Davis, 2008) making further connections and realizations.

The uniqueness of problem-solving in the visual arts provides students with the power and persistence of expression of multiple interpretations of worth and mutual respect of human emotion (Davis, 2008). The visual arts "provide opportunities for students to demonstrate new patterns of thinking and learning" (Hardiman, 2010, p. 233). Because of the creative and experimental nature of visual arts, experiences in shifts of thinking are likely for the learner. Problem-solving in the arts provides opportunities for students to express and empathize with injustices, poverty, and misfortunes, whereby initiating a voice for positive social change (Davis, 2008).

The arts provide a spotlight to celebrate and understand diversity and cultures while demonstrating and representing human relations (Davis, 2008). “The arts help to make learning matter to students” (Stevenson & Deasy, 2005, p. 17). When students find something they enjoy, learning becomes more important. “In schools we studied, the arts put students in active and meaningful roles in their classrooms and connected schools to student’s lives and cultures” (Stevenson & Deasy, 2005, p. 17). In this example, students found something personal and important to learn about through the arts.

Visual art educators can be agents of successful positive social change in delivering reform (Lam & Kember, 2004; Wilson, 1997). The promotion of arts education had been the focus of education reform in Hong Kong as part of a balanced education to develop the intellectual, social, and emotional growth of students (Education Commission, 2000, as cited in Chan, Chan, & Chau, 2009). The potential results of this study could result in the promotion of a concentrated effort to increase the teaching strategy of PBL in visual art education in the United States of America.

Summary

Educators do not know whether problem-solving lessons or studio skill lessons in art education increased drawing ability for seventh grade visual art students. The purpose of this study was to compare teaching strategies, PBL, and SBL. This quantitative comparative quasi-experimental design with a nonequivalent control group with pretest-posttest (NR O_1XO_2 NR O_1 O_2) determined the extent to which these two groups scored on CDAT. The design of this study was based on the conceptual framework of PBL, a recognized teaching strategy. Results of this study add to the body of knowledge, closing a gap in the literature. The importance of this study may influence the way in which visual arts teachers deliver their lessons, influencing critical thinking of their students as well as increasing the awareness of perception and drawing ability. This study will create positive social change affecting short and long term advancements in the delivery of visual art teachers' lessons affecting the student, institution, and the profession, as well as new research.

Chapter 2 presents important aspects of theory examined as well as a literature-based description of research variables. Previous research of various methodologies and strategies relating to the independent variables as well as methodologies related to the dependent variable, drawing ability will be discussed. In Chapter 3 I discuss the research design and methodology including the research approach, justification, and logical connection to the problem is developed fully. Descriptions of the population and method, a defence of the sample size as well as the instrumentation and materials will be discussed. The process of reliability and validity of the instrument of measurement will also be discussed in Chapter 3 as well as a further discussion of the methodology. Chapter 4 will discuss the findings of the study. Chapter 5 will discuss the interpretation of the findings for further recommendations and implications for positive social change.

Chapter 2: Literature Review

Introduction

PBL in middle school visual art is lacking in research, especially in comparative studies with traditional SBL (Collard et al., 2009). I attempted to fill that gap by comparing the learning outcomes of PBL with SBL as they relate to improving students' drawing ability. This problem has negatively impacted visual arts students because a higher quality of learning may be present for seventh grade visual art students (Beach, 2007; Boud, 1985; Cerezo, 2004; Eilouti, 2007; Smith, 2008). A possible cause of this problem is lack of research (Beach, 2007; Boud, 1985; Cerezo, 2004; Eilouti, 2007; Kozbelt, 2002; Kozbelt & Seeley, 2007; Lam & Keber, 2004; Smith, 2008). The differences in teaching methods are revealed in this comparative study as they relate to student outcomes of drawing ability.

The purpose of this study was to compare teaching strategies to determine which strategy; PLB or SBL increases drawing skills. Visual arts teachers use PBL and SBLwithout knowing which teaching strategy increases drawing ability more (Lam & Kember, 2004). Teachers disagree which teaching strategy increases drawing skills (Marshall, 2008). This created a gap in literature because it is not known which teaching strategy increased students' drawing abilities (Lam & Kember, 2004).

Content of Review

The extent to which PBL or SBL in art education increases drawing ability for seventh grade students is unknown. As a result, this problem negatively impacts short and long term drawing ability outcomes for students. Visual arts teachers and higher learning institutions do not know which teaching strategy results in increased drawing ability for students. The purpose of this study is to determine the extent to which PBL affects the outcome of drawing ability. The purpose of Chapter 2 is to make a literature-based argument for the need of this study. The chapter includes conceptual summaries of PBL, SBL, and previous research; descriptions of the research variables; methodologies investigating drawing ability; as well as CDAT and its use in research.

A review of the research included concise summaries and descriptions of the literature that help define the most important aspects of the teaching strategy of PBL to be tested in this study followed by a partial breakdown of PBL in research. Next, there is a literature-based description of the research variables with the dependent variable drawing ability and independent variables PBL and skills-based learning. The review closes with literature related to the use of differing methodologies to investigate the outcomes of drawing ability to the present study and followed with a conclusion. A review of the method and measurement used in the present study is discussed in Chapter 3.

Literature Search Strategy

In searching the literature, the following databases were used: Education Research Complete, ProQuest, ERIC, Teacher Reference Center, and Science Direct. The following keywords were used: *PBL, traditional activities-based learning, art, retention, comparison studies, middle school, problem, teaching art, traditional, thinking, thought, how to teach art, conceptions of teaching art, art education, pedagogy, PBL, problem-based, problem-finding, problem-solving, traditional art skills, art, art skills, creativity, comparison studies, middle school, problem, teaching art, thinking, thought, how to teach art, conceptions of teaching art, art education, pedagogy, cognitive load,* *technical skills, creative problem solving, increasing creativity, cognitive, cognition, haptic, , correlation studies, artistic ability, improving artistic ability, draw, drawing, drawing skill,* and *drawing ability*.

From databases and other sources, 180 articles were chosen to examine the research question. Scholars recognize that visual arts teachers recognize the visual arts are lacking in empirical research (Cerezo, 2004; Dobbs, 2008; Kozbelt, 2002; Kozbelt & Seeley, 2007; Lam & Keber, 2004; Smith, 2008); as a result, there is little critical and analytical empirical knowledge in the visual arts (Snow & McLaughlin, 2005). The most relevant research published within 5 years on problem- and skill-based visual art and drawing ability was integrated into a critical essay. At times, published knowledge that was not as current as within 5 years was used in this review; all sources were peer reviewed from academic journals edited books.

Conceptual Framework

The conceptual framework of this study was PBL. The research question driving this study was, to what extent are the differences, if any, in scores on CDAT between seventh grade visual-art students taught through PBL and those taught through SBL**.** Major components of the research reviewed were drawing ability, PBL, technical skills-based learning, and the measure used in this study, CDAT. In this section I discuss the teaching strategy of PBL and its relation to art education.

The conceptual basis for this study inherent from the research question was PBL which originates from a problem a student desires to solve (Boud, & Feletti, 1997). Boud and Feletti, (1997) defined PBL as "an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning" (p. 15). When the curriculum replicates problems from the workforce, it creates a real-world problem that interests students. " PBL [problem based learning] is an instructional method that uses a real-world problem as the context for an in-depth investigation of core content" (Checkley, 1997, p. 3). When "real-world" problems are introduced, students are more invested in the learning process. Teachers adjust their pedagogy according to the learning needs of their students presented in their field of teaching using this definition to guide their problem-based curriculum (Boud & Feletti, 1997). PBL provided independent, self-directed learning that is advantageous in learning (Boud & Feletti, 1997; Checkley, 1997).

PBL used problems modeled after professional practice as the center of the curriculum for student learning (Boud & Feletti, 1997; Checkley, 1997). Incorporating problems into an already designed curriculum is not what Boud and Feletti (1997) had in mind for PBL. Rather than starting with knowledge, PBL starts with ill-structured problems (Boud & Feletti, 1997). In PBL, knowledge is presented in the context through sequenced events in conjunction with learning materials, media and technology (Boud & Feletti, 1997). PBL is very similar to constructivist learning in that students drive much of the learning process with guidance by the tutor/teacher (Sayer, Wilson, & Challis, 2006).

Characteristics and Attractive Features of PBL

PBL has no universal standards; however, the following characteristics are commonly found in problem-based curriculum (Boud & Feletti, 1997). Using motivational media materials and technology facilitate understanding of the visual art problem, question, or issue (Boud & Feletti). The problem is presented to students as an authentic issue similar to what professionals encounter (Burton, Horowitz, & Abeles, 1999; Cerezo, 2004; Kelly et al.; 2009; Rasmussen, 1997; Schmidt, Vermeulen, & van der Molen, 2006). Students are guided with limited resources to think critically about, define, and attempt to solve the problem (Boud & Feletti, 1997; Kelly et al., 2009; Tiwari, Lai, So, & Yuen, 2009). After exposure to PBL, students work in cooperative learning groups with a tutor as a guide and group facilitator well informed of the problem (Boud & Feletti, 1997; Cerezo, 2004; Kelly et al., 2009). PBL promotes team-building skills necessary for the work environment when they leave school (Delisle, 1997; Schmidt, Vermeulen, & van der Molen, 2009). Students become familiar with and identify learning strengths and resources available to help them solve the problem (Boud & Feletti, 1997; Collard et al.; 2009; Fiske, 2006). Students apply their new knowledge to solve the original problem and self evaluate their learning process. (Boud & Feletti, 1997).

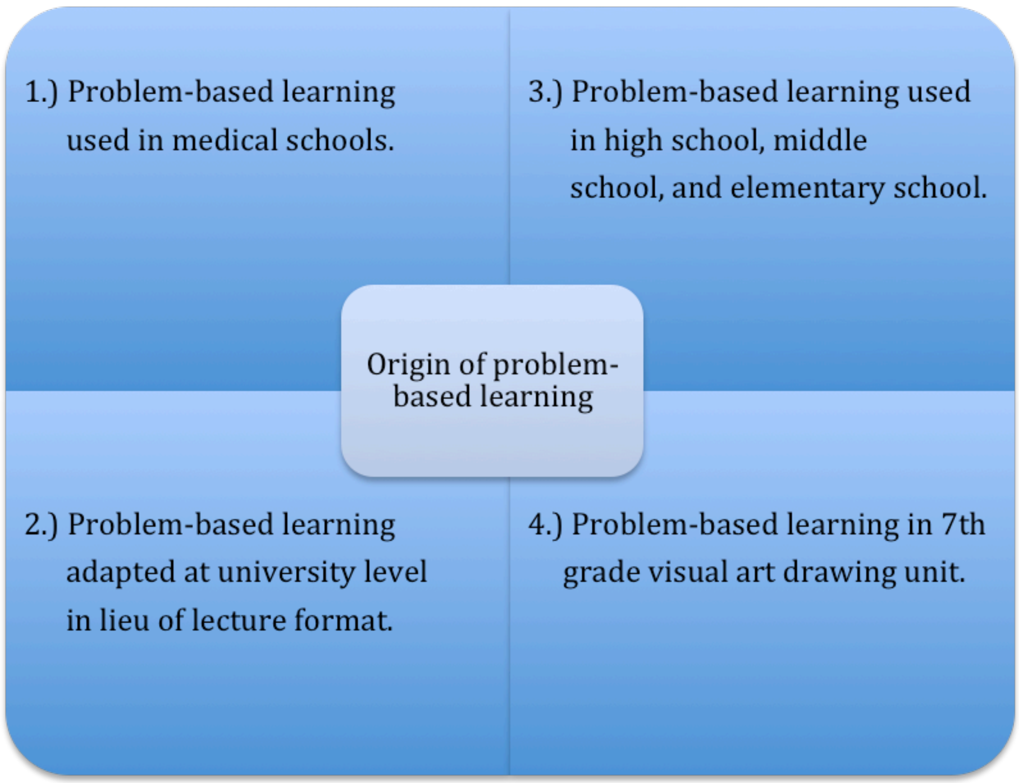
PBL innovatively fosters teamwork, self-organization, information searching skills, as well as comprehension of knowledge (Burton, Horowitz, & Abeles, 1999; Kelly et al., 2009; Marti, Gil, & Julia, 2006). The increased interest in resourcefulness in turn increases active learning, which is focussed on students solving an interdisciplinary problem (Marti et al., 2006; Gil, & Julia, 2006; Tarnvik, 2007; Tiwari, Lai, So, & Yuen, 2009). Visual arts can be a good fit for interdisciplinary problem-solving because of the cultural context that usually is accociated with visual art. In a formative evaluation process, students learn through their mistakes movin g from failure to success and removing failure as an option, replacing it with learning (Fiske, 2006; Marti et al., 2006). PBL is an active student driven learning that teaches students to learn on their own

(Cerezo, 2004; Delisle, 1997; Fiske, 2006; Tarnvik, 2007) and helps students learn more efficiently (Schmidt, Vermeulen, & van der Molen, 2009). Most impressive, is that the lowest performing students make the greatest improvements after an integrated problem-based curricula (Fiske, 2006; Haney, Wang, Keil, & Zoffel, 2007; Vansant, 2011), as well as at-risk students (Cerezo, 2004).

The Origins of PBL

According to Boud and Feletti, (1997), PBL in its most basic form began at McMaster University in Canada in 1980, and at Harvard Medical School in 1990. These two medical institutions began experimenting with the tutorial process and small group instruction which enabled students to problem solve real life situations. PBL continues to grow and develop in structure from these early origins attracting attention because of its pro-active features. It can be argued students learn most effectively when the learning is active not passive, and happens in the context for which knowledge is meant to be used (Boud & Feletti, 1997). The developmental use of PBL is diagramed in Figure 1.

Figure 1. The Relationship and Growth of PBL From its Origins to its use in the Present Study.



The Process of Teaching Through PBL

The process of teaching through PBL is remarkably similar to the four stages of creative problem-solving: preparation, incubation, illumination, and verification (Wallas, 1926, as cited in Helie & Sun, 2010). In PBL, students are first presented with a carefully planned, ill-structured problem that can be time-consuming for teachers to construct (Liu, 2007). After which, teachers must then be willing to relinquish their teaching role for that of a tutor (DeYoung, Flanders, & Peterson, 2008). Delisle (1997) suggests organizing problem based learning in the following steps by; "connecting with the problem, setting up the structure, visiting the problem, revisiting the problem, producing a product or performance, and evaluating performance and the problem" (p. 26). These steps in preparation introduce students to the problem and help them with an in-depth look at the situation surrounding the problem and provide an opportunity to create a performance or demonstration that they evaluate as a solution to the problem. "The real problem, therefore, is how to develop a new problem formulation, transforming the ill-defined problem into a well-defined problem that can be solved" (DeYoung, Flanders, & Peterson, 2008, p. 279). The difficulty for the teacher is to formulate something abstract (the ill-defined problem) into something concrete (well-defined) for students to solve. "A well-written problem forces students to learn from a variety of different sources and to make decisions based on their research" (Delisle, 1997, p. 13). In this manner, students view the problem through a larger scope enabling them to increase connections and meaning-making through problem-solving. An ill-defined problem begins to be solved with defocused attention, and as the problem-solver is closer to the solution attention increases (Vartanian, 2009). Ill-defined problems do not get solved at the beginning of the problem-solving stage (Helie & Sun, 2010) because of their sofistication (Stewart & Walker, 2005). Insight into problems need retructuring prior to being resolved (DeYoung, Flanders, & Peterson, 2008). Ku and Soulier (2009) argued the learning goal should be clear to help direct students who need clear directions.

According to Zeki (2009, p. 87) ambuguity causes people's brain to find meaning, which in turn causes the brain to find a solution. An ill-defined problem is ambiguous and this is what makes it a great starting tool for learning in addition to being more life-like. In an ambiguous situation, one solution is not immediately definitive, instyead it leads people to seek definition and meaning from the ambiguous, ill-defined problem (Zeki, 2009, p. 87). Additionally it has been argued that anbiguity is one of the causes of creativity, which can also be applied to creative learning (Dorn and Madeja, 2004, p. 78).

The classroom procedure is similar to this. Students are placed in small groups of four to five. They then identify what is known about the problem and hypothesize outcomes (Checkley, 1997; Delisle, 1997; Marti, Gil, & Julia, 2006). Delisle (1997) also advised to brainstorm possible solutions at this time. Next Checkley et al., (2006) recommended having students identify the issues involved with the problem, and decide what other information they need to know in order to test and reorganize their theory so they can begin to find a solution(s) individually or in groups. After the students are well prepped, they begin to find ways to solve the problem, similar to incubation, and at some point, they begin to find solutions, or illuminations. At this juncture, the ill-structured problem is encrypted into long-term memory. The problem remains unsolved while underlying mechanisms seek solutions (Helie & Sun, 2010). After the solutions are found, students verify and present their solutions, and present results to the teacher/tutor and classmates.

Arts, Gijselaers, and Segers (2006) devised a problem-solving template. In this template, these steps are followed:

- Find a problem in your data
- Define the problem and provide underlying data as evidence
- Brainstorm different hypotheses

- Students state group learning objectives and provide tutor a copy
- Work on learning objectives through discussion
- Discuss results from all groups
- Relate findings to other coursework (Arts, Gijselaers, & Segers, 2006, p. 77)

This template is similar to the process of how other researchers describe the delivery of PBL (Checkley, 1997; Delisle, 1997; Marti, Gil, & Julia, 2006). What is different in Arts, Gijselaers, and Segers' design is the ill-structured problem was based on explicit data originating from a need. After students presented the solution(s), a further discussion revoled around how this problem related to other coursework (Arts, Gijselaers, & Segers, 2006).

A variety of benefits result from employing PBL. For example, any lesson can be taught through a PBL approach, which is not replacing what was taught, rather how it was taught (Rasmussen, 1997). It is important to try to include both linear and nonlinear problem-solving to reach most student's learning styles (Atasoy, Guyer, & Atasoy, 2008). PBL fully engages low achieving students (Haney, Wang, Keil, & Zoffel, 2007) who learn better by excitement, discovery, and thinking with others (Rasmussen, 1997). When students were provided the opportunity to conduct online research for their project, their risk-taking increased. (Wang, 2007). A sign of a successful PBL unit is when students solve a proposed problem without constant direction from the tutor/teacher (Delisle, 1997).

The Role of the Tutor/Teacher

The tutor guides student learning clarifying the students' ideas. According to Marti, Gil, and Julia, (2006), the tutor:

- should not present ideas or opinions, but rather should ask for the ideas, opinions, and reasoning of individuals in the groups
- should point out faulty reasoning and/or contradictions of thinking and encourage critical evaluation of thought processes and knowledge
- acts as a facilitator for discussion, seeking interaction amoung all groupmembers, ensuring an exchange of ideas and experiences were not passed up
- discusses strategies with students, remaining neutral of any decision making which was always left up to the group

Visual Art Education and PBL

Recent literature on themes from the research question has guided this review to uncover knowledge gaps in the literature. PBL in art education are discussed in conjunction with problem-finding and problem-solving because of the characteristic nature of teaching visual arts. The reason PBL is the strategy driving this study is its attention to solving a problem. Much attention was given to the manner in which visual art education was being delivered (Ibrahim & Yusoff, 2009; Lamm & Kember, 2004; Snow & McLaughlin, 2005). An equal amount of attention was given to the structure of delivery, in relation towhether teaching through PBL or SBL improves drawing ability (Leyendecker, 2010; Snow & McLaughlin, 2005). This study attempts to address whether one method of delivery improves drawing ability better than the other.

This literature review begins with a discussion of different points of view of the delivery of visual arts education. Cox and Rowlands (2000) investigated a study on the Steiner, Montessori, and traditional approach to children's drawing ability in the United

Kingdom with interesting outcomes. In the Steiner method, visual arts are used to support other subjects and Steiner teachers received substantially more visual arts training than traditional approaches. Art media available were watercolors, thick crayons, pencils and found objects with which the children are encouraged to express their feelings. Montessori teachers receive some art training and art is used as sensory stimulation. Art materials made available to Montessori students were finger painting, collage, modeling, and building materials. Observation drawings and paintings are encouraged in the Montessori method. In traditional schools, art is regarded as important for development and free drawing is encouraged as self-expression. Art activities were part of daily activities (Cox & Rowlands, 2000).

In the Cox and Rowland (2000) study, participants created three drawings: a free drawing, a scene, and a drawing from observation. When rated, Steiner drawings received higher ratings from judges in the scene drawing, as well as use of color in the free drawing. Steiner drawings had greater detail: shading and were more realistic with greater exactness of proportion than Montessori or traditional schools. Steiner children spent more time looking back and forth at the model when drawing from observation than Montessori or traditional schools (Cox & Rowlands, 2000). From this study, it can be stated that the Steiner method of delivering visual arts education was superior because of the higher ratings, greater detail in drawings, and overall greater maturity level of output from students.

An interesting point of view is the approach taken at the Arts Institute at Bournemouth, United Kingdom where the tutor is a silent witness in PBL (Hardie, 2007). In a graphic design course, learning happened by doing, and the method of delivery was "teaching with your mouth shut" (Finkel, 2000, p. 9; Hardie, 2007). The teacher facilitated the exploration of ideas, and students took responsibility for their own learning while the teacher verbally withdrew, listening to the students' discussion (Hardie, 2007). This method of delivery is not mentioned in any other visual arts literature.

Problem-Finding and Problem-Solving in the Visual Arts

In this section, previous research on problem-finding and problem-solving are discussed in relation to PBL. Problem-finding and problem-solving are two different and distinct methods of approaching PBL. Through problem-finding, students learn by finding a new ill-defined problem or idea to solve, one that takes deeper thinking than problem-solving alone (Kozbelt, 2008). In problem-solving, students are presented with a problem to solve and must work to solve the problem. Problem-finding takes deeper thinking than problem-solving.

Problem-solving in visual arts education has its roots in the Bauhaus movement of design where designers were provided a problem to solve as effectively and efficiently as possible, with prized solutions being elegant, visually appealing while respecting the economy of means (Eisner, 1997). In a paradigm for the analysis of visual problem-solving, Eisner commented,

> The greater number of conditions that an individual imposes as *restrictive conditions*, the fewer options the student has to choose. Conversely, the fewer the number of conditions one imposes, the larger the number of choices will be left to students to make (1997, p. 188).

As teachers increase the number of conditions to a problem, the student is left with fewer choices, the fewer conditions, the better (Eisner, 1997). Allowing students to "define their own problems and proceed in their own way to solve them" (Eisner, 1997, p. 189) causes students to think critically. This allows for deeper thinking on the part of the student as well as allowing for self-organization (Krenik, in press).

Problem-Finding and Problem-Solving in the Visual Art Curriculum

For many students, the process of creating artwork is more important than the product created (Gardner, 1990; Newton & Newton, 2005). The process of creating can involve both problem-finding and problem-solving (Newton & Newton, 2005). Some researchers agree that the process of creating art includes more problem-solving (Eisner, 1994; Garner & McDonagh-Philp, 2001; Kozbelt, 2008; Lampert, 2011; Newton & Newton, 2005). Chung and Ro (2004) argued the nature of the visual arts lends itself to problem-solving, which includes a learner-centered curriculum and a reflective thinking process. A problem-solving curriculum enhances creativity more than a traditional curriculum, specifically so with originality (Chung & Ro, 2004). Andrews (2010) argued allowing student input into the design of the curriculum creates outcomes such as deep thinking and detailed self-assessments. Efland (2002, p. 164) argued the visual arts curriculum mirror students' map of learning to make way for cognitive growth. Self-assessments encourage students to think about the problem-solving process of creating art (Newton & Newton, 2005). Designing curriculum is problem-finding, which should involve students whenever possible because the benefits of student learning outweigh the time it takes to allow students to self-organize their own curriculum (Andrews, 2010; Eisner, 1994).

Problem-finding is finding new solutions to a problem (Andrews, 2010). Problem-finding includes the cognitive acts of perceptual reorganization of visuospatial representations, and the generation of new ideas and interpretations, (Suwa, 2003). Benefits include deep thinking, which may also be called higher order thinking, or critical thinking, all of which educators desire in proportion of students for the workforce (Andrews, 2010; Lampert, 2011; Riley, 2006). Allowing students to design curriculum means teachers themselves take risks as they allow unknown events to unravel (Atkinson, 2008).

When students are provided the opportunity to become involved in the design of the curriculum, the focus shifts from the teacher telling students what to do, to problem-finding and problem-solving, and the exploration of personal meaning through studio projects while at the same time learning about art concepts and technical skills (Eisner, 1994; Hafeli, Srokrocki, & Zimmerman, 2005). This is especially so when the problem is personally meaningful to the students (Eisner, 1994, p. 82). Ill-structured, ambiguous problems with enduring ideas of real life issues make learning meaningful and compelling for students (Stewart & Walker, 2005).

Students who were taught through textual and visual images out-performed students who were taught through textual information only (Angeli, Valanides, & Kirschner, 2009). This is important for visual art educators to remember in the PBL environment where technology can be used to an advantage in problem-solving. PBL provides opportunities for interdisciplinary learning and allows students to direct their own learning. This, in turn gives them greater responsibility for their learning and helps students learn on their own (Burton, Horowitz, & Abeles, 1999; Delisle, 1997; Fiske, 2006; Marti, Gil, & Julia, 2006; Tarnvik, 2007; Tiwari, Lai, So, & Yuen, 2009). The self-organizing skills from which students learn the process of PBL could last a lifetime.

Problem-Finding in the Visual Arts

Problem-finding is an important factor in PBL. According to Getzels and Csikszentmihalyi (1976, p. 80), the cognitive functions underlying problem-finding include memory, reason, and imagination. These three in conjunction with the problem, method(s) of solution, and solution(s) make problem-finding what it is. The problem is known to the student when it is in conjunction with memory; whereas the solution to the problem is unknown to the student when it is in conjunction with imagination. The method of finding a solution and reasons for arriving at the solution happen somewhere in between the problem and solutions. It also appears a heierarchy involved with reasoning in memory, followed by reason, progresses to the imagination as a higher order thinking mechanism in a solution to the problem found. In the visual arts, it makes sense to problem-find and problem-solve with imagination, or as Getzels and Csikszentmihalyi hold, with *discovery* (p.83). During the process of problem-finding, *openness* to content, *exploratory* activity, and *changes* made to content were observed (p. 90). The most original and creative artwork was created as a problem rooted in deep personal experience where an axion of tension exhisted (Getzels & Csikszentmihalyi, 1976, p. 139).

Problem-finding includes cognitive acts of perceptual reorganization of visuospatial representations, and the generation of new ideas and interpretations (Suwa, 2003). Benefits include deep thinking; also called higher order thinking, or critical thinking, all of which are valued by educators as well as the workforce (Andrews, 2010; Burton, Horowitz, & Abeles, 1999; Riley, 2006). Allowing students to design curriculum as a form of problem-finding means teachers themselves taking risks as they allow unknown events to unravel (Atkinson, 2008).

When students are not part of problem-finding and the responsibility is solely on the teacher, Delisle (1997) recommends considering the following points. First, review the curriculum to determine the content and skills to be covered and developed; then write a problem statement. Second, develop the problem "from knowledge of the individual student needs, values, interests, experiences, feelings, culture, and backgrounds" (p. 16). When the problem connects closest to students lives, they will be more willing to invest in it, and work hard to solve it. If during the process it is found the problem is too easy or difficult, the problem must be altered by providing more information to students or changing the presentation format to accomadate successful learning (Delisle, 1997).

According to Rostan (2005), the relationship between problem finding and technical skill depends upon the nature of the drawing task itself. The processing of visual information is synonymous with problem-finding, leading to increased knowledge in the visual arts. Novice students when processing new information experienced more problem-finding than experienced students (Rostan, 2005). Processing new technical information for novice students can be a form of problem-finding.

Critical Thinking and Problem-Solving in the Visual Arts

Critical thinking skills are sought after by most educators and are learned through ill-structured problems that foster inquiry (Lampert, 2011). Green (2006) argued students use the following critical thinking behavior dispositions to solve problems: persistence, tolerance for ambiguity, uncertanity, revision, risk-taking, objectivity, fluency, flexibility, and self-regulation. Green (2006) argued the creation of art through critical thinking requires "complex and reasoned thinking" (p. 53). When people create art through critical thinking such as through problem-solving, the experience of creating is complex and the thought process organized (Lampert, 2011). Artists often refer to problem-solving as a driving force in thier creative process when writing artist statements (Kozbelt, 2008). Smilan and Miraglia (2009) argued critical thinking evolves more fully from engaging problem-based methodologies. Furthermore, Lampert (2006) argued aesthetic inquiry can be used as "an exploration into broad questions about the value, nature, meaning and definition of art" (p. 46) and can be a discussion about art in general which uses higher order thinking skills. Broad open-ended questions lead to deeper thinking and meaning making as students define and make sense of aesthetic experiences. PBL art students showed increased critical thinking skills compared to non-arts students (Burton, Horowitz, & Abeles, 1999; Lampert, 2006). Open-ended and ill structured problems facilitate critical thinking skills (Lampert, 2006, 2011). A choice of well-structured or ill-structured problems offer students opportunities to learn through content, variety of problems, and domains (Maker et al., 2008). In PBL, rather than giving students one way to solve or imitate a problem, they are expected to consider multiple resolutions. As a result, individualuals think deeply, inquiring about the problem creating artwork that looks very original (Lampert, 2006, 2011). Hardiman (2010) argued it is up to the teacher to design lessons that engage students in divergent thinking which lead to multiple approaches to problem-solving.

Leshnoff (1995) argued ambiguity offers various perceptions and interpretations about the context of artwork while providing critical thinking for students. In PBL where teachers take on the role of a tutor, the opportunity to create critical thinking dialogue with students can be accomplished by presenting problems, questions, and arguments all while remaining nonjudgemental. Teachers can help students self organization, and reasoning abilities by remaining nonjudmental and respectful of students' responses and contextual frameworks (Leshnoff, 1995). Teachers who use artwork as discussion points to demonstrate how artists solve problems create exellent examples for a student's problem-solving skills (Leshnoff, 1995).

Meaning-Making and Problem-Solving in the Visual Arts

Visual art teachers may find it difficult to design a meaningful, engaging problem-based curriculum because of their own lack of understanding how to do so (Gnezda, 2009; Walker, 2004). At the core of this problem Walker argued, is an understanding of the conceptual approaches to visual artmaking, as well as how visual artists accomplished this goal. The defining characteristic of this conceptual framework is big ideas supported by meaningful connections, through knowledge, problems, reflection, and boundaries. With new understandings come a respect for meaning making and greater confidence about artmaking. Tolerance for ambiguity, risk-taking, delaying closure, seeking contradictions, and embracing the unconventional is where meaning making in art takes place (Burton, Horowitz, & Abeles, 1999; Walker, 2004).

According to Wilson and Smetana (2009), students should think about their own thinking because in doing so they can better prepare locations of resources that organize their responses to problems. This creates active learning and performance. Self questioning such as "Does this make sense?" (Wilson & Smetana 2009), and "Is this helping me solve my problem?" help students monitor and regulate their learning

(Burton, Horowitz, & Abeles, 1999; Wilson & Smetana, 2009). Atkinson (2006) and Gnezda (2009) argued, meaning making happens through art production, which can be applied to PBL through inquiry, practice with skills and techniques while problem-finding or solving. Discussions with classmates and teachers about meaningful visual art problems can reveal understandings and meanings about the subject matter, artist, social awareness and creative process of the artwork (Atkinson, 2006).

All too often teachers assign visual art lessons for self-fulfillment rather than student generated (Gnezda, 2009). Projects generated by students increase their problem-solving skills. Gnezda argued drawing skills as a standalone could be a problem-solving lesson generated by students. Open-ended or ill-structured issue-based learning to involve collaboration increases meaning-making for students (Gnezda, 2009).

Problem-Finding and Problem-Solving in the Visual Arts Workforce

Sloan (2010) argued visual art education offers students critical thinking, problem-solving, and drawing skills while making personally meaningful connections inside and outside of school especially for disadvantaged students in high-poverty regions. Handicapped students, argued Silver (1989) are faced with many problems and challenges making them sensitive to their environments; because of constant readjustments, this may make handicapped students better problem-finders and problem-solvers.

The most efficient creative problem solver uses both divergent and convergent thought processes, which businesses seek (Brophy, 1998). Burnard, Craft, Cremin, Duffy, Hanson, Keene, Hayes, and Burns (2006) describe problem-finding and problem-solving as ‘possibility thinking’. This method of working with problems has an advantage because it generates multiple ways of asking the question, 'What if?' As a result of possibility thinking, self-determination increases. Burnard et al. (2006) and Noppe & Gallagher (1977) argued creative individuals are systemically more organized in the process of their responses, a character trait sought after in the workforce.

According to Garner and McDonagh-Philp (2001), mood boards can help visual artists in problem-finding and problem-solving because they suspend judgment. Mood boards are a collection of visual images such as photographs, drawings, newspaper, magazine and Internet clippings, found objects, samples of industrial and natural objects, and color and texture swatches juxtaposed on foam core board for the purpose of bringing ideas together. Mood boards can make a great starting point for both problem-finding and problem-solving. Mood boards are used in "the graphics industry, television and theatre, [and] industrial design" (Garner & McDonagh-Philp, 2001, p. 58). Mood boards used in graphics might include computer files and software of fonts, imaging techniques and animation. Television and theatre may use mood boards to display textiles for design sets, lighting, camera positions, microphones, and set colors. Industrial design may use mood boards for paint color and texture, as well as forms for architectural design.

According to Lee and Breitenberg, (2010) contemporary education is suited for PBL because it is based on creative, active, visual, and applied learning, as well as spatial and holistic thinking. In a project-based approach for PBL in the visual arts, students worked as professional designers. Lee and Breitenberg (2010) argued "the skills, knowledge and processes of design are mastered more successfully in this project-based approach" (p. 59). This may be due to PBL mimicking the professional workforce, where students feel and perform professionally.

The inquiring that takes place with problem-finding, and solving reaches all students, especially those at-risk (Wilhelm & Wilhelm, 2010). This process makes learning purposive, relevant and immediate, which in turn implants a deep understanding. Wilhelm & Wilhelm argued essential questions drive the inquiry process because they are engaging, enduring, are self driving, ambiguous, resource-oriented, understood in context, and easily agreed upon by students. Allowing students freedom to solve the problem through their own methods provides for personal ownership for their learning (Burton, Horowitz, & Abeles, 1999; Sloan, 2010; Wilhelm & Wilhelm, 2010).

Literature Review Related to Key Variables and Concepts

The research variables discussed from literature have been formed from the research question: what, if any, are the differences in scores on CDAT between students taught through PBL and skills-based learning among seventh grade visual art students? The dependent variable was drawing ability, and the independent variables were PBL, and SBL.

Drawing Ability and Perception

Drawing ability was the dependent variable in this dissertation. Drawing ability and perception are closely related and will be discussed together because drawing depends on how artists and nonartists perceive things (Kozbelt & Seeley, 2007). Research, as to why some people draw better than others is lacking (McManus, Chamberlain, Loo, Rankin, Riley, & Brunswick, 2010). Garmendia, Guisasola, and Sierra (2007) report 50% failure rates of first year engineering graphics students because of perception difficulties.

Much of the literature on drawing and perception originates from rich data collected from the Kozbelt (2002) dissertation that is very similar to the study conducted by Getzels & Csikszentmihalyi (1976, p. 85-86) minus the video camera. Through perception, an artist must understand the structure of objects because it is through creating convincing representational drawings of forms that separate the artist from nonartist (Arnheim, 1974, p. 169-170). Kozbelt and Seeley (2007) claim artists' perception and attention of their world are for the most part better than nonartists, and because of this they have an advantage in drawing. Arnheim (1997) disagreed as he postulated both the artist and nonartists view the world the same way. Kensler (1965) argued differences in a person's ability to perceive accounts for the degree of ability to understand and draw in perspective as well as understand the structure of under lapped objects. Teaching students to perceive may be the essence of what teaching art is all about (Perex-Fabello, & Campos, 2007). Yet art educators as well as researchers know so little about how to do it (Kensler, 1965). Artists have the capacity to overcome perceptual biases by concentrating throughout interferences of common knowledge about what they know and see; which allows them to see objects anew (Kozbelt & Seeley, 2007; Seeley & Kozbelt, 2008).

Naghshineh et al. (2008) argued the observation skills acquired from *Visual Thinking Strategies* (Yanawine, 1997) and other observation exercises dramatically increased observations in patient care for medical students involved in the intervention compared to the control. In each of the following subsets: observations, speculative thinking, interpretations and evidence, pertinent negatives, and use of fine arts concepts; higher scores were reached by the intervention group through observation practices (p.

996). Interestingly, the highest improvement in the intervention was use of fine arts concepts which was almost double that of the control (Naghshineh et al., 2008).

Observation drawing is an excellent way to improve perception skills. Many schools such as The Virginia Commonwealth University Department of Communication Arts emphasis increased use of observation drawing classes to increase perception skills (Benitez, 2009). Finding objects to draw from observation is an excellent example of problem-finding in a visual arts PBL environment.

Kozbelt & Seeley (2007) hypothesized superior perception allows people to draw accurately what they see, whereas misperception is the cause of awkward mistakes in observation drawing. In a 2001 study, Kozbelt's investigation resulted in artists outperforming nonartists in both drawing and perceptual tasks, leading to his claim that if people draw well, they also perceive well. Students, who attentively gaze back and forth between the object and their drawing while drawing the object, create a drawing with greater accuracy (Coen-Cagli, Coraggio, Napoletano, Schwartz, Ferraro, & Boccignone, 2009; Kozbelt & Seeley, 2007; Milbrath, 1998). Artist's advantage at perception and drawing stem from declarative knowledge of object recognition, and practice with manual dexterity of media along with concentrating throughout previous knowledge interferences (Kozbelt & Seeley, 2007; Milbrath, 1998). Coen-Cagli et al. (2009) argued the eyes when drawing from observation most often fixate upon salient stimuli. Coen-Cagli et al., (2009) also argued an artist's eyes are fixated on stimuli most when drawing the stimuli, especially when following edges.

It is through knowledge of object recognition and manual dexterity that explain the advantage in artists' perception and drawing abilities (Kozbelt & Seeley, 2007;

Seeley & Kozbelt, 2008). Knowledge of object recognition and manual dexterity, Kozbelt and Seeley hypothesized, starts with declarative knowledge and a slow process of interpreting step-by-step instructions. These instructions turn into efficient, dexterous problem solving mini-manuals that are refined through practice. With time and use of self-assessments, and with the aid of assessments from viewers, manual dexterity of drawing becomes almost automatic, seemingly effortless (Kozbelt & Seeley 2007).

Seeley and Kozbelt (2008) claim the following of artists' perceptual advantages (PA):

> [PA] 1. Artists are better at the type of visual analysis necessary for depiction in their medium.
>
> [PA] 2. These perceptual advantages are derived from technical proficiency with the tools of an artistic medium.
>
> [PA] 3. Artists technical proficiency in a medium confers an advantage in visual analysis, which consists of the ability to focus attention on sets of stimulus features sufficient for adequate depiction (Seeley & Kozbelt, 2008, pp. 150, 153).

Artists have refined their domain, so they quickly and accurately create representations. They do this with expertise in their domain from practice with tools and techniques. Through years of developing expertise in their domain artists also begin to develop expertise in what works best in representing certain situations within their artwork. Earlier research by Kozbelt (2001) provides evidence that if artists are good at drawing, they are also good at perception tasks (Seeley & Kozbelt, 2008). Furthermore, artist's strength in technical drawing skill contributes to their perceptual advantages (Seeley & Kozbelt, 2008).

Seeley & Kozbelt (2008) created a model for understanding the psychological processes underlying the artistic production and visual analysis for technical drawing skill. Artists across all media create preliminary drawings to guide the direction of their work, which is one reason why drawing is a prerequisite for other visual coursework in art schools and what makes drawing so fundamentally important for visual artists. From the perception of artists, there is no singular way to form depictions. Depictions are formed from "systems of marks that suffice to induce desired perceptual effects" (Seeley & Kozbelt, 2008, p. 156). These marks may be remains of graphite from a pencil to create a sketch of a particular form. Artists employ patterns of perceptual strategies when visually analyzing data to create effective drawings. This leads to how stimulus is categorized influencing how stimulus is perceived, and this perception affects the outcome of the drawing. Seeley and Kozbelt (2008) also argued perception, identification, and manual dexterity function together to create the process of drawing and that, which is perceived.

According to Seeley and Kozbelt (2008), anticipating or planning an action such as drawing a complicated edge affects spatial understanding or perception, increasing the likelihood of drawing the stimulus accurately. Conceiving a stimulus or object, as it would be drawn enhances visual analysis. Artist's perceptive forming patterns of selective attention provide them with greater perception than nonartists, which also help artists separate the object from its identity (Seeley & Kozbelt, 2008). When just thinking about the intention of exercising muscles, people can increase muscle volume by thirteen and a half percent (Blakemore & Frith, 2005, p.164). Would thinking about the intention of drawing a line with greater accuracy also increase the ability to draw the line with greater accuracy by a similar percent? Blakemore and Frith (2005, p. 164) argue similar mental exercises may also be beneficial in developing technical drawing skills. It may be argued improving drawing skills may also be due to this dual experience of intention and concentration.

Snow & McLaughlin, (2005) argued children mostly draw what they know and not what they see because their brains are preprogrammed with knowledge, and not with perception. Arnheim (1997) argued, "children are technically unable to reproduce what they perceive" (p.163). Children have not yet developed the technical skills necessary to draw what they see. Milbrath (1998) argued because implicit memories are significant factors in drawing young children mostly draw from memory and almost never draw from observation. Snow and McLaughlin, (2005) also argued that both visual and perceptual processing are pivotal in creativity, and drawing makes students more curious and observant; and the images remain in their memory. McManus, Chamberlain, Loo, Rankin, Riley, and Brunswick, (2010), argued visual memory is related to drawing accurately. The visual storage in memory is like a library of structures for artists to recall when needed. Arnheim (1997) argued it's not the perception that matters to a child; it's that the drawing meets the child's requirements.

According to Perez-Fabello, and Campos, (2007) imaging has a special bearing to the technical skills for the visual arts, and mental images and imagination are essential for creativity. They are related to perception, which provides a greater capacity for students to visualize and draw scenes. Students with a greater imaging capacity have a greater capacity to remember visual images, which enhances their memory (Perez-Fabello, & Campos, 2007).

Spatial Visualization and Drawing Ability

There may be a direct link between drawing ability and visual-spatial processing skills. Silver (1989) argued people who say they cannot draw actually have difficulty processing spatial information. This difficulty may be students cannot fully comprehend what they see. Silver further argued students should be placed in school based on their visual-spatial processing skills rather than adeptness with language, learning disabilities, or hearing impairments. Drawing tests are already being conducted on stroke victims with language impairments to evaluate their perceptual and cognitive abilities (Silver, 1989).

Lowenfeld and Brittain, (1987, p. 375) argued those who say they cannot draw are the same people who probably experience difficulty visualizing geometric problems. Perez-Fabello and Campos (2007) argued spatial visualization and accuracy of visual recall are dependent on a person's imaging capacity. Perez-Fabello and Campos also agreed women are better at spatial visualization then men (p. 133).

According to Edens and Potter (2007) drawing tasks with problem solving performance can show student levels of spatial understanding. One of these tasks is to have students visualize objects and graphically represent numerical information about the object. The complexity of how an axis used in the drawing correlates to success in math. An example of an axis in a drawing is a horizon line, or ground line. Edens and Potter (2007, 2008) argued schematic drawings are an example of using math to solve problems. Schematic drawings are graphic diagrams more than drawings with accurate proportions depicted, which take into account spatial relations (Edens & Potter, 2007, 2008). It is not clear why having students draw schematic diagrams to solve problems does not always work. In a study conducted by Edens and Potter, (2007) a positive correlation was found with schematic drawings and problem solving ($r = .29$, $p < .0001$) using the *Draw for Math* task. In another study investigated by Edens Potter (2008), students who used schematic drawings had higher problem-solving scores.

Consistent with Edens Potter (2008) spatial visualization, also called *mental rotation*, an experience shared with both mathematics and visual art is the ability to imagine how an object would look if it were rotated in another position. Mental rotation has been associated with mathematical problem-solving (Edens & Potter, 2008), although it may also be applied to both problem-finding and problem-solving in the visual arts. Edens and Potter (2008) found a significant relationship between spatial ability and use of schematic diagrams, and between spatial experience and problem-solving. In this study there were negative correlations found between graphic representations and spatial knowledge, as well as negative correlations between pictorial representations and problem-solving. Another striking finding from this study indicates that graphic representations were negatively correlated to drawing skill. This may be due to the criteria used for both drawing skill included overlapping and details, both of which are also spatial elements that may skew the data results. This study did show a positive correlation between problem-solving and drawing skill. Also from the results of this research, Edens and Potter (2008) argued, “accurate representations facilitates problem-solving” (p. 195). Perhaps because drawings with clear correct proportions help students understand clearly as well.

According to Garmendia, Guisasola, and Sierra (2007), spatial visualization is paramount to engineering students. The engineer needs to comprehend two-dimensional sets of visual diagrams in three dimensions, as well as being able to draw them. Without this knowledge, it is impossible to succeed. Some of these students despite having formal drawing experience, still experience difficulties with spatial manipulation. The core of this problem stems from an inability on the part of students not being able to visualize an object in space from more than one viewpoint (Garmendia, Guisasola, & Sierra, 2007). A PBL environment may remedy this situation because this is an ambiguous problem for them to solve, or for students to problem-find on their own. Solving such a problem would be a huge benefit for students interested in an engineering career.

Drawing Development

Humans, no matter which culture they were cultivated within, begin their visual art experience of drawing with scribbles (Lowenfeld & Brittain, 1987). A child's first scribbles are spontaneous and not intended as a representation of which they have little interest; they are for discovery and motor enjoyment and appear to be organic and intuitive (Arnheim, 1997; Eisner, 1997; Gardner, 1990; Lowenfeld & Brittain, 1987; Winner, 1982). This stage is known as the scribbling stage, happening between one and two years of age (Winner, 1982). Scribbling begins the change in the child from kinesthetic motion to the world of imagination and imagery (Lowenfeld, 1965, p. 19). At around three and a half, children begin to tell people what their scribbles represent as well as "a basis for visual retention" (Lowenfeld & Brittain, 1987, p. 193). Children at this stage begin to remember that a rotational movement of their hand on a crayon creates circular lines. Between the ages of one and three, children develop a *drawing system* consisting of representative information, and behavior (Wolf & Perry, 1989). In a child's second year, the lines they create become a contour line with graphic meaning to be read, turning into a communication device (Hall, 2009; Wolf & Perry, 1989).

At around three years of age, children begin to draw geometric shapes and visual-spatial representations, and around five to seven, these images greatly expand (Wolf & Perry, 1989). The circle appears in children's drawings around three years of age while the square appears at around age four (Lowenfeld & Brittain, 1987, p. 205). When students get frustrated, they regress to an earlier drawing comfort level (Arnheim, 1997). I have witnessed this on many occasions. An example is after being asked to draw what is most important to them middle school students have been observed scribbling with a fistful of markers. Another example is a need to make handprints with paint, whenever allowed to do so. It almost appears to be like a need to regress and start learning over what they know. "It is essential, however, that materials be selected and employed in such a way that they challenge the student to work on tasks of visual organization at his own level of conception and make it possible for him to do so" (Arnheim, 1974, p. 205). The challenge of using media should not be too difficult and yet at a level enabling self-expression. This self-organization is important for the student to find and develop for themselves their own visual literacy (Arnheim, 1974).

At around six to ten years of age, children begin to draw ground lines that Lowenfeld (1965) describes as a "base line" (p. 25). They avoid overlapping and demonstrate different points of view by deliberately trying to show characteristics of each object, and at times draw X-ray and fold-out views (Gardner, 1990; Lowenfeld, 1965; Winner, 1982). At nine or ten, children begin to imitate how their peers draw graphic images (Winner, 1982). As students transition into middle school, technical skill increases, and aesthetic sensibility decrease (Gardner, 1982; Rosenblatt & Winner, 1989). At around this time, the baseline gradually disappears and the child discovers the picture "plane" (Lowenfeld, 1965, p. 41) through perspective drawing and awareness of their own visual perception. The picture plane is the area on the paper where the imagery is located. Lowenfeld (1965) argued people are aware of space kinesthetically, rather than visually, as so with the "schema" (p. 63) or organization of the drawing on the surface of the paper. Gardner (1990) argued children in middle childhood begin an interest and value in photographic realism in drawings whereas adolescents usually begin to steer away from realistic drawing.

Adolescence is a time of self-discovery and drawing, and the visual arts can be a tremendous outlet of expression and self-identification (Lowenfeld & Brittain, 1987, p. 353). In adolescence, linear perspective may be attempted, and if not, this stage will be the end of the child's drawing phase and will remain so into adulthood, for without further training, the drawings will not change (Winner, 1982). When a child at this age continues to draw, their technical skill increases and when this technical skill is used as a form of communication to express their identity changes, they usually continue to draw (Gardner, 1990).

It has been proven debatable whether a child must pass through these consecutive stages in order to draw well, as this has not been the case with all children all over the world (Winner, 1982). Gardner (1982) maintains proficiency in drawing can only be accomplished through a talented teacher, especially so with middle school students who appear to learn perspective quickly. In adolescence, students appear to be less interested in the arts for unknown reasons (Gardner, 1982).

After a student enters middle school (beyond grade 5) there is a decline in creating art due to high stakes testing, and an emphasis on "logical activities, which we call arithmetic and geometry, physics and chemistry, history and geography, and even literature" (Gaines, 1983, p. 57). Emphasis on logical activities may leave a creative activity for which logic need not apply such as drawings with less value and logic. Gaines (1983) argued children are less perceptually flexible than artists are at this age. Rosenblatt and Winner, (1989) argued for including reflection along with perception and production because it aids in freedom and decision-making that may increase perceptual knowledge. Rosenblatt and Winner, (1989) also argued perceptual skills and ability do not generalize to other domains.

Lowenfeld and Brittain (1987) identified these stages of drawing:

- The scribbling stage (2 to 4 years of age)
- The preschematic stage (4 to 7 years of age)
- The schematic stage (7-9 years of age)
- The gang age (9 to 12 years of age)
- The age of reasoning (12 to 14 years of age)
- The period od decision (14 to 17 years of age)

Lowenfeld and Brittain argued a child must pass through one stage prior to moving on to another stage has been refuted by Winner (1982) and Gardner (1982).

Two developmental, creative types have been identified as *visual* and *haptic* (Lowenfeld, 1965; Lowenfeld, & Brittain, 1987). The visual type experiences the world as objectively spectator depending on their vision. The haptic type experiences the world subjectively through their bodily senses and emotions. According to Lowenfeld, and Brittain, (1987, p. 357) about half of the population fall under the visual type, a quarter haptic, and the remainder are neutral. The visual type tends to create drawings with an awareness of the whole drawing, whereas the haptic will focus on expressing a subjective feeling without regard as to how the drawing looks. The haptic type may appear to possess less technical drawing skill than the visual kind because of the emphasis on exaggerated emotional expression. Haptic type may also find observation drawing and linear perspective drawing frustrating because of the emphasis on the visual representation (Lowenfeld, & Brittain, 1987, pp. 362, 367-368).

Horowitz (1967) argued for seven developmental stages of drawing ability; "motoric drawing, the circle, the square, the diagonal and the cross, the triangle, mounting of forms, and the game of forms" (as cited in Liu, 2007, p. 345). Motoric drawing is scribbling, the diagonal and the cross are straight lines, mounting forms are 3D forms and the games of forms are attempts at drawing in 3D. Milbrath (1998), argued for three models of drawing development: conceptual development, the perceptual factor, and production difficulties that equate talent with complexity (as cited in Liu, 2007, p. 346).

According to Grant, Langer, Falk, and Capodilupo (2004), many people have learned they are unable to draw, even though they can. A novel environment increases the chances people's attitudes that they can draw. Being mindful or aware of surroundings by drawing them made people feel better about their self-worth. Exercises such as drawing surroundings can be applied to other subject areas to increase an understanding of their self-worth (Grant, Langer, Falk, & Capodilupo, 2004).

Children are for the most part more interested in the process of drawing rather than the product that was drawn (Gardner, 1990). I have personally experienced students create very accurate drawings which they appeared to enjoy creating, and watch them throw the drawing in a waste paper basket. Experience affects our perception (Eisner, 1997), which in turn affects the way people draw. Many professionals in and out of the visual arts field argue the drawings of students are a direct reflection of their personality (Eisner, 1997). I have noticed numerous occasions where similarities between the creative products middle school students create reflect the physical appearance and mannerisms of the students themselves. For example, a thin, frail girl might likely draw with long, thin, light lines whereas a large heavy boy might draw with bold, simple lines.

According to Coutinho, Ferreia, Darras, and Miranda (2008) drawings created from observation are similes and those from memory are schemas that mark a drawing style. Children draw the structure of objects first, followed by definition, and secondary characterizations last. The schema is described as a regular form an object takes as it is drawn repeatedly (Coutinho et al., 2008).

The detail confined in a student’s drawing can be correlated with validity coefficients of .55 to .75 to the student’s level of intelligence as measured by the *Draw a Man Test* (Goodenough, 1924; Harris, 1963, as cited by Eisner, 1997). Contextual referents provide cognitive developmental turning points for students. These referents include how artwork makes them think and notice formal structures in symbolic drawing, along with thematic encounters that demand skill with media (Eisner, 1997). The most significant aspects of the drawing are exaggerated, and conceptions of shapes drawn are reflective of student's age (Eisner, 1997; Lowenfeld, 1965). Children use drawings to express ideas and paintings to express emotions (Eisner, 1997). Daglioglu, Calisandermir, Alemdar, and Bencik Kangal (2010) argued children draw as a reflective and expressive device.

When provided with paper and pencil and asked to draw, children instinctively draw a person, with girls attending most to feet and boys attending most to eyes and eyebrows Daglioglu, et al. (2010). According to Eisner (1997), people are drawn more than any other topic. In observation drawing, children tend to draw what they know rather than what they see. Some students may find it confusing to explore a medium without being given specific instructions to do so, which may cause difficulties for students in a PBL atmosphere (Eisner, 1997).

Hall, (2009) argued drawing is a visual language where students should be taught to use different techniques of drawing, which is also stated in the *National Curriculum Handbook for Primary Teachers* in England (1999). In England, drawing is viewed as a pre-writing skill, one used as a primary source of communication. With an emphasis on drawing as a pre-writing skill in England, Hall argued drawing for its own sake is becoming diminished.

PBL in Art Education

The two independent variables in the research question for this dissertation are PBL and technical SBL, which will be compared to other studies. Previous research comparing PBL to SBL in the visual arts includes PBL study using a concrete approach to teaching aesthetics (Constantino, 2002). A second study discusses a constructed textile design course using PBL (Sawyer, Wilson, & Challis, 2006). A third study discussed a PBL project for computer-supported architectural design pedagogy (Eilouti, 2007). A fourth PBL experience was in the teaching of computer graphics (Marti, Gil, & Julia, 2006).

In an after-school program for gifted students addressing PBL and aesthetics, Constantino (2002), investigated a study and argued PBL develops students' higher order thinking skills while solving open-ended problems in real-world situations from which art educators organize. These real-world situations are designed for collaborative deep thinking about ill-defined problems. This places demanding efforts on the part of the art teacher, consuming time which in turn causes many teachers to use PBL in a portion of the unit rather than the entire unit, such as an introduction due to the length of time required for students to self-organize and problem-solve. The art teacher must also feel comfortable giving up the role as an authoritative person and be willing to assume the role of a tutor or guide and encourage students to be self-directed learners. When the art teacher develops the problem, it is important to consider a topic salient to students to ensure a meaningful experience for students. It is better for students to create their own groups of about four students and develop their own problem that will ensure salience, deep meaning, effort, accountability, and ownership Constantino (2002).

In Constantino's (2002) process, students first list what they know about the problem, then list questions they need answered to solve the problem as they develop a conceptual map of research. Next, students prioritize the questions according to their interest and relevance to the problem. Students then determine the resources from a variety of places for answers to their questions, using the problem as a guide and organizer for their curriculum. At this point students are divided into groups with each student responsible for the research question or area of research and the investigation begins. After researching, student's reconvene to review the information and strategize the next steps in a self-organizing, self-directed, cooperative environment. This step may be repeated several times until a conclusion has been reached. Through self-directed learning and research, students construct an understanding of the problem based on self-organization. In the final step, their research is presented to a panel or written report serving as an assessment. Constantino also discussed a similar museum outreach program for students in third, fourth, and fifth grade using a similar process. As a caveat, Constantino (2002) indicated both programs had to be condensed which created shallow reasoning skills which would have been deeper had the program more time for students to investigate and think with greater depth into the problem.

In the Constantino (2002) approach, the teacher serves as a coach or facilitator, guiding students to reflect on their thinking, their problem-solving strategy, and thoroughness of research in a problem-centered curriculum. Constantino argued, this PBL method emphasized learning how to learn, and makes students accountable for their learning, which translates into other learning activities. This model could be improved with students finding their own ill-defined problem to solve, which would increase the salience, meaningfulness, ownership, self-directed learning and self-organizing skills for students.

Although this model was conducted for after-school gifted art students in upper elementary school, a gap exists for comparative studies in middle school art to determine the effects of PBL in a natural day-time classroom environment. PBL has been used in K-post secondary school settings with mixed results. Time appears to be the factor lacking in creating successful results Constantino (2002).

In a post-secondary PBL program at the University of Manchester, ten students volunteered to take part in a pilot study to determine whether PBL was more effective; however, a comparative study was not conducted (Sayer, Wilson, & Challis, 2006). The focus of the study was on student centered learning that was traditionally taught through a combination of lecture and laboratory classes. Similar to visual art, textile design involves a delicate balance of information between 2D and 3D knowledge and judgment. Data collected from the students within the pilot program at the Textile Design and Design Management School at the University of Manchester revealed they were not internalizing or making connections with technical concepts. Furthermore, they did not understand the working processes of related equipment from lectures and laboratory classes with their projects. This demonstrated the need for practical real-world situations, in order to make connections in understanding technical applications and processes of equipment. Sayer, Wilson, and Challis (2006) hypothesized PBL would create a more independent and holistic approach as well as the application, consolidation and extension of student learning in various contexts.

Eilouti (2007); Sayer, Wilson, and Challis (2006) argued PBL was used successfully in units and academic programs in such subject areas as medicine, languages, and engineering at the University of Manchester because it allows students to mimic problem solving in real life situations. PBL encouraged students to work cooperatively in a team, which also reflects real world values (Sayer, Wilson, & Challis, 2006; Sawyer, 2007). Sayer, Wilson, and Challis (2006) found high excitement when students were working in groups motivating for students because it kept them involved in the PBL program. They also reported PBL gave students a clear understanding of 3D design as well as understanding complicated ideas, and most students reported they felt improved teamwork and communication skills, and were rewarded from a difficult task. Sayer, Wilson, and Challis (2006) also reported student's maintained interest, enthusiasm, and commitment, students became active learners, and reduced boredom was noticed.

According to Eilouti (2007) architecture students demonstrate difficulty-applying knowledge from separately taught traditional classes, lectures, labs, and studios. In a four-week pilot PBL project at the Jordan University of Science and Technology, Eilouti surveyed eighteen third-year students and found most learn best through a constructivist, active learning situation. These students who were grouped in threes' involved themselves fully in the project. Eilouti argued a traditional approach is not as effective for teaching creative design and hypothesized a PBL format would be more effective because it addresses multi-disciplinary skills, self-organization and development of learning and real life situations to solve problems of an architectural nature.

Eilouti (2007), argued a traditional approach to teaching hampers imagination, creativity, active participation and deep involvement in creative design courses that PBL provides. With PBL, problem solving, self-knowledge building, informed decision making, and self-evaluation affords students solutions to design problems reflective of real life situations (Eilouti, 2007). Characteristics of PBL that help students achieve deeper learning include "integrative, top-down, collaborative, whole-to-part, practice-oriented, student-centered, process-focused and [the] problem focused" (Eilouti, 2007, p.

202). When students are problem-solving and working in an interdisciplinary manner in groups, they start with big ideas and work toward solving the details. Through these practices, students focus on solving the problem.

The problem students needed to solve in this study was designing a house that expands and deflates as the family grows in numbers and decreases as children grow up and leave, was assigned by the instructor along with a number of challenging architectural design stipulations (Eilouti, 2007). Students were first introduced to the problem, followed by the instructor checking for student understanding the problem and exploration of boundaries of the problem. Students were then asked to make real life connections to determine what was known about the situation. Students identified what they did not know and began exploring solutions. Architectural areas of concern were then assigned to each of the three students in each group to explore and solve, after which the group reconvened to propose alternative solutions and determine the next step. Solutions were evaluated and a final computer model was created and presented with each member of the group discussing the problems they encountered and how they were solved. At the end of the unit, student's self-evaluated their project and were given feedback from classmates (Eilouti, 2007).

Findings of the study indicated each student understood flexible designing in four-dimensions, and student interpretation drove solutions (Eilouti, 2007). Other findings showed students communicated with a variety of media, and high levels of student concentration. The process, each group took was different, and the ambiguity of problems encouraged students throughout the process. The design method became more evident than in traditional teaching and learning; organization and reflection phases were most important, and online tools provided support. Most students reported more training about methodology, design process, dynamic architecture, and communication skills through PBL than through traditional methods (Eilouti, 2007). A few students reported greater difficulties and increased workload with PBL than with traditional learning (Eilouti, 2007; Sayer, Wilson, & Challis, 2006). When learning is self-directed such as in PBL, students are more likely to explore, invest more time and refine techniques in order to express their topic (Amorino, 2009).

In another study, medical students at Thammasat University Medical School in Thailand frequently used white boards to sketch anatomical structures while solving problems and communicating to others (Haddawy, Dailey, Kaewruen, Sarkhette, & Hai, 2007). These sketches demonstrated perspective viewpoints a person looks at from the brain, the structure of anatomical parts, and an ability to recognize the viewpoint and structural components while communicating (Haddawy et al., 2007). This demonstrates the importance of technical skill while problem solving.

According to Stepien and Gallagagher, (1993), it is through investigations of real world collaborations, which the mind naturally seeks to find connections; these collaborations redefine real life conditions which enhanced student learning. Through PBL, ill structured or ambiguous problems cause students to think deeply about the ramifications of the problem boundaries. When the problem is student owned, motivation is increased as well as the likelihood of students becoming self-directed learners. Ill structured problems offer a student way of learning that is unparalleled. Postholes are another learning opportunity that teachers may offer when big ideas are inappropriate and occasional PBL ideas are desired (Stepien & Gallagagher, 1993).

This study did not have a PBL middle school visual arts comparative model for PBL. In place of PBL are adaptations from previous research. The proposed study benefits from these previous studies in adopting parts of methodologies, strategy, and ideas appropriate for middle school students.

Technical Skills-Based Learning

Much can be learned about technical drawing skills from neuroscience that provides a foundation of information. It has been hypothesized toddler scribbles are modeled after the manner in which neurons make connections in the brain and are the beginnings of a drawing, reading and writing (Sheridan, 2002). This leads to the question: Are all drawings humans create a verification of a neuronal model of our understanding? The scribbling toddlers create are loaded with meaning (Atkinson, 2008). As toddlers' scribbling continues, argues Sheridan (2002), they begin focusing on drawing separate edges, lines and shapes, and at the same time they notice themselves and their world. Drawing becomes a method of self-organization, informing brain connections and patterns of thought through mark making, which leads to organization of thought (Sheridan, 2002). Children's scribbles represent, make, and refine understanding, which leads to speech and literacy (Sheridan, 2002). Drawing as a form of communication pre-dates writing in both human history and human development from cultural perspectives (Sheridan, 2002). With these basic beginnings of a drawing, Sheridan sheds light on the foundation of drawing in the visual arts.

Deep brain stimulation in the left sub-thalamic region argued Drago et al., (2009), left a patient who was an artist with Parkinson's disease with diminished technical drawing skill to create representational drawings. Drago et al. postulated that an activated left hemisphere via deep brain stimulation creates a reduction in technical drawing ability because of an imbalance with the right hemisphere. This imbalance occurs, Drago et al. argued because the left hemisphere performs categorical encoding of spatial relationships and focal attention, and the right hemisphere performs coordinate encoding, mediating spatial relationships, continuous thought, and global attention (Drago et al., 2009; Drago et al., 2009 b). Damage to either hemisphere causes *constructional apraxia,* leaving the artist with seriously diminished drawing ability (Drago et al.). Right hemisphere damage specifically leaves the artist with diminished spatial relation abilities and the ability to draw accurate linear perspective drawings, whereas left hemisphere damage leaves the artist creating over-simplified drawings (Drago et al.).

Shamay-Tsoory, Adler, Aharon-Peretz, and Mayseless (2010) argued suppressing the dominant frontal and anterior temporal regions of the prefrontal cortex which controls how people think is central for drawing skills in artists with progressive aphasia. Drago et al. (2009 b) argued right frontal lobe injury in artists inhibits fluency of line drawing and makes the artist draw the same figures repeatedly. Deep brain stimulation in the left hemisphere prevents the right hemisphere from creating novel drawings (Drago et al., 2009 b). Perception of technical skill depends on the visuospatial relationships located primarily in the right hemisphere (Drago et al. 2009 b). Artist patients with left anterior temporal and orbital frontal degeneration diagnosed with progressive aphasia demonstrated an increase in visuospatial-artistic technical skills created drawings that were more creative (Miller, Ponton, Benson, Cummings, & Mena, as cited in Drago et al., 2009; Drago et al., 2009 b). This demonstrates an artist uses both hemispheres to create accurate representational drawings; however, from previous studies, the right prefrontal cortex appears to have dominance over the left (Drago et al.).

With neuroscience, educators can link visual arts teaching to skill development. According to Diket (2009), although teachers were reserved to do so pending clear outcomes from empirical research. Drawing exercises that are short in duration and projects that are lengthy in duration both taken together can support a PBL approach. As students draw from observation, they recognize shifts in depth and form, creating awareness of spatial orientation while at the same time increasing their mathematical understanding (Diket, 2009).

Social scientists, behavioral scientists, and neuroscientists have yet to understand the perceptual, cognitive and motor processing involved in skillful renditions of visual representations (Kozbelt, Seidel, ElBassiouny, Mark, and Owen, 2010). The skill required for accurate visual representations is superior perceptive skill because perception has been correlated with drawing accurately (Kozbelt et al., 2010). Skilled visual artists have the capability to block out conceptual interferences in order to better concentrate on their skill (Kozbelt et al., 2010). Reasons for people unable to draw what they see are inaccurate perceptions, poor decisions as to where to place marks, poor motor control, and incorrect judgment about their depictions (Cohen & Bennett, 1997, as cited in Kozbelt et al., 2010). Most of these mistakes occur because people draw what they know rather than what they see due to conceptual interference (Kozbelt et al., 2010). Skilled artists are very good at selecting what to include in a drawing and work from the inside of the object outward to an outline, rather from an outline to the inside (Kozbelt et al., 2010). Marshal (2008) argued to improve technical skill, it should be taught simultaneously with conceptual skills, especially when working with contemporary issues.

According to Schiferl (2008), recent developments in neuroscience shed light on the way scientists and art educators approach perception and drawing ability, challenging the writing of Betty Edwards (1979, 1986). Realistic drawing breaks people's response from visualizing objects to realizing edges, surfaces, shapes, and depth as an end in itself without labeling the object. This "Western treatment" of observation drawing, "requires the suspension of visual cognition" (Schiferl, 2008, p. 78) while maintaining attention to changes of, observed sensory qualities. To suspend visual cognition while drawing the object, a person concentrates on what is observed rather than what is understood. Schiferl (2008) argued for abandoning Edwards (1979, 1986) views of separate brain hemisphere locations for artistic and technical skill in favor of complex neural pathways.

It is debatable whether left-handed artists are more creative than right-handed artists (McManus et al., 2010). In a study investigating handedness, Magnus and Laeng (2006) report judges rated drawings created with the left hand better than those created with the right hand. Magnus and Laeng (2006) argue the right hemisphere might also be superior in drawing convincing spatial depth and shading, as it is responsible for control of the left hand.

Technical skills have always been an important aspect of drawing and are difficult to learn (McManus et al., 2010). In many art careers, drawing ability is no longer a necessity that causes concern for visual arts teachers in higher education where drawing is necessary, and these same teachers face students with poor drawing skills (McManus et al., 2010). Historically speaking society focused attention on technical skill most during the Renaissance; at a time when technical skill was most revered as aesthetic excellence (Moffett, 1975). Using the Meier Art Judgment Test, a study conducted in 1975 repeated these same views. Carpenter & Tavin (2010) argued technical drawing skills have developed into digital media. Technical skills can be delivered to a learning population in a variety of methods that depend on the knowledge, confidence, and experience of the visual arts educator.

Many elementary visual arts teachers do not feel confident in teaching the visual arts, and often rely on step by step cookie cutter projects that leave little imagination for their students. This can make students feel frustrated because they cannot work independently on salient projects (Snow & McLaughlin, 2005). Drawing is as basic to the visual arts as penmanship is to writing (Snow & McLaughlin, 2005). Technical skill in drawing requires concentration and repetitive practice similar to most skills in life (Krenik, in press; McManus et al., 2010; Snow & McLaughlin, 2005).

According to Snow and McLaughlin, (2005), to further develop and increase drawing skills, keen perception skills are needed. There are a number of visual arts educators who believe art should be taught using intellectual methods, while the number of other visual art teachers and psychologists discovered drawing can be taught following step-by-step procedures. Students can be taught to draw a depiction of depth by teaching basic perspective, overlapping, dimension, planes, and converging lines. Teaching drawing skills in a systematic way improves the technical drawing skill of elementary students, and these drawing skills are not only teachable, but learnable as well (Snow & McLaughlin, 2005).

According to Babaian (2009) manual dexterity, is more than hand-eye coordination because while people draw, their hand is like an extension of their brain self-organizing a map of information while building neural networks. Depicting transparency, rotation, and transverse section or cross-sectional drawings are three essential cognitive skills necessary for visual competence using this neural network conceived by Leonardo DaVinci (Babaian, 2009). Lack of these essential cognitive skills lead Babaian to use the illustration of Leonardo DaVinci's Vitruvian Man to teach his students how to draw internal organs.

Babaian (2009) instructs his science students to use slate blackboards to illustrate life structures. In this step-by-step approach, Babaian simplifies the illustration process of drawing Leonardo DaVinci's Vitruvian Man for his students. Students first draw internal organs separately with very simple shapes. Next he instructs them to draw the basic structure, then to draw the simple shapes within the structure, after which these shapes are refined. The last step includes defining the systems with different colors of chalk (Babaian, 2009).

Views of Teaching Drawing

Conceptions teachers have on how and what they should teach influences temporal and contextual aspects of what is taught in the visual arts classroom (Amorino, 2009; Lam and Kember, 2004). Lam and Kember argue there are two orientations of teaching the visual arts, of which there are four categories, essentialist who teach in art for moral or artistic development in art, and contextualist who teach through art for intellectual development or expression and therapy through art. The essentialists teach art for art's sake and rely heavily on technical skill assessed separately from creativity. For those who teach visual arts for moral development, technical skill is essential for successful outcomes, and creativity is understood in relation to content and ideation. According to Lam and Kember, those who teach artistic development in art, skill and creativity co-exist and are the essence of the artwork. For teachers teaching intellectual development through art, skill is inventive, more than a method to be considered with content and creativity being one element. For teachers teaching expression and therapy through art, creative expression and personal style are encouraged, creative ideas are the main concern and are seen as a reflection of experience, while skill is seen as the means of expression (Lam and Kember, 2004).

Technical sketches used to help medical students think through a problem are being used at many Medical Universities such as Thammasat University Medical School to draw anatomical structures and as artifacts to communicate to other students (Haddawy, Dailey, Kaewruen, Sarakhette, & Hai, 2006). These sketches involve visuospatial capacities of recognition of the anatomical structure to describe the angle of view (parietal, frontal, basal, dorsal), the ability to identify the anatomical parts of the sketched sections, as well as understanding annotations from the sketch and communicate with them (Haddawy et al., 2006).

Drawing provides a focus for many students, especially drawing from observation, which involves perception (Diket, 2009). Drawing from observation also involves technical skill as a student works to understand spatial orientation, mathematical conventions, and shifting between exercises and projects (Diket, 2009). Diket provides examples of helping students become aware of their own technical skills such as having students draw an object as they know it, then drawing it from observation; providing students with the intellectual knowhow and tools, and then encouraging them to go forth with their own drawing. Drawing techniques and skill are a means to help students become aware of aesthetic and expressive qualities to express ideas and experiences (Silver, 1989).

Lappe (2004) and Cain (2010) argued for increasing students' technical drawing skills by copying artwork from master painters and draftsman. When teaching these skills with students, Lappe suggested first having students master basic geometric forms, and then work toward overlapping to create depth, and then move on to shading with graphite. Cain suggests cognition happens while drawing through the body. Lappe argued students think critically as they transfer their knowledge of these basic geometric forms into life drawings of people and objects. Many colleges and universities take positive notice of these practices when reviewing student's portfolios for entrance (Lappe, 2004).

According to Marshall (2008), thinking and concept development are as fundamental as technique and design elements. Conventional art lessons designed in a linear fashion emphasize style, materials, techniques, and genres of art with the expectation that students know what to do with all this information (Amorino, 2009). Additional research is needed to understand visual arts teaching and learning (Amorino, 2009; Ivashkevich, 2009; Marshall, 2008; Walker, 2004). Ivashkevich (2009) argued developmental approach in the visual arts step-by-step drawing has already passed. Many art teachers believe technical skills need to be reached a proficient level prior to developing conceptual skills, a belief Marshall does not hold. Marshall (2008) argued technical and conceptual skills be taught simultaneously.

Eisner (1997) argued there are four artistic skills needed to learn: use of media, qualitative perceptive relationships between environment and mental imagery, inventiveness with technique, and creative organization. Eisner argued in order to properly express artistic vision it is necessary for the artist to be able to successfully manage technical aspects of the medium. These contemporary views of teaching drawing skills are some of which will be applied in the control group and discussed in greater detail in chapter 3.

Methodologies Investigating Drawing Ability

In reviewing the literature on methodologies related to results on drawing ability, many different approaches in methodological design were considered for the present study. These included Equivalent Materials Design, Randomized Materials Design, Equivalent Time Samples Design, Counterbalanced Design, Institutional Cycle Design, One-Shot Case Study, Untreated Control Group Design with Dependent Pretest and Posttest Samples using a Double Pretest, and True Experimental Pretest-posttest Control Group Design, (Campbell & Stanley, 1963; Creswell, 2009; Shadish, Cook, & Campbell, 2002). I decided to investigate the present study using a quasiexperimental design with a pretest-posttest nonequivalent control group design (NR O_1XO_2 NR O_1 O_2) (Campbell & Stanley, 1963, p. 8; Creswell, 2009, p. 161; Shadish, Cook, & Campbell, 2002, pp. 136-137) with a drawing ability test (CDAT) as a treatment for the experimental group was not located in the search for literature. For this reason, research designs closest to addressing the interest of increasing drawing ability will be discussed to justify my decision. The varying number of dependent and independent variables, and the variety of designs within methodological models in the following research brought to light different possibilities for this dissertation. This section examines how varying methods were used to examine drawing ability.

Equivalent Materials and Randomized Materials Designs and Drawing Ability

In an Equivalent Materials Design (Campbell & Stanley, 1963), Rostan (2005) investigated the independent variables of problem finding, technical skill, perseverance, evaluation, and creative ideation and the dependent variables of drawing from imagination and drawing from life. These variables were factors to compare 30 experienced students with 29 novices and three adult artists to assess technical skill and creativity in drawings. Two judges scored five randomly selected videotaped sessions of each group drawing, and three judges scored each drawing on creativity and technical skill (Rostan, 2005).

In the present study, I investigated whether problem finding/solving results in increased drawing ability. Rostan (2005) examined whether problem finding and technical skill (among three other variables) affect artistic talent (skills and art-making behavior) (p. 237). The variables examined in this study are similar to the variables being examined in the present study. For this reason, I decided to include this less recent article in this review.

In another Equivalent Materials Design (Campbell & Stanley, 1963), Rostan, Pariser and Gruber (2002) investigated a study where judges assessed drawings of 160 randomly selected children of which half were from New York City suburbs, and half from Chinese communities in Montreal and Toronto, mixed with juvenile the drawings of 32 widely acclaimed Western artists. From the Chinese participant population, half received art enrichment and the other half did not. In the study, each child created one drawing from life, and one drawing from imagination. Fifteen judges educated in North American and 15 educated in China were randomly selected into the following five groups: parents of young artists, parents of non-art students, teachers, artists, and art critics. The thirty judges rated the students drawing on a score of 1 to 7, on their own criteria of aesthetic success, with 7 being the highest rating. The life and imagination drawings were also scored on technical skill and creativity using their own criterion (Rostan, Pariser & Gruber, 2002). With an almost two-to-one ratio of students to judges, this unusually high number of judges should increase the validity of the study.

Coutinho, Ferreira, Darras, and Miranda (2008) examined the process of drawing from memory comparing student outcomes of two countries, France and Brazil in an Equivalent Materials Samples Design (Campbell & Stanley, 1963). To examine the drawing process, the investigators had the students draw the same five objects while being videotaped: pineapple, typewriter, teapot, starfish and telephone. The sequence of parts of each object, as well as the number of actions it took to draw each object was tabulated and data was compared (Coutinho, Ferreira, Darras, & Miranda, 2008). The drawing process is what interested me in this article. The measurement used has not been named, nor were there any evidence of validity and reliability results of the drawing test. Different in the present study interest is on results of drawing and not the process. With these unresolved issues, use of this design in the present study has been rejected.

In another Equivalent Materials Samples Design (Campbell & Stanley, 1963), Edens and Potter (2008) investigated how 214 fourth and fifth grade students resolve math problems by creating drawings. For the test students were provided with a packet, *Art and Math Challenges* with three problem scenarios. The test measured spatial visualization, mathematical problems, and drawing tasks. The drawing skill task had students draw themselves with their friends in the schoolyard with the school in the background and a dog in the foreground (Case, Stephenson, Bleiker, & Okamoto, (1996). The drawing task was scored on use of all figures and objects as described in the drawing directions, as well as overlapping, and use of details. Data was analyzed using SPSS descriptive statistics and ANOVA.

The drawing task in this research is very similar to one of the four tasks in CDAT; draw yourself with your friends playing in the schoolyard. The drawing task reported in this study is task specific, making it appealing for the present study. The drawing task in this study had no evidence of prior use, or validity and reliability results, and for this reason I rejected its use.

The work of Kozbelt and colleagues (Kozbelt, 2001; Kozbelt, 2002; Kozbelt & Seeley, 2007; Seeley & Kozbelt, 2008; Kozbelt, 2008; Kozbelt & Serafin, 2009; Kozbelt, Seidel, ElBassiouny, Mark, & Owen, 2010) have provided more knowledge base on the topic of drawing and perception than any other researchers in the field. What follows are reviews of differing methodologies on the extensive research related to drawing ability and perception. Perception is very closely related to PBL because in solving problems with drawing, people depend on their perceptual abilities as well as declarative and procedural knowledge and memories as a database to draw from (Kozbelt, 2001, 2002). The four articles and dissertation reviewed will discuss drawing ability, technical skill, and problem solving from varying angles that provide reasons for the methodology leading to the direction of this dissertation.

Kozbelt (2001) investigated examined an Equivalent Materials Samples Design (Campbell & Stanley, 1963) study to determine how artists differ from non-artists in visual cognition. Kozbelts' (2001) study tested two sets of tasks: *perception*, which requires visual analysis without drawing, and *drawing*, which requires both visual analysis and manual dexterity. Of the 46 participants from Carnegie Mellon University, 17 were first year art students, 13 fourth year students, and 16 novices (non-art students). Two areas were investigated: perception and drawing. The next four perception tasks were conducted: identify the subject of an out-of-focus picture, identify the subject of a drawing with missing visual information, find a simple shape in a more complex pattern, and compare two block figures to see if they can be rotated to match each other. The five drawing tasks consisted of: draw a pair of scissors from observation or a photo; copy three wavy lines either upright or rotated positions; copy a "B" in a box without having to erase; draw composite "A" and "C" without erasing; draw only areas of overlap of "A" and "B" without erasing; copy a contour line drawing of a profile face upright, inverted, tilted, or rotated; and copy a complex one-line drawing without corrections. The three raters scored drawings on a scale from 1-10 on accuracy of proportions and the intercorrelation of raters was .60 (Kozbelt, 2001).

This was Kozbelt's initial research on drawing and perception. The design of this study is weak in external validity, especially so with interaction of testing and the tasks performed. The results of this study were of high interest to me because they identified superior perception of practicing art students. It is in research like this that creates the positive social change that I want to create. Although it measures drawing ability outcomes, as does the present study, the methodology Kozbelt (2001) used does not compare teaching strategies in order to find a better method of delivery. Furthermore, the unnamed measurement used (drawing tasks) did not include validity and reliability reports, which is why this measurement was rejected.

Kozbelt's dissertation (2002) examined two studies: "(1) the nature of aesthetic judgment of the Quality of drawings and (2) the relation between the Quality judgments of the drawings and the problem solving strategies visual artists use to create the drawings" (p. x.). Study 1 examined artistic and technical skill, and study two examined the qualities of study one with problem-solving strategies. In study 1 using an Equivalent Materials Design, twenty-four art students participated in the study of which thirteen were first year students and eleven were fourth year students. The drawing task used was adopted from Getzels and Csikszentmihalyi (1976). The task was to draw a still life using black and white media within an hour, which was videotaped. The participants were asked a set of questions and completed three drawings, separated by about one week (p. 34). Participants then rated the drawings on a seven-point scale according to how well they liked each drawing as well as answering biographical questions (p. 34-35). Of the 35 judges, five subgroups were formed; (1) six law students, (2) eight psychology graduate students, (3) five first year art students, (4) eight fourth year art students, and (5) eight professional artists with art degrees and art teaching experience (p. 35-36). A 25-item survey instrument was used to measure quality, originality, and technical skill (p. 37). Figure 3.1 depicted a scalogram to display the results and analyzed through Rasch analysis (Rasch, 1980; Wright & Masters, 1982, as cited in Kozbelt, 2002, p. 40), of which was new to me and one I may find useful in my dissertation.

Study 2 used the same data from twenty-four artists observed while drawing during three sessions while being videotaped (Kozbelt, 2002, p. 101). The videos were coded by both drawings as final products, and the creative process through InGest software (p. 102, 104). The videos were coded according to “handling objects, selecting objects, selecting media, drawing, incidental pauses, and pausing” (Kozbelt, 2002, p. 106). These phrases were coded to understand better the problem-solving strategies of the participants in the study.

Study 2 presented a very smart process of determining “the problem solving processes that the artists use to create the products” (Kozbelt, 2002, p. 102). A video camera taped the participants creating artwork. The software used was new to me as well, and one that would reveal very interesting results in my dissertation, though it appears to be very time consuming in execution, coding, and data analysis. It would also take additional time to videotape each student in the control group, which would make this method unlikely for my dissertation. Although the origin of the drawing tasks was revealed, again, this dissertation lacked validity and reliability reports. This particular dissertation was groundbreaking and a model example of positive social change in both execution and results, which is why I included it in this review.

In the Kozbelt (2008) study, data from the Kozbelt (2002) dissertation were used to examine the extent high versus low creative artists differ as well as the significance of cognitive processing. Results of this study analyzed through hierarchical linear modeling resulted in a deeper investigation of PBL and quality outcomes of drawings through problem finding analysis (Kozbelt, 2008, p. 197). This information has clarified the design of my dissertation.

The Kozbelt and Serafin (2009) study investigated how "quality of artworks change throughout the process of creation" (p. 349). Kozbelt and Serafin used the same data sets from the Kozbelt (2002) dissertation to examine technical and artistic changes occurring while creating a drawing. Employing *dynamic evaluation*, Kozbelt (2006) mechanized the creation of assessing contrasting aesthetic viewpoints, artist's goals and accomplishments how close the artist is to finishing the work and other considerations for the process of creating art. Artistic quality was measured through Rasch statistical analysis (Rasch, 1980; Wright & Masters, 1982), in WINSTEPS software (Linacre & Wright, 2000) (Kozbelt & Serafin, 2009). HLM (Raudenbusch & Bryk, 2002; Silvia, 2007), a quantitative, multilevel analysis technique was used for analyzing high- or low-creativity (Kozbelt & Serafin, 2009).

Although the data sets were not new, a fresh analysis of data resulted in new information. I found the software used in this report new and one that might be useful. Again, the drawing task without validity and reliability reports leaves questions about the results.

Kozbelt, Seidel, ElBassiouny, Mark, and Owen (2010) conducted an investigation on the extent to which artist' drawing ability and skill at visual selection using artists and nonartists to trace a photograph of a face using 70 pieces of dark brown tape. Of the 31 participants in study one, 15 were undergraduate art students, and 16 were undergraduate non-art students. The judges were 15 artists who rated the drawings on accuracy. Study 2 involved 44 non-art undergraduate participants who participated in the same drawing task. Of these 44 students, 21 were randomly assigned to draw upright, while the others drew inverted (upside down). Analysis was conducted through Rasch analysis.

Study 1 was an Equivalent Materials Samples Design (Campbell & Stanley, 1963), which was sufficient to examine the outcome. Study 2 was a Randomized Materials Samples Design that does not appear in the Campbell and Stanley (1963) manual. The task of drawing with tape however was not previously used and questions immediately arise on the validity and reliability of its use. For this reason, I am hesitant in using this methodology. Furthermore, this methodology used materials differently for both groups opening up further questions about the design of this study. Kozbelt and colleagues research although pivotal in the visual arts education field leave many unanswered questions about validity and reliability measurements used. For this reason, the drawing tasks used in these studies have been rejected in the present study.

Equivalent Time Samples Designs and Drawing Ability

Maker, Jo, & Muammar (2008) in an equivalent Time Samples Design (Campbell and Stanley, 1963), investigated the development of creativity and the *Discovering Intellectual Strengths and Capabilities while Observing Varied Ethnic Responses* (DISCOVER) curriculum. Elementary students were assessed for three consecutive years using the Test of Creative Thinking-Drawing Production (TCT-DP), (Urban & Jellen, 1996), a measurement to identify creative students. The test, available in two forms is a drawing completion, testing for fourteen criteria. In addition to the drawing test, data was collected from student conversations, classroom observations, teacher interviews, and teacher ratings (Maker, Jo, & Muammar, 2008).

I found this longitudinal study very interesting. The drawing test would not be appropriate for the present study because it was designed to measure creativity and not drawing ability. The Time Samples design would be possible for the present study;

however, it would take three or more years to conduct, making it an unlikely methodological design for the present study and that is why it has been rejected.

Huntsinger, Jose, Krieg and Luo (2010) conducted a longitudinal study on how Chinese American and European American drawing skills affect creativity. This was an Equivalent Time Samples Design (Campbell & Stanley, 1963). In the Chinese culture of both calligraphy and drawing, students are taught step-by-step how to write and draw. In the United States of America, it is customary to withhold demonstrating to students how to draw or copy and instead students are encouraged to be creative, imaginative and self-expressive. The Chinese believe teaching basic skill encourages later creativity, and the Americans believe teaching basic skills stifles creativity (Huntsinger et al., 2010).

The Huntsinger et al. (2010) study began with 40 participants in preschool and kindergarten. The Draw-A-Person Test (Goodenough, 1926, revised by Harris, 1963) was used as a measure for drawing skill, and two judges rated the drawing on a 5-point Likert scale with creativity defined as "the inclusion of novel or unusual elements in the drawing" (Huntsinger et al., 2010, p. 137). Novel and unusual elements are often associated with creativity. In time one, students were measured on visual discrimination, fine motor coordination, and the amount of time spent on fine-motor tasks. In time two, students were also measured on visual-motor control, and spatial relations test. In time three, students were measured on figural creativity. Parent measures were conducted at time one on the importance of art, and mothers' and fathers' personal attitudes toward art; at times two and three children's activity and attendance; and at time three, parents' ways of fostering creativity. The measures in between all three times were two years apart from each other (Huntsinger et al., 2010).

A longitudinal study interests me because of the impact they usually make toward social change. This study also was of interest because of the dependent variable drawing skill (ability) is the same dependent variable as in the present study. Although the independent variable was creativity, the study was an important step in the field of visual arts education.

Counterbalanced Designs and Drawing Ability

A between Groups Pretest-posttest Crossover Design (Huck & Bounds, 1996), also called a Counterbalanced Design (Campbell & Stanley, 1963) was used in the Snow and McLaughlin, (2005) study. The study was investigated "to determine if the sequential method of teaching art skills (Brooks, 1986) could improve the success of intermediate grade school art students" (McLaughlin, 2005, p. 18). A formal step-by-step approach sometimes increases student outcomes. This design was used to evaluate and compare linear perspective drawings pretest and post training. Groups were first pre-tested, the experimental group was trained in the sequential method of drawing, and after both groups had drawing time, they were post tested. In their study, Snow and McLaughlin, used the art teachers' evaluation system to score drawings using a 10 point scoring system on the following: a) use of space; b) use of 3D; c) use of depth; d) placement; e) correct use of ellipse on bottom; f) correct use of an ellipse on top; g) correctly converging horizontal lines; h) vertical lines being parallel; i) overlapping; j) light source (p. 21).

The pre-test for both groups consisted of a still life with various cylinders at various heights (Snow & McLaughlin, 2005). The posttest control group consisted of various furniture typically found in the art room situated in a corner of the room. The posttest experimental group received lessons on drawing cubes, cones, and cylinders in various positions around the vanishing point; above, below, left, and to the right using rulers, with the addition of using light sources and shadows (p. 22). In posttest 2, the control group was trained and tested as the experimental group.

This study was an inspiration to me and is worth considering as a model for the present study; however I hesitate because of a few questionable internal and external validity concerns. I do like the use of linear perspective as a topic of drawing in a study and is one in which I may use in the present study. There are difficulties in delivering a PBL situation with linear perspective because it is a difficult concept for students to grasp and for teachers to teach.

Liu (2007) argued, "since creativity involves very complex concepts, creativity-testing instruments are the reflection of the ambiguity and difficulties of all theories" (p. 345). The complexity of creativity further complicated the testing of creativity. A series of instruments were in place to examine the relationship between the qualities of creativity, drawing ability, and visual/spatial intelligence. They were: "the *Milne-Kasen Story Pictures* (A Test for Creativity), the *Young Visual Artist's Checklist*, the *Portfolio Review Measurement,* and the classroom teacher's nomination of *Milne-Kasen Visual/Spatial Intelligence Checklist*" all used as measurements (Liu, 2007, p. 346). This complicated combination of measurements demonstrates the complexity of measuring creativity. A sample of 134 third grade students representing the top 16% and lower 16% of the population of 11,653 students from 99 Taiwan public schools participated in the study. A Pearson product moment correlation coefficient was used to analyze data from all the checklists (Liu, 2007).

The written portion of the methodology used for this study as written in the article was exclusive and confusing, making it difficult to follow the format of the methodological design, as the temporal aspects were absent. Visual and spatial intelligence appears to be the dependent variables and creativity and drawing ability appear to be the independent variables. As for the research design, it appears the Counterbalanced Design (Campbell & Stanley, 1963) was employed with some use of Regression Discontinuity in admission of the upper and lower 16% of the sample for the study.

I initially found this article of interest because of my interest in drawing ability and spatial intelligence. I originally had a hunch technical skill may have a connection with visual/spatial intelligence, so I was looking for this connection in the results of the data; however, the information I sought was not there. If I were to repeat this study, I would keep one creativity test (abbreviated Torrance Test of Creativity), add one drawing ability test (CDAT), and include one visual/spatial intelligence test (Children's Embedded Figures Test). These three measures would suffice to examine the relationship between creativity, drawing ability, and visual/spatial intelligence.

Institutional Cycle Design and Drawing Ability

In perhaps the most interesting methodological design to measure drawing ability, McManus, Chamberlain, Loo, Rankin, Riley, and Brunswick, (2010), used the Institutional Cycle Design (Campbell & Stanley, 1963). Two studies were conducted to examine why some art students experience difficulties in drawing, and whether this is related to dyslexia. In study 1, consisting of 277 art students, the measurements were nine educational surveys. For Study two, 38 participants were selected from study 1. These participants were measured on drawing ability with eight measurement tasks compared with these same abilities to the control group consisting of 30 non-art students (McManus et al., 2010).

This method of measuring drawing ability was very complicated, and not one recommended for a dissertation as it involved six investigators from four different Universities. This study introduced me to several visual drawing tests I was previously unaware, such as the Rey-Osterrieth Complex Figure (Rey & Osterrieth, 1993) to test for visual memory, the Arp Drawing to test for spatial relations, and the Malevich Drawing to test drawing ability. Although interesting, these drawing tests are inappropriate for this dissertation.

One-Shot Case Study and Drawing Ability

In a PBL course offered at the University of Barcelona in Spain using computer graphics, Marti, Gil, and Julia (2006) chose to investigate learning outcomes of "the classic teaching approach" with PBL "because it improves the student learning initiative" (p.95). Traditional learning is usually thought to be a standard pedagogical approach to improving student learning. This Pre-Experimental Design was a One-Shot Case Study (Campbell & Stanley, 1963). Students add their own functions using Visual C++ application with OpenGL libraries with MFC or GLUT under Windows or Linux computer software loaded with a basic skeleton of lighting functions, perspective projection, mouse interaction and three predefined objects (Marti, Gil, & Julia, 2006). In this situation, groups of four to six students were responsible for problem-finding and problem-solving Marti, Gil, and Julia (2006). Two problems presented to students were described in the article; project one: Solar system, and Project 2: Chess (Marti, Gil, & Julia, 2006).

This study design was of interest because it incorporated PBL in the visual arts. Although it was conducted at a university and in a computer lab, it was a rare study on PBL in the visual arts. The design of the study was weak in that there was no control group, and it had serious concerns in both internal and external validity.

CDAT

In the present study, the dependent variable was drawing ability and the independent variables were the teaching strategies of PBL and skills-based learning. CDAT (Clark, 1984) a measure to determine the extent to which there are differences (if any) in scores on (CDAT) between seventh grade visual-art students taught through PBL and those taught through skills-based learning. CDAT was used as a pretest and posttest. This drawing test has been chosen because it measures drawing ability through problem solving and technical skill. Drawing ability as measured by CDAT was the dependent variable, and PBL and technical skills-based learning were the independent variables and teaching strategies.

Few national standardized drawing tests exist, and those that do attract a variety of questions and concerns about their use (Clark, 1989 b; Clark & Zimmerman, 2001; Eisner, 1997). Some of these drawing tests include CDAT (1989), *Silver Drawing Test* (1983), *Narrative Drawing Assessment and Visual Memory Assessment* (1982), and the *Non-Verbal Ability Test* (1979) (Liu, 2007). Clark and Zimmerman (2004, p. 24) argued the standardized Silver Drawing Test was created to identify learning disabilities in students rather than artistic talent or drawing ability. State visual art assessments are mostly multiple choice and do not measure drawing skills (Clark & Zimmerman, 2001). Research on assessments and agreed upon terminology complicated research because of the difficulties identifying talented visual art students (Clark, 1989b).

The *Clark-Gareri Drawing Instrument* had three drawing tasks, which were the first three drawing tasks in CDAT that latter led to the development of the fourth drawing task of the present CDAT (Clark & Zimmerman, 1987, p. 48). Clark (1989) argued CDAT is used for identifying gifted and talented students with superior abilities in any area of the visual arts because drawing is fundamental in the visual arts, and drawing can be correlated to general intelligence. Clark (1989) mentioned 17 different researchers who declared drawing ability as a form of expression to be tested because drawing is the primary and most basic method of communicating in the visual arts (Clark & Zimmerman, 2004, p. 25). Clark argued, “Talent in the visual arts is a normally distributed human characteristic, as is intelligence” (1989, p. 100). Like intelligence, visual art talent is widely dispersed throughout the population.

Methods used with Clarks Drawing Abilities Test

The following is a discussion of studies that used CDAT (CDAT) as a measure in their investigation that will provide the reader with information about its use. The methodology justification begins with the inception of CDAT as a measure by Clark (1989) to screen talented visual art students and continues with an investigation by Clark & Zimmerman (2001) to identify artistically talented students in rural communities. The discussion continues with an investigation assessing gifted visual art students in Hong Kong by Chan (2008). Chan, Chan, & Chau (2009) investigate whether nonexperts could make expert-like judgments judging drawing abilities of Hong Kong Chinese gifted students. The next review is an investigation to determine to what extent age and artistic involvement make a difference in the relationship between drawing skill and artistic creativity by Chan & Zhao, (2010). This final review using CDAT is an inquiry by Chan and Zhao (2010) to investigate the connection between drawing skill and artistic creativity in relation to age groups and levels of artistic involvement. Further investigations of using CDAT in three studies by Chan (2008, 2009, and 2010) appear in the methodology section at the end of chapter 2.

The dependent variable in Clark's (1998) investigation was visual arts talent. The seven independent variables were teacher ratings, scores on the Children's Embedded Figures Test, and the four sections of CDAT (house, person running, friends playing, fantasy drawing). Clark chose the two independent variables other than those within CDAT purposively to validate CDAT. I may need to follow a similar structure of validation for the methodology in my study. This particular article was pivotal in my research and is what drove my dissertation in the direction of limiting drawing as the dependent variable.

In a 2001 study, Clark and Zimmerman (2001) investigated a study to identify artistically talented students in four rural communities, in the United States under the name Project ARTS using CDAT. The dependent variable again was visual arts talent. The independent variables were CDAT, an abbreviated Torrance Test of Creativity, and local achievement test scores. The Torrance Test of Creativity measures inherent abilities unaffected by previous experiences, whereas CDAT measures problem solving skills and drawing abilities affected by previous experiences. This indicates the Torrance Test of Creativity scores will remain constant; however, CDAT scores may change with time and experience (Clark & Zimmerman, 2001). Clark (1989) advises the CDAT was not be the only method of screening students for advanced placement in the visual arts as effective as it is in identifying gifted students. Twelve years later Clark and Zimmerman, (2001) recommended using the CDAT "as a measure for identification of students with high potential or high abilities in the visual arts" (p. 113) because of the high correlations with the modified Torrance Test of Creativity.

Chan (2008) investigated the extent to which the dependent variable, drawing abilities correlated with the two independent variables, the Impossible Figures Task-28 (Schacter, Cooper, & Delaney, 1990) and two drawing tasks from CDAT. These two tests were used to measure greater sensitivity screening talented visual art students. Chan hypothesized the impossible figures task will identify visual arts talent in spatial ability. The Impossible Figures Task-28 measures global visual-spatial ability. Thirty figures flash by for two seconds each. The participant decides if each figure is 'possible' or 'impossible.' To test the independent variable spatial ability, Jackson's (2003) Multidimensional Aptitude Battery II, the Mental Rotation Test was used. This test "assesses respondents' ability to visualize abstract objects in different positions in two-dimensional space and to be sensitive to critical differences among alternatives" (Chan, 2008, p. 369). The same shape is viewed from a different angle for identification.

Chan (2008) argued two of the four tasks in CDAT favor realistic representational drawings that places students who do not draw realistically at a disadvantage. Although the Impossible Figures Task -28 identified the students with high drawing ability from students with low drawing ability, the CDAT used in the Chan (2008) study did not follow standard standardized scoring procedures. Because standard scoring procedures were not followed, the results of CDAT remain questionable because of validity and reliability concerns.

Chan, Chan, and Chau (2009) investigated a study using the two tasks of drawing a house and the person running adapted from CDAT to determine whether nonexperts could make expert-like judgments. Drawing ability was again the dependent variable and an abbreviated CDAT was the independent variable. Because of cultural differences in CDAT, two drawing sections were not used in the Chan, Chan, and Chau, (2009) study. The house and the person running tasks were chosen from CDAT because they are common objects drawn (Chan, Chan, & Chau, 2009).

As in the present study, the Chan, Chan, and Chau (2009) investigation incorporated two samples of participants, however, in the Chan, Chan, and Chau study, sample A was judged by experts only and sample B by experts and nonexperts; the nonexperts judged sample B again two weeks later. The ratings were based on the lineation, representation, and organization from the two tasks, house and running person in CDAT. Clark used a 10-point scale to rate drawing from CDAT (ARTS Publishing Co. Inc., 2006) whereas Chan, Chan, and Chau (2009) had the expert and nonexpert judges use a 3-point scale to rate the two drawing tasks from CDAT. This brings about questionable results from the Chan, Chan, and Chau study because of the discrepancies of the two different rating systems using the same tasks of measurement.

Chan and Zhao (2010) employed two dependent variables; drawing skill and artistic creativity, which were examined in relation to the two independent variables of age groups and levels of artistic involvement among Chinese students in Hong Kong (p. 27). Four measures were used in this investigation, the first and second are the fantasy drawing from the fourth task in CDAT, and a self-report scale for rating creative behavioral characteristics (SRBCSS, Renzulli, Smith, White, Callahan & Hartman, 1976). The third and fourth measures were divergent thinking tests from Wallach-Kogan Tests (WKT; Wallach and Kogan, 1965) to test for creativity, and the DAC and the art-related activity self-checklist (Chan & Chan, 2007) for art involvement (Chan & Zhao, 2010). The fantasy drawings from CDAT were not scored in a standardized procedure by the three judges, instead they were judged on a 5-point scale (Chan & Zhao, 2010). This study compared drawing ability with artistic creativity at three different age levels, child, adolescent, and young adult. Three separate judges judged the following skills in the fantasy drawing: artistic creativity, drawing skill and both creativity and drawing skill.

CDAT has been chosen as the measurement to determine what the differences are (if any) between seventh grade visual-art students taught through PBL and those taught through skills-based learning in the present study. The reason CDAT has been chosen is because it is a measurement of artistic talent via drawing ability. The only other standardized measurement testing for drawing ability is the Silver Drawing Test (1983), which is used to identify disabilities (Clark & Zimmerman, 2004). CDAT measures artistic ability in four drawing areas that made it very well suited for this dissertation.

The articles reviewed leave a gap in knowledge. These investigations did not compare technical skill of drawing with PBL measuring drawing ability using CDAT. The investigation I intend to use will close this gap.

Summary and Conclusion

From the literature, it became clear the independent variables for the present study be teaching strategies, PBL and SBL. It also became apparent the dependent variable was drawing ability. The literature review covered the most recent related literature on comparing teaching style outcomes between students taught through PBL and SBL. The most significant positive social change was a methodology using a quasi-experimental design with a pre-test-posttest nonequivalent control group. (NR O_1XO_2 NR O_1 O_2). A drawing ability test was used as the treatment for the experimental group. This methodology was not located in the search for literature. This created a gap in research where a comparative nonequivalent pretest-posttest study testing whether PBL or skills-based learning will increase drawing ability for seventh grade students. Therefore, a PBL unit of study has been created based on literature and theory. The positive social change was a better method of teaching drawing to seventh grade students, as well as new knowledge created in a unit of study in drawing ability using PBL.

In Chapter 3, I present the research design and methodology for this study. Chapter 4 will discuss the findings of the study. Chapter 5 will discuss the interpretation of the findings and implications for positive social change.

Chapter 3: Research Method

Introduction

The purpose of this study was to compare teaching strategies already in place without changing teachers' present curriculum. In this chapter, I describe the research design and rationale. Major sections of this chapter include the research design, methodology, threats to validity and the summary. In the methodology section, I discuss the population, sampling, and sampling procedures, followed by procedures for recruitment of participation and data collection, and instrumentation and operationalization of constructs. This chapter includes an intervention involving manipulation of the independent variable, and operationalization for each variable. Ethical procedures follow threats to validity, and data treatment. The chapter ends with a summary and transition into Chapter 4.

Research Design and Rationale

I investigated whether PBL compared to SBL explains the relationship between increased drawing ability. The dependent variable was drawing ability and the independent variable was teaching strategies. The covariates are sensory qualities, formal qualities, expressive properties, and technical properties. For this study, I chose quasi-experimental design with a nonequivalent control group design using a pretest-posttest (NR O_1XO_2 NR O_1 $O_{2)}$ drawing ability test (CDAT) for the experimental group and control group. This research design was best suited to help me find answers to the question, what are the differences (if any) in scores on CDAT (CDAT) between seventh grade visual-art students taught through PBL and those taught through SBL?

This decision was made because randomization was not possible and classroom assignments were more convenient (Campbell & Stanley, 1963; Creswell, 2009; Frankfort-Nachmias & Nachmias, 2008; Johnson & Christensen, 2008). The two teachers in two different schools were using two different strategies; one taught PBL and the other taught SBL. There were no changes to their curriculum. This places the study within the time constraints of a quarter of the school year, or 9 weeks.

Other designs considered were quasi-experimental, separate-sample, and pretest-posttest control group design because of comprehensive and strong indicators of internal and external invalidity. These designs were rejected because they were not previously used and they required a large population and sample, had a time limitation, and had considerable expense (Campbell & Stanley, 1963; Creswell, 2009; Frankfort-Nachmias & Nachmias, 2008; Johnson & Christensen, 2008). A quasi-experimental, separate-sample, pretest-posttest design was rejected because of its weakness in maturation and interaction of selection and maturation. Posttest-only control group design was also considered because of the strengths in internal and external validity; however, this design was rejected after careful consideration because there are no improvements to compare it with, such as a pretest-posttest. An untreated control group design with dependent pretest and posttest samples, using a double pretest was strongly considered and rejected. This was because it would take too much art time to administer the tests three times within 9 weeks, and the art teachers might have to use two classes for each of the three test segments (Campbell & Stanley, 1963; Creswell, 2009; Frankfort-Nachmias, & Nachmias, 2008; Johnson & Christensen, 2008; Shadish, Cook, & Campbell, 2002).

Methodology

Population

The target population was 144 seventh grade students in two middle schools similar in geographic location, cultural, and socioeconomic status. The total number of students from both schools in Grade 7 was 144. The target sample size of 40 students was in two self-contained classrooms for visual arts classes taken from one quarter of the school year. The sample size in the proposal was 40 visual art students. After attrition, the actual sample size for the study was 81. The two different teachers are already using two different teaching strategies, one teacher teaches PBL, and the other teaches SBL.

Sampling and Sampling Procedures

The design of the study needed two different classrooms, and I could not use my own because of obvious biases. In this case, two outside middle schools were sought and secured. These classrooms could not be randomized which is why the sampling strategy is a non-random convenience sample. The sample then was drawn from two groups, each nonrandom and each from different schools found to be representative of the two different teaching strategies needed for this study. The sampling frame included two classrooms from different schools and excludes all other samples in this study.

The instrument and data collection tools consisted of a pre- and post drawing ability test (CDAT) developed by Clark (1984). The same tool was used for the pretest and posttest. SPSS descriptive statistical analyses were conducted on the data collected. Data analysis consisted of a *t* test to determine if there are and correlations between the dependent variable drawing ability, and the independent variable teaching strategies.

The calculated effect size is an estimate, however, not in the sense of statical-based parametric estimates. Power analysis is best made by previous estimates in review of the literature or data from previous research. Effect size from a study such as this has not been located so a conservative estimate was used. The effect size was calculated from G*Power 3.1.2. with central and noncentral distributions. The test family was set at *t test*, the statistical test set at *correlation: Point biserial model*, power analysis: *A priori: Compute required sample size – given* α*, power and effect size d* 0.40, α *err prob* 0.05, Power (1-β *err prob*) 0.85, sample size group 1 = 20, sample size group 2 = 20, total sample size = 40 (Faul, Erdfelder, Buchner, & Lang, 2009). The sample size for the study was 81.

Instrumentation and Operationalization of Constructs

The name of the published instrument and provider used in this study is CDAT (Clark, 1984). The *t* test was appropriate for this study because it included the dependent variable, drawing ability measured by the independent variable, teaching strategies, measured by problem-solving, and drawing skills. Clark granted permission to use CDAT in an email letter.

Clark (1984) conducted research to validate CDAT. Sixty participants entering Grades 7-11 from the 2-week 1984 Indiana University Summer Arts Institute took part in the study (Clark, 1989). To gain entrance into the institute, participants had to meet at least three of the following requirements:

> (1) highly interested in one or more of the visual arts, (2) experienced in participating in one or more of the visual arts, (3) highly motivated and self-confident in one or more of the visual arts, (4) achievement scores at least two

grades higher than the students' present grade, (5) measured, above-average intelligence, or (6) presently placed in a local gifted/talented school program (Clark & Zimmerman, 1984, as cited in Clark, 1989, p. 100).

These entrance requirements ensured students were noticed as having some visual arts talent. Teacher ratings were used at the end of the Institute to establish the validity for the CDAT (Clark & Zimmerman, 1984). Each student was rated three times by three different Summer Institute teachers from three different classes (Clark & Zimmerman, 1984).

The published reliability and validity values relevant to their use in the study are discussed as follows, as well as the populations CDAT served when validity and reliability were established. Emperical validity measures were created and validated by correlating scores of CDAT with an Abbreviated Torrance Test of Creativity approved by Torrance's staff at the University of Georgia (Clark & Zimmerman, 2001). Emperical validity uses correlation coefficient measures as "index of how much two measures or variables are related" (Frankfort-Nachmias & Nachmias, 2008, p. 151). Clark (1989) correlated the CDAT using Pearson Correlation Coefficients to compare variables with Childrens Embedded Figures Test (CEFT) (Karp & Konstadt, 1963). Clark argued the CDAT is validated through correlations with CEFT (Karp & Konstadt, 1963) CDAT is also validated from three different teacher ratings and classes offered for talented visual art students at the 1984 Indiana University Summer Arts Institute. The rating was reported with a .90 inter-judge correlation as argued by Clark, (1989). The judges were the author (Clark) and two art education graduate students (Clark & Zimmerman, 1984).

CEFT is a reliable measure to distinguish artists from nonartists because of perceptual awareness of artists and because of artist's ability to distinguish shapes in a complicated pattern (Clark & Zimmerman, 1984). The CEFT was administered at the beginning of the institute (Clark & Zimmerman, 1984). At the .05 significance level, correlations between the teacher ratings and CDAT were all significant (Clark & Zimmerman, 1984). There was a significant correlation $p < .05$, $N = 60$, between CEFT, and the four tasks in CDAT (Clark, 1989, p. 101).

The Validity results are as follows. Pearson Correlation Coefficients were validated with CEFT at the .05 significance level; Draw 1, .36, $p = .005$, Draw 2, .29, $p = .022$, Draw 3, .27, $p = .034$, and Draw 4, .32, $p = .012$ (Clark, 1989, p. 101). There was also a significant correlation between Teacher Ratings and CDAT at the .05 significance level, with further validations; Draw 1, .34, $p = .008$, Draw 2, .35, $p = .006$, Draw 3, .37, p = .005, and Draw 4, .39, $p = .003$. (Clark, 1989, p. 101).

High scores on the CEFT indicated field independence. In addition, students who were rated very high by their visual arts teachers also scored high in CEFT. Students who rated lowest by their visual arts teachers (weakest drawing skills) also scored lowest on the CEFT indicating field dependence (Clark, 1989). There was a high significant degree of relationship among correlations of all four drawing tasks at the .01 level (Clark & Zimmerman, 1984, p. 102).

Retest reliability results of CDAT were reported by Clark and Zimmerman (2001). In their Project ARTS investigation, three judges scored the CDAT. The Pearson product-moment correlation indicated a high retest reliability, $r = .85$, $\bar{x} = 73.2$, $SD =$

29.96 (Clark & Zimmerman, 2001). Because CDAT is both valid and reliable and because it measures drawing ability, CDAT was used in this dissertation study.

Intervention Study for Independent Variable: PBL

The literature review revealed a research gap in visual arts education teaching strategies comparing PBL and SBL measured by drawing ability using CDAT. This led to investigate the extent an intervention, PBL and drawing ability visual art curriculum for seventh grade visual arts students. Without this knowledge, a curriculum must be created for this study based on theory and literature from similar studies in various subject areas. The PBL curriculum for this study will focus on one unit of study of the purpose of temporal feasibility. The unit of study is designed for the duration of four weeks, a sufficient length of time based on similar studies (Snow, 2005; Wang, 2007).

Teaching PBL in the Visual Art Classroom

PBL begins with ill-defined problem students desire to solve. If students are unsuccessful in finding a drawing problem, the art teacher may decide to present a selection of problems to solve, or assign one. Students research and discuss what they do know and need to know to solve the problem, as well as strategies to solve the problem, and additional information/skills needed. The art teacher then provides additional drawing information students missed. Students begin solving their drawing problem and re-adjusting their problem-solving strategy until successfully solving their drawing problem with little assistance from their art teacher.

Conceptual Framework for Teaching Drawing Through PBL

The conceptual framework for this teaching strategy is PBL. It is based on a problem a student wants to solve in an authentic setting using real world problems (Boud,

& Feletti, 1997; Burton, Horowitz, & Abeles, 1999; Checkley, 1997; Cerezo, 2004; Kelly, Haidet, Schneider, Searle, Seidel, & Richards, 2009; Rasmussen, 1997; Schmidt, Vermeulen, & van der Molen, 2006). Students were guided with limited resources to think critically by defining and attempting to solve the problem (Boud & Feletti, 1997; Kelly et al., 2009; Tiwari, Lai, So, & Yuen, 2009). The visual arts teacher began with an ill-structured drawing problem with as few conditions as possible for the students to solve (Eisner, 1997; Hathaway, 2008; Liu, 2007) Students had the option to find their own drawing problem which the teacher may pose in the form of an essential question or a big idea (Hathaway, 2008; Walker, 2001). Allowing students to find their own problem is akin to a self-designed curriculum creating greater student involvement (Andrews, 2010; Hathaway, 2008; Tarnvik, 2007; Tiwari, Lai, So, & Yuen, 2009) as well as a greater risk taking (Atkinson, 2008). For the visual arts, both problem-solving and problem-finding are appropriate for PBL projects (Kozbelt, 2008; Newton & Newton, 2005). After students choose a drawing problem and are placed in small groups of 4-5 they research and discuss what they know about the problem and various ways of solving it (Checkley, 1997; Delisle, 1997; Marti, Gil, & Julia, 2006). Next students decided what additional information is needed to solve the problem as individuals and/or in groups (Checkley, 1997; Delisle, 1007; Marti, Gil, & Julia, 2006). Providing students with multiple strategies to solve a problem such as experimenting with a variety of media results in students creating very different artwork from others (Lampert, 2006) or introducing them to different forms of expression such as drawing heroes, manga, still life, realistic, invented, memory, and/or perspective drawings. With this information, students begin solving a drawing problem meaningful to them (Eisner, 1994, pp. 19, 86), perhaps because they wished to draw in 3D. A successful PBL unit is experienced when students solve their problems with little assistance from the teacher (Delisle, 1997). Such a student-centered curriculum allows students to make numerous connections (Kalchman, 2011).

Art teachers administered CDAT from middle schools where the study was being investigated. Data from pretests and posttests were collected and coded by art teachers in respective schools. Tests were forwarded to Arts Publishing Co Inc., who scored and returned results for analysis.

Variables

The independent variable was teaching strategies and the covariates were PBL, and SBL. The Dependent variable was drawing ability (drawing skills). The covariates for the dependent variable were sensory qualities, formal qualities, expressive properties, and technical properties. All CDAT tasks required problem solving and drawing skill.

Definitions of Dependent Covariates

Drawing skill: "Two such components, which might be referred to as "representational accuracy" and "artistic-aesthetic value" (Hermelin & O'Connor, 1990, p. 218).

Expressive properties: "mood, originality" (Clark, 1989, p. 100)

Formal qualities: Intellecutal expressive art concept qualities of pattern, contrast, rhythm, movement, balance, emphasis, and unity. (Clark, 1989, p. 100; National Board of Professional Teaching Standards, 1997)

Problem solving: Problem solving is a convergent act, and artwork created by a problem solving artist exhibits great craftsmanship (Csikszentmihalyi, 1965 as cited in Sawyer, 2006).

Sensory qualities: Emotionally expressive art concept qualities of line, shape, color, texture, space, form, and value. (Clark, 1989, p. 100; National Board of Professional Teaching Standards, 1997)

Skill-based learning: Teaching through activities where students learn the "how and why behind a variety of artistic techniques" (Dolamore, 2009, p.131).

Technical properties: "technique, correctness of solution" (Clark, 1989, p. 100)

CDAT has four tasks of measurement that have been adapted from numerous sources deemed as sufficient evidence of different drawing abilities and include:

> (a) Draw a picture of an interesting house as if you were looking at it from across the street. (b) Draw a person who is running very fast. (c) Make a drawing a picture of you and some of your friends playing in a playground. (d) Make a fantasy drawing from your imagination. Be as creative as you wish and draw whatever you like. Make your drawing as interesting as you can. (Arts Publishing, CDAT, 2006, pp. 39-40).

These four concepts are measured by CDAT. Each drawing is to be completed within 15 minutes using a #2 pencil. Unfamiliarity of various media can be intimidating for students with the exception of drawing; therefore, pencils are a choice media for testing, and drawing a choice assignment (Chan, 2008; Chan, Chan, & Chau, 2009; Clark, 1989 b; Clark & Zimmerman, 2004, p. 25). Reasons and sources for the four drawing tasks are well grounded in literature (Clark, 1989 b.)

The following scoring criterion was used: "(1) sensory properties (line, shape, texture value, (2) formal properties (rhythm, balance, unity, and composition), (3) expressive properties (mood, originality), and (4) technical properties (technique, correctness of solution)" (Clark, 1989, p. 100). These four criteria were scored holistically on a scale of 1-5 for all four components within each criterion. Numerically, each criterion in the test was assigned a value on a range of scores from 12 (when one is the lowest score for each criterion) to 60 (when five is the highest score for each criterion) on each drawing (Clark, 1989, p. 100: also see Arts Publishing, CDAT, 2006; Clark & Zimmerman, 2001; Clark & Zimmerman, 2004, p. 26). Rouse (1965) adopted this five-point scale along with Lewis and Mussen (1969), Silver (1983), and (Clark, 1989). In the controlled conditions of this study all participants took work-sample CDAT pretests simultaneously as well as the posttest, making comparative results more valid and reliable (Clark & Zimmerman, 1987, p. 49).

Data Analysis Plan

The software used for analysis was SPSS. Data cleaning (editing) and screening are important and must be done prior to data analysis (Frankfort-Nachmias & Nachmias, 2008). Data editing included making sure all data was coded properly both during and after data processing. This was necessary to check for inconsistencies in data such as the pre-test and posttest before and after they were sent to Art Publishing for scoring. Data cleaning was necessary while proofreading the data to "catch and correct errors and inconsistent codes" (Frankfort-Nachmias & Nachmias, 2008, p. 314). Generating a frequency distribution checked for illegitimate wild codes to the data sets that causes problems similar to outliers (Frankfort-Nachmias & Nachmias, 2008).

Covariates were included in the data analysis because they were key elements in finding answers to the research question and testing the hypotheses. Results were interpreted through a *t* test. For *t* test analysis on a repeated measures design with an intervention such as this study, I ran both mean differences and relationship between variables. I did this because I wanted to know the general differences on scores between the two teaching styles in order to run an effective and complete investigation of the research question, hypothesis and data sets (Green & Salkind, 2008).

Research Question

To what extent do differences exist, if any, in scores on CDAT (CDAT) between seventh grade visual art students taught through PBL and those taught through skills-based learning?

Null Hypotheses

$H_0$1: There will be no statistically significant difference in CDAT assessment posttest scores between students who have been taught through PBL and those taught through SBL.

$H_0$2: There will be no statistically significant difference in CDAT assessment scores (pretest –posttest = difference) between students who have been taught through PBL and those taught through SBL.

Alternative Hypotheses

H_A1 : The scores on CDAT posttest assessment will be higher in students that have been taught through PBL than those taught through SBL.

H_A2 : There will be statistically significant difference on CDAT assessment scores between (pretest –posttest = difference) students who have been taught through PBL and those taught through SBL.

Art teachers administered CDAT from middle schools where the study was being investigated. Data from pretests and posttests were collected and coded by art teachers in respective schools. Tests were forwarded to Arts Publishing Co Inc., who scored the tests and returned the results for analysis. CDAT was designed to measure visual artistic talent through drawing ability. The tasks within CDAT include problem-finding and problem-solving which PBL is composed of as well as measuring drawing skill. For this reason, CDAT was chosen as a measurement for the independent variables PBL and skills-based learning. The dependent variable was drawing ability as measured by CDAT.

SPSS descriptive and correlation analysis of the CDAT data were conducted to clarify the relationship between the independent variables PBL and SBL to determine whether the hypothesis should be accepted or rejected. The population of participants was pre-tested on CDAT. One group received a problem-based unit of drawing (experimental group) while the other group received a unit of skill-based drawing (control group). SBL is a common practice used by most middle school art teachers by default (Mittler & Ragans, 1999; Mittler & Ragans, 1999b; Mittler, Morman Unsworth, Ragans, & Scannell, 1999; Ragans, 2000). Both groups after completing their drawing units were post tested using CDAT. Both the control and experimental group were from different schools to avoid contamination of data results.

Once the schools were identified, permission to conduct research was sought from the visual arts teachers' principals and superintendents of each school. Once permission was granted, I trained the visual arts teachers in the middle schools where the research was investigated. The art teachers in respective schools did not need permission from students, and parents because teachers were already using CDAT in their schools.

After Arts Publishing Co Inc. returned scoring data to me I began data analysis. The data extruded from the CDAT scores are continuous values, and as such they are agreeable for analysis with ordinary least square methods. It is not known if the distributions of the data would approach normality with the small sample size in the present study. Because of this, an ordinary least square methods, a *t* test was used to analyze the data. ANOVA being more sensitive to departures from normality on dependent (response) variable in data may cause full dependence yet more tolerant to departures from normality than a *t* test.

Threats to Validity

Threats to external validity in this quasi-experimental design were present as is the case with most experimental designs in education. The interaction of testing and X is very unlikely because a person's attitudes are unlikely to change (Campbell & Stanley, 1963). The interaction of selection and X is unlikely because of lack of "freedom to sample widely" (p. 50) a randomized grouping (Campbell & Stanley, 1963). The threat to reactive arrangements should have been unlikely in this study as there was less chance and reason to react because of the difference in teaching method, and geographic distance (Campbell & Stanley, 1963). This was not the case in the present study, more of which will be discussed in chapter 4. In this manner, this quasi-experimental design is consistent with research designs needed to advance knowledge within the discipline of visual arts education.

Sources of internal validity inherently drove the decision toward a quasi-experimental nonequivalent control group design. Statistical regression was not likely in the design of this study because the samples, control, and treatment were not selected in the extremes of the distribution. There would be a concern about regression towards the mean if samples deviated in an extreme manner from the two populations of students in the seventh grade in their respective schools. Comparing samples to the populations from which they were derived with *t* test methods can check this. If samples were not statistically different from their populations of origin, this finding would suggest regression towards the mean is unlikely. Statistical regression occurs when the samples are located at the tails of the distribution. SSPS associates the problem of regression towards the mean, and data, if transformed, could, perhaps achieve normality. Maturation was not a concern because both groups act as cohorts and as such they both move through cycles simultaneously, as well as having similar compositions of race/ethnicity as well as socio-economic status. With the external control group, results of greater accuracy might be expected than if both groups were within the same school.

Ethical Procedures

Walden University's Institutional Review Board (IRB) oversaw the research conducted for this dissertation. The Walden University IRB approval # 02-13-13-0060927 was issued on February 13, 2013 and expired on February 12, 2014. All protocol required by the IRB were strictly adhered to. No research began until IRB approval was been granted in order to protect participant's privacy rights and ethical concerns. Permission was granted from superintendent of schools and art teachers to conduct the study. Middle school art teachers, Arts Publishing Co Inc. staff as well as a researcher, handled data collection. Data, which are now confidential, are locked in storage cabinets in my home office and password safe on my personal computer, which is inaccessible to others. After five years the records will be destroyed and the data erased from the researcher's computer.

I was careful not to disturb the educational process of the students such as local school testing, exams, and high stakes testing. After the study has been completed, the data will be made available to the superintendent, principal, and teachers. No monetary funds were awarded students.

Summary

Increased drawing ability differences between PBL and traditional SBL remain unresolved. This study attempted to resolve these differences. The conceptual framework used in this study was PBL. It was developed by Boud (1985), and used to study what is needed in the professional workplace (Boud, 1985 as cited in Eilouti, 2007, p. 199). The purpose of this quasi-experimental study was to test the level of drawing ability, with two different teaching strategies for middle school seventh grade art students. This approach holds that simulated real life situations through independent problem solving deepen understanding of topics (Eilouti, 2007). Applying these strategies to the present study, it was expected that the independent variable, PBL would influence the dependent variable, drawing ability because simulated real-life problem solving generates motivation and independent learning.

This teaching strategy was investigated to determine whether PBL or SBL increased drawing ability for seventh grade visual art students. I investigated teaching strategies to explore the relationship between levels of drawing ability. A quasi-experimental pretest-posttest control group design was used because of the nonrandom convenience groupings. The target population was 144 middle school students in seventh grade from two different Middle Schools. The sample size was 40 visual art students. The instrument and data collection tools consisted of CDAT. Clark and Arts Publishing Co Inc. conducted reliability and validity studies on the CDAT.

Data collected from this study revealed wide differences in drawing ability of PBL and traditional SBL. This may inform art educators to rely more heavily on PBL or SBL. Outcomes of this study may clarify how students increased drawing ability. This study adds to new knowledge to the field of education providing useful information on teaching styles creating a positive social change in the field of arts education.

Although the results were skewed, this important study provides insights into ways teaching strategies promote understanding of seventh grade visual art concepts which may benefit students, teachers, and administration. Factors such as drawing skill, use of expressive art concepts, formal and sensory properties, technical, artistic properties, problem-based learning, skill-based learning, and problem solving should be considered in visual art classes to increase the influence of positive social change. Chapter 4 discusses analysis of the results of the study in detail.

Chapter 4: Results and Analysis of Data

Introduction

The purpose of this quantitative study was to determine the extent to which PBL and SBL produce differential results in the measurement of drawing ability levels for visual arts students. Specifically, the purpose of this study was to determine the extent of differences in drawing ability levels between PBL and SBL among seventh grade visual art students through quantitative measures.

Research Question

To what extent do differences exist, if any, in scores on CDAT (CDAT) between seventh grade visual art students taught through PBL and those taught through skills-based learning?

Null Hypotheses

$H_0$1: There will be no statistically significant difference in CDAT assessment posttest scores between students who have been taught through PBL and those taught through SBL.

$H_0$2: There will be no statistically significant difference in CDAT assessment scores (pretest –posttest = difference) between students who have been taught through PBL and those taught through SBL.

Alternative Hypotheses

H_A1 : The scores on CDAT posttest assessment will be higher in students that have been taught through PBL than those taught through SBL.

H_A2 : There will be statistically significant difference on CDAT assessment scores between (pretest –posttest = difference) students who have been taught through PBL and those taught through SBL.

Abilities assessment scores between the difference (pretest –posttest = difference) between students that have been taught through PBL and those taught through SBL.

Organization of Chapter 4

Chapter 4 is organized beginning with an introduction. Next, major sections of this chapter outline descriptions of data collection, the intervention, and results of the research. The data collection section describes the time frame, discrepancies of data collection from the proposal, demographic characteristics of the sample, how the sample may be representative of the population, challenges to the planned intervention, as well as any adverse events. Results will be reported through descriptive statistics, statistical assumptions will be evaluated, and statistical analysis including probability values, confidence intervals, and effect sizes will be reported. Reports on post-hoc analysis as well as any other additional statistical tests such as *t* tests, will be described, and figures and tables will illustrate results. The chapter ends with a summary of the findings to the research question and will transition into the interpretation of the findings in chapter 5.

Data Collection

Time Frame and Recruitment of Schools

The data collection began March 13, 2013 and ended on June 25, 2013. Actual recruitment for teachers to participate in this study began in October of 2009, and by April 2012, I had two willing teachers teaching two different teaching styles PBL and SBL. I personally invited 48 art teachers, in addition to advertising on professional teaching websites and seeking teachers out at various visual art educator meetings. The response rate was 0, as none of these 48 art teachers responded. I could not teach both teaching styles at the middle school where I work because of bias issues; in addition, the only other art teacher in my school only taught one section of seventh graders. My district superintendent provided me with suggestions to pursue a few districts in the area, and after e-mailing these school superintendents and their middle school teachers, I found the two willing seventh grade art teachers to work with during the process of data collection.

Discrepancies in Data Collection from Proposal

I investigated two different teaching strategies, PBL and SBL, to explore the relationship between levels of drawing ability. A quasi-experimental design with a nonequivalent external control group design with pretest-posttest was used because of already assigned convenience groupings. The target population was 144 middle school students in seventh grade from two different Middle Schools. The real target sample remained the same. The sample size in the proposal was 40 visual art students. The sample size for the study was 81. The PBL group comprised two different sections. One section had 11 students and the other section had 14 students making the total 25 students. The SBL group comprised 55 students in four sections with the following number of students each: 16, 14, 11, and 14 students respectively. The numbers in these six combined sections of the sample is 81 (Table 1).

The instrument and data collection tool, CDAT (Arts Publishing Co. Inc., 1984) was responsible for scoring the pretests and posttests. CDAT tests were given one score for all four sections of the test, therefore, the dependent coefficients could not be used in the data analysis, reducing the amount of data collected.

Table 1

Number of Students in Each of the Two Different Teaching Styles

	PBL		SBL	
Groups	A	12	A	16
	B	14	B	14
			C	11
			D	14 *
Totals		26		55

Note. * = Group D excluded from posttest data collection as students did not complete CDAT due to students being taken out of class for assemblies.

Baseline Descriptive and Demographic Characteristics

The art teachers of the two teaching styles compared were both from similar demographics and geographic location and both from moderately sized school districts in the Northeast United States. Participants were taken from two different middle schools in two different school districts. Both groups of participants were taken from preassigned grade 7 visual art classes during the 2012-2013 regular school year. Of these two groups, one middle school visual art teaches two classes consisted of the treatment, PBL. The other middle school visual art teaches four sections of visual art consisted of the control SBL. The two sections of the experimental group contained 26 students and the four sections of the control group contained 55 students. Both groups took a pretest as a baseline for the study as measured by CDAT. Student participants in both groups also took a posttest in order to measure any improvement heir drawing ability as measured again by CDAT. The study was driven by the research question: to what extent do differences exist, if any, in scores on CDAT (CDAT) between seventh grade visual art students taught through PBL and those taught through skills-based learning?

In order to test the hypothesis, the two groups were compared by means, as well as a *t* test at a significance level of $\alpha = 0.05$ and a confidence level of 95%. Descriptive statistics and histogram graphs were analyzed in order to understand the statistical observations (Frankfort-Nachmais & Nachmais, 2008; Green & Salkind, 2008; Johnson & Christensen, 2008).

CDAT scores were investigated using a series of statistical analysis. A dependent *t* test and paired sample for means were computed and analyzed for both the experimental and control group in order to determine the extent to which drawing ability was improved for both groups from the baseline data. Statistical analysis included an independent *t* test on the CDAT to determine at what extent, if any, there were differences in the posttest compared to the baseline data. The entire data analysis was driven by the research question; to what extent do differences exist, if any, in scores on CDAT (CDAT) between seventh grade visual art students taught through PBL and those taught through skills-based learning? The mean, median, mode, variance, and standard deviation are displayed as such (Green & Salkind, 2008) in Table 2. SBL group D was excluded from posttest data. Data were analyzed through descriptive statistics using SPSS.

Table 2

Pretest and Posttest Raw Scores by Group

	Teaching styles			
Test type	PBL (*n* = 25)	*SD*	SBL (*n* = 39)	*SD*
Pretest mean	5.460	1.7555	5.6026	1.80343
Posttest mean	5.280	1.7385	5.8846	2.09467

Note. SD = standard deviation.

Challenges Presented Through Data From the Proposal

Covariates could not be analyzed due to holistic scoring of CDAT, meaning only one score was provided from all four sections of CDAT. This problem was an unknown factor. The second challenge was the large decrease in posttest CDAT scores, in the PBL group. To remedy this problem, outliers such as incomplete pretest or posttest results were eliminated. The third challenge presented by the posttest data was, of the four sections of visual arts classes in the SBL, one section did not take the post CDAT due to students being pulled out of class to attend school assemblies. The lack of attendance caused a reduction of usable subjects to 39 compared to the total number of 55 at the beginning of the study.

Adverse Events Related to the PBL Group

There was an unexpected decrease in posttest scores, in the experimental group (Table 2). To remedy this problem, a secondary analysis was conducted eliminating outliers such as incomplete pretest or posttest CDAT scores. In this manner, all CDAT scores with completed pretest and posttest scores were the only data included in analyses.

Results

Descriptive Statistics that Appropriately Characterize the Sample

Eighty-one participants were examined to address the research questions. Table 3 shows the number of male and female participants as well as accounting for the number of participants throughout the study. CDAT has four sections (four of four) of which some participants did not have time to complete. There were no participants who had an incomplete pretest (81, 100%), while there were 15 participants (19%) with an incomplete posttest. The majority of the participants examined were taught with traditional instruction SBL (66, 82%). Frequencies and percentages for nominal data are presented in Table 3.

Table 3

Frequencies and Percentages for Nominal Data

Variable	*n*	%
Gender		
Female	24	30
Male	40	49
Missing	17	21
Incomplete		
4 of 4		
At pretest	0	0
At posttest	15	19
Instruction		
type		
Problem-based	25	31
Skill-based	56	69

CDAT (CDAT) scores ranged between 3.00 and 10.00 at pretest and posttest. At pretest, the average score was 5.63 (SD = 1.74). At posttest, the average score was 5.65 (SD = 1.97). Teacher grades ranged from 2.00 to 4.00 at pretest and posttest. The average teacher grade at pretest was 3.58 (SD = 0.57). Average teacher grade at posttest was 3.73 (SD = 0.51). Means and standard deviations for continuous data are presented in Table 4.

Table 4

Means and Standard Deviations for Continuous Data

Variable	*n*	*M*	*SD*
CDAT pretest	81	5.63	1.74
CDAT posttest	64	5.65	1.97
Teacher grade pretest	55	3.58	0.57
Teacher grade posttest	63	3.73	0.51

Research Question 1

To what extent do differences exist, if any, in scores on CDAT (CDAT) between seventh grade visual art students taught through PBL and those taught through skills-based learning?

To examine the research question and hypotheses, an independent samples *t* test and a one-within one-between ANOVA were conducted to assess if the CDAT scores were significantly different by instruction type. The independent samples *t* test compared the pretest scores by instruction type while the one-within one-between ANOVA compared both sets of scores by time (pretest vs. posttest) and instruction type. The independent samples *t* test was conducted first.

Prior to analysis, the assumptions of normality and equality of variance were assessed. Normality was assessed with the Kolmogorov Smirnov (KS) test. The results of the test were significant for pretest (p = .008), suggesting a violation in normality. However, with more than 50 participants, the assumption of normality can be violated with little effect on Type I error (Morgan, Leech, Gloekner, & Barrentt, 2007). Equality of variance was assessed with the Levene's tests. The results of the test were not significant (p = .576), suggesting that the assumption was met.

The results of an independent samples *t* test were not significant, $t(79) = -0.59$, $p = .560$, suggesting that the pretest CDAT scores were not significantly different by instruction type. Since the scores were not significantly different, null hypothesis 1 cannot be rejected in favor of the alternative hypothesis. Results of an independent samples *t* test are presented in Table 5.

Table 5

Results for Independent Sample t Test for CDAT Pretest Scores by Instruction Type

	Problem-based		Skill-based				
Variable	*M*	*SD*	*M*	*SD*	*t*	*df*	*p*
CDAT pretest	5.46	1.76	5.71	1.74	-0.59	79	.560

The one-within one-between ANOVA was conducted next. The results of the main effect of time did not show significance, $F(1, 62) = 0.07$, $p = .789$. This suggests that the scores were not significantly different by time (pretest vs. posttest) for both groups. The main effect of instruction type did not show significance, $F(1, 62) = 0.72$, $p = .401$. This suggests that the scores (overall) were not significantly different by instruction type. Lastly, the results for the interaction between time and instruction were not significant, $F(1, 62) = 1.48$, $p = .229$. This suggests that there were no differences in the CDAT scores by the interaction of time and instruction type. The null hypothesis two cannot be rejected in favor of the alternative hypothesis because the one-within one-between ANOVA did not show significance by time, instruction type, or by the interaction of time and instruction type. Results for the ANOVA are presented in Table 6. The findings indicate inconclusive results because of the reactive assessment environments, which were demonstrated by a decrease in scores, in the PBL groups between pretest and posttest. This decrease may have been due to disruptive classroom environments, an in proportional number of special needs students, and students taking high stakes tests during the same time CDAT was presented may have caused student reactions to test prompts.

Table 6

Results for One-Within One-Between ANOVA for CDAT Scores by Time and Instruction Type

Source	*SS*	*df*	*MS*	*F*	*p*	Partial η^2
			Within subjects effects			
Time	0.08	1	0.08	0.07	.789	.00
Time*Instruction	1.63	1	1.63	1.48	.229	.02
Error	68.17	62	1.10			
			Between subjects effects			
Instruction	4.25	1	4.25	0.72	.401	.01
Error	368.65	62	5.95			

Power Analysis

A sample size power analysis was conducted using G*Power 3.1.7. The analysis was run for the independent samples *t* test and one within one between ANOVA. The independent samples *t* test, alpha of .05, and power of .80 requires a sample size of 128 to find significance if there is a medium effect size. The one within one between ANOVA, alpha of .05, power of .80, with two groups and a measurement repeated twice requires a sample size of 40 to find significance if there is a medium effect size.

Rationale for Selection of Statistical Procedure

An independent sample *t* test is the appropriate analysis to conduct when the goal is to assess if there are significant differences in a continuous dependent variable by a dichotomous independent variable (Pallant, 2010). In this case, the continuous dependent variable is CDAT pretest scores. The dichotomous independent variable is instruction type, with levels: problem-based and traditional. The independent samples *t* test would assess if there were differences in the pretest scores by instruction type. The purpose of comparing the two groups with a *t t*est procedure was to demonstrate their similarity.

The one within one between ANOVA is the appropriate analysis to conduct when the goal is to assess if there were significant differences in a continuous dependent variable, measured at multiple time points, by a nominal variable. The continuous dependent variable is CDAT score, measured at pretest and posttest. The nominal independent variable is instruction type, with levels: problem-based and skill-based. The one within one between ANOVA would assess if there were differences in the CDAT scores by time and instruction type.

Statistical Assumptions Appropriate for the Study

Sources of Internal Validity

History: History is controlled for because any historical event occurring in the experimental group would also occur in the control group at the same time and therefore would produce no difference

Maturation Interactions and Testing: (selection-history interaction or selection-testing interaction) most common when one group having “a higher rate of maturation or autonomous change than the other,” (Campbell & Stanley, 1963, p. 48). Both maturation and testing were controlled for because they happen simultaneously. In this study, the experimental group had a higher rate of maturation or autonomous change in the CDAT posttest as evidenced in the actual decrease, in scores.

Instrumentation: with both groups using the same instrument in pretest and posttest scores, this should have posed no significant threat to validity.

Regression: If "the means of the groups are substantially different, then the process of matching not only fails to provide the intended equation but in addition insures the occurrence of unwanted regression effects" (Campbell & Stanley, 1963, p. 49). Since the matching of any grouping was not part of this study, regression is not likely to pose a problem.

Homogeneity of Regression: Uniform regression between both groups (Campbell & Stanley, 1963, p. 49). Since there was a difference in the regression of one group, this was a source of weakness in this study.

Selection-maturation: Since students in both or either group were not specifically selected for this study, the interaction of selection and maturation was not a problem.

External Validity

Interaction of Testing and X: This design is weak with Interaction of Testing and X because of uncontrollable differences in geographic and socioeconomic regions.

Interaction of Selection and X: Interaction of Selection and X is questionable because of differing characteristics from school to school, or other historical events that may affect results.

Reactive Arrangements: Reactive arrangements present but to a lesser degree than true experiments (Campbell & Stanley, 1963, pp. 50). Reactive arrangements are not controlled for because outside conditions are different for each study.

Multiple-X Interference: Multiple-X Interference is not controlled for in the nature of this study.

Statistical Analysis Findings

Statistics and Associated Probability Values

There was a 0.18 decrease on PBL mean scores on the CDAT posttest and 0.282 increase in SBL CDAT mean scores. Since the PBL CDAT scores decreased and SBL CDAT scores increased, I asked what PBL teacher's thoughts were on why the scores decreased. The PBL teacher reported student-testing burnout; students took the posttest at the end of the term and were also taking State-mandated high stakes testing at the same time. In addition, the teacher reported students' felt like it was their last days of school and students blew off the posttest. Lastly, the PBL teacher reported this group had a larger than normal amount of special needs students and other issues distracting the students.

Results of Post-hoc Analysis

It was unnecessary to conduct Post-hoc analysis since the findings were inconclusive.

Additional Statistical Tests and Findings

Because of the low drop in PBL CDAT scores, additional statistical tests were performed. First, the outliers were eliminated. The outliers included any SPL or PBL CDAT scores that dropped from pretest to posttest scores.

Conclusion

In summary, both the experimental and control group were relatively equivalent in baseline data. There was a decrease in CDAT scores in the experimental PBL group whereas the control group increased in CDAT scores. With the unusual decrease in PBL CDAT scores, further statistical tests were not conducted because the CDAT scores were inconclusive. The problems resulting in a decrease, in PBL posttest CDAT scores will be discussed in chapter 5. Interpretation of these findings, limitations to the study, and recommendations and implications will all be discussed in chapter 5.

Chapter 5: Interpretation of the Findings

Introduction

It is not known the extent to which problem-based learning (PBL) or Skill-based learning (SBL) in art education increases drawing ability for seventh grade students. This problem negatively impacts short and long term drawing ability outcomes for students. Visual arts teachers and higher learning institutions currently do not know which teaching strategy results in increased drawing ability for students (Collard et al., 2009). The purpose of this quantitative study was to determine the extent to which PBL and skills-based learning produce differential results in the measurement of drawing ability levels for visual art students. Since there is no current research specifically on the topic of this comparative study, it addresses a gap in the existing body of research. The design of this study is based on the conceptual framework of PBL, a teaching strategy.

The method of inquiry was a quantitative study using a Quasi Experimental Design with a Nonequivalent Control Group Pretest-posttest design (Campbell & Stanley, 1963; Shadish, Cook, & Campbell, 2002) to investigate the difference between two teaching strategies through drawing ability. The instrument used for pretest and post testing was CDAT (Clark, 1984). This quantitative study investigated the comparison of the experimental group to a control group being taught using different strategies.

Findings were inconclusive and may be due to at least two reasons. First, there were reactive environments with a disproportionately large number of special needs students in PBL art classes. Second, CDAT testing administered simultaneously during high stakes testing may have skewed scores. There was a drop in PBL posttest scores from the pretest, when this happens results are inconclusive rather than significant or insignificant.

Interpretation of Findings

This study adds to new knowledge, in the sense that there are very few similar empirical studies in art education engaging middle school student as subjects (Lam & Kember, 2004). The inconclusive findings cannot be generalized. The design of this study was a quasiexperimental design with a pretest-posttest nonequivalent control group design (NR O_1XO_2 NR O_1 O_2) (Campbell & Stanley, 1963, p. 8; Creswell, 2009, p. 161; Shadish, Cook, & Campbell, 2002, p. 136-137).

The findings do not confirm or disconfirm knowledge in the discipline; however, the findings do extend knowledge in the discipline of art education. Although inconclusive, this study attempted to compare teaching styles. I did not locate in the literature an arts education study comparing PBL with SBL, so this study adds to the literature on teaching styles which are of interest to art teachers and administrators (Ibrahim & Yusoff, 2009; Lamm & Kember, 2004; Leyendecker, 2010; Snow & McLaughlin, 2005). The conceptual framework for this teaching strategy is PBL. It is based on a problem a student wants to solve in an authentic setting using real world problem (Boud, & Feletti, 1997; Burton, Horowitz, & Abeles, 1999; Checkley, 1997; Cerezo, 2004; Kelly, Haidet, Schneider, Searle, Seidel, & Richards, 2004; Rasmussen, 1997; Schmidt, Vermeulen, & van der Molen, 2006). Other conceptual studies in visual art education comparing SBL and PBL followed a different course of action and design than the present study (Angeli, Valanides, & Kirschner, 2009; Benitez, 2009; Cain, 2010; Chung and Ro 2004; Constantino, 2002; Cox and Rowlands, 2000; Eilouti, 2007; Getzels

& Csikszentmihalyi, 1976; Haddawy et al., 2007; Hardie, 2007; Kozbelt, 2008; Kozbelt & Seeley, 2007; Lampert, 2011; Lappe, 2004; Leshnoff 1995 ; Newton & Newton, 2005; Rostan, 2005; Schiferl, 2008; Sawyer, Wilson, & Challis, 2006).

Limitations to the Study

Limitations of this study related to the design including internal and external validity; construct validity, and confounder variables and how they are being addressed. The design of this study is limited in validity and reliability because of a lack of tested criteria in PBL for seventh grade visual art students.

Limitations due to the design are common in education (Campbell & Stanley, 1963). Drawbacks on the quantitative experimental design in this study included threats to external validity such as testing and X, interaction of selection and X, and threat to reactive arrangements. Internal threats to validity included threats to reactive arrangements, regression towards the mean, and maturation. The decision to use an experimental design was made because randomization was not possible and the arrangement of classroom assignments was more convenient (Campbell & Stanley, 1963; Creswell, 2009; Frankfort-Nachmias, & Nachmias, 2008; Johnson & Christensen, 2008). This quasi-experimental design is consistent with research designs needed to advance knowledge within the discipline of visual arts education.

Other limitations were due to unforeseen problems. In this study, a problem arose in reactive assessment environments. The probable cause of the decrease in CDAT posttest scores from the PBL experimental group may be due to "resentful demoralization" (Shadish, Cook, & Campbell, 2002, p. 80-81), as well as CDAT taken simultaneously during high stakes testing. This reactivity threat to construct validity, although not universal, requesting students to repeat the same test may result in students purposely changing their response as a form of retaliation. This would especially happen with a group of students having a disproportionately large number of students with special needs who may be more inclined to retaliation (Shadish, Cook, & Campbell, 2002).

Another limitation of this study is all four sections of CDAT were not scored separately. If they were, teachers could compare sections of CDAT to their projects. Researchers could study teaching styles more accurately with the addition of four sections. For example, a study could compare drawing 3D figures and fantasy. These could be compared with greater accuracy with individual scores for each CDAT section.

Recommendations

There are several recommendations for further study. Pretests/posttests should be carried out at the beginning rather than end of the school year to avoid the possibility of resentful reactivity. This might resolve some of the 'testing out mode' due to high stakes testing. Too many tests might have turned students off to CDAT.

In addition, scoring CDAT differently may not only enrich results, but also it might cancel out the over testing mode because the four sections on CDAT would only be taken once, not twice. Also, different scores for each separate test would result in five scores, four of which representing for each of the four CDAT tasks with a fifth overall mean score. In this manner, scores for each of four sections on CDAT (3,7,9,6) separately, not holistically.

Perhaps having students take one or two of the four CDAT sections may reduce the amount of time students take drawing tests. Chan, (2008); Chan, Chan, and Chau

(2009), used an abbreviated CDAT. Having both the experimental and control groups then take one or two sections different from those in the pretest can serve as a posttest, effectively giving the appearance of different test which may hold the interest and attention of seventh grade students. Such a study was investigated in the Snow & Mclaughlin (2005) study. The pretest for both groups consisted of a still life with various cylinders at various heights (Snow & McLaughlin, 2005). The posttest control group consisted of various furniture typically found in an art room situated in a corner of the room.

Other options include complementing or replacing CDAT with GEFT/CEFT, or NEAP, or teacher assessments. Students could draw themselves with their friends in the schoolyard with the school in the background and a dog in the foreground (Case, Stephenson, Bleiker, & Okamoto, 1996). The drawing task was scored on use of all figures and objects as described in the drawing directions, as well as overlapping, and use of details. Results were inconclusive due to resentful demoralization as a reactivity threat to construct validity.

Implications

Positive Social Change

Although the results were skewed, this important study provides insights into ways teaching strategies promote understanding of seventh grade visual art concepts which may benefit students, teachers, and administration. Factors such as drawing skill, use of expressive art concepts, formal and sensory properties, technical artistic properties, problem-based learning, skill-based learning, and problem solving should all be considered in visual art classes to increase the influence of positive social change.

Conclusion

Results were inconclusive due to resentful demoralization as a reactivity threat to construct validity. This study demonstrates the need for further research in comparative teaching styles using drawing tests and further validating them. The implications of the inconclusive findings guard against having students taking pretests and posttests during high stakes testing, even though teachers administer the CDAT sections around high stakes testing.

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Tarnvik, A. (2007). Revival of the case method: a way to retain student-centered learning in a post-PBL era. *Medical Teacher, 29*(1), 32-36, doi:10.1080/01421590601039968

Tiwari, A., Lai, P, So, M., & Yuen, K. (2009). A comparison of the effects of PBL and lecturing on the development of students' critical thinking. *Medical Education, 40*, 547-554. doi:10. 1111/j.1365-2929.2006.02481.x

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Walker, S. R. (2001). *Teaching meaning in artmaking.* Worcester, MA: Davis Publications.

Wang, T. H. (2007). What strategies are effective for formative assessment in an e-learning environment? *Journal of Computer Assisted Learning, 23*, 171-186. doi:10.1111/j.1365-2729.2006.00211.x

Wilhelm, D, & Wilhelm, P. (2010). Inquiring minds learn to read, write, and think: Reaching *all* learners through inquiry. *Middle School Journal, 41*(5), 39-46.

Wilson, B. (1997). The second search: Metaphor, dimensions of meaning, and research topics in Art Education. In S. D. La Pierre, & E. Zimmerman (Eds.), *Research methods and methodologies for art education* (pp. 1-32). Reston, VA: National Art Education Association.

Wilson, N. S., & Smetna, L. (2009). Questioning as thinking: A metacognitive framework. *Middle School Journal, 41*(2), 20-28.

Winner, E. (1982). *Invented worlds: The psychology of the arts*. Cambridge, MA: Harvard University Press.

Wolf, D., & Perry, M. D. (1989). From endpoints to repertoires: Some new conclusions about drawing development. In H. Gardner, & D. Perkins (Eds.), *Art, mind& education: Research from project* zero (pp. 3-15). Chicago, IL: University of Illinois Press.

Wright, B. D., & Masters, G. N. (1982). *Rating scale analysis: Rasch measurement*, Chicago, IL: MESA Press.

Zeki S. (2009). *Splendors and miseries of the brain: Love, creativity, and the quest for human happiness*. Malden, MA: John Wiley & Sons.

Curriculum Vitae

John Krenik

Education

Ph.D., General Education, Specialization in Art Education Walden University, Minneapolis, MN. Dissertation Topic: The Influence of Problem-based Learning on Drawing Ability, Expected 2014
Masters in Art Education, UMASS Dartmouth, North Dartmouth, Massachusetts, Thesis Topic: A Pilot Self-Esteem Art Program for Middle School Students, 1994
Bachelor of Science, Art Education, Mankato State (Minnesota) University, 1980

Teaching Experience

Nauset Regional Middle School, Orleans, MA, 1987-present, Art Teacher, grades 6-8
Nashua Catholic Junior High School, Nashua, NH, 1984-1987, Art Teacher, grades 7-9
Holy Infant Jesus Elementary School, Nashua, NH, 1985-1987 Art Teacher, grades K-6
Nature's Classroom, New England Locations, 1981-1984, Outdoor Education, grades 4-9
Public and Private Schools, Minnesota 1980-1981, Substitute Teaching, all subjects, 6-12

Professional Service

Created, organized, and chaired Arts Day at NRMS 2008-2013
Phi Delta Kappa International: panel of reviewers for April Issue of *Classroom Tips*, 2012
Phi Delta Kappa International: panel of reviewers for Future Educators of America Projects' Moment Competition, 2012
Kappa Delta Pi Educational Foundation: Scoring *Literacy Alive* Projects, 2011-2012
Instructional Consultant, Class Measures, 2006-2007

Recent Committees

Greenhouse and Greenhouse Art Auction Committee, Nauset Regional Middle School, 2012-13
Steering Committee, Nauset Regional Middle School, 2011-13
Discipline Committee, Nauset Regional Middle School, 2011-12

Professional Education Achievements and Art Education Awards

Kappa Delta Pi, Teacher of Honor, 2010, Honored at KDP Convo Indianapolis, IN, 2011
Cambridge Who's Who, Professional of the Year, Art Education, 2007

Manchester's Who's Who Among Executives and Professionals, 2005-06, Professional of the Year, 2007
Nauset Teachers Association: Building Representative, 2005-2006; Vice President 2006-2007
Manchester Who's Who Registry of Professionals and Executives, Life Member, 2005
Massachusetts Middle School Art Educator of the Year, 2003
Teacher Leadership Academy of Massachusetts, Fellow 2003, Lifetime Member 2003, Board of Directors 2006, Co-Chair 2006-2009
Master Teacher, Massachusetts Department of Education, 2001-2008
National Board Certified Teacher, Early Adolescence through Young Adulthood/Art, 2001-2011
National Board of Professional Teaching Standards, Assessment Scorer 2003

Presentations at National and International Professional Education Organizations

"The Influence of Problem-based Learning on Drawing Ability" at the National Art Education Association Convention in San Diego, California, March 29-31, 2014.

"Creating a Visual Arts Visual Culture Online Learning Course: From Theory to Research to Practice" at the National Art Education Association Convention in San Diego, California, March 29-31, 2014.

"Would Teaching Either Problem-based Learning or Skills-based learning Significantly Increase Students Drawing Abilities?" at the National Art Education Association Convention in Fort Worth, Texas, March 7-10, 2013.

"Revisiting Field Dependence/Independence, Perception, Creativity, and Artistic Outcomes", at the National Art Education Association Convention in Fort Worth, Texas, March 7-10, 2013.

"*The Influence of Problem-based Learning on Drawing Ability* ", poster session at the Learning and the Brain Conference in San Francisco, CA, February 14-16, 2013.

"*Arts Day: Engaging Your Entire School Population in the Arts during an Entire School Day*" at the Canadian Society of Education through Art 2012 Conference in Edmonton, Alberta, October, 25-27, 2012.

"Graduate Research Symposium: The Influence of Problem-based Learning on Drawing Ability" at the Canadian Society of Education through Art 2012 Conference in Edmonton, Alberta, October, 25-27, 2012.

"*Arts Day: Engaging Your Entire School Population in the Arts during an Entire School Day*" at the National Art Education Association Convention in New York, NY, March 2, 2012.

"*Creativity and Intelligence: What Underlying Influences do Motivation and Attention have on Creativity and Learning*?" at the Canadian Society of Education through Art 2011 Conference in Fredericton, New Brunswick, Canada, October 14, 2011.

"*Creativity and Intelligence: What Underlying Influences do Motivation and Attention have on Creativity and Learning*?" at the 2011 National Art Education Association National Convention in Seattle Washington, March 17-20, 2011.
"*Neuroscience and Creativity: Why Every Art Teacher Should Know How Their Students Think and Create*" at the 2011 National Art Education Association National Convention in Seattle Washington, March 17-20, 2011.
"*Neurological Functions, Thinking, and Creativity*" poster session at the 2seventh International Learning and the Brain Conference; No Brain Left Behind: Improving Teaching, Testing and Treatment in Cambridge, MA November 19-21, 2010.

"*Neurological Functions, Thinking, and Creativity: Gaining a Greater Understanding of How People Think and Create*" at Art/InterFace; Ontario Society of Education through Art/Canadian Society of Education through Art Conference 2010 on October 16 at the Ontario College of Art and Design, in Toronto, Canada.
"*Neurological Functions, Thinking, and Creativity*" poster session at the National Art Education Convention in Baltimore Maryland, April 14-18, 2010.

"*Neuroscience, Self Awareness and Relation to Art: A Specific Look at Adolescent Neurology*", poster session at the Learning and the Brain Conference in Washington, D.C., May 7-9, 2009. John also introduced the guest speakers, Dr. Lawrence Steinberg, and Dr. Robert Epstein for their session, "Teen Brains and Thinking", as well as a scheduled panel discussion immediately following the lectures.
"*Neuroscience, Self Awareness and Relation to Art: A Specific Look at Adolescent Neurology*", as well as a poster session on the same topic at the National Art Education Association' National Convention in Minneapolis, MN in April, 2009.

"Mindful Expressions of Fear, Memories, and the Surreal", National Art Education Association 4seventh Annual Convention, March, 2007, NY, NY

"*Visual Figurative Language with Meaning", "Creating Beautiful Elaborate Patterns"*, National Art Education Association 46th Annual Convention, March, 2006, Chicago, IL

"Creating Art from Personal Issues", "Memorials and Tributes", National Art Education Association 45th Annual Convention, March, 2005, Boston, MA

"Meaningful and Controversial Social and Personal Art Issues", Association for Supervision and Curriculum Development 60th Annual Conference and Exhibit Show, April, 2005, Orlando, FL

"Meaningful and Controversial Art Issues" National Art Education Association 44th Annual Convention, April, 2004, Denver, CO

Presentations at Regional Professional Educational Conferences

"Creating Meaningful Art from Personal Issues", New England League of Middle School Students Annual Unified Arts Conference, November, 2006
"Creating Art from Personal Issues", New England Art Education Biennial Conference, November, 2005
"Linear Perspective", New England Art Education Biennial Conference, November, 2003
"Personal Issue Posters", New England Art Education Biennial Conference, November, 2001
"Rotational Patterns", New England Art Education Biennial Conference, November, 1999
"Sundials", New England Art Education Biennial Conference, November, 1997

Presentations at Massachusetts Art Education Association Conferences

"*Arts Day: Engaging Your Entire School Population in the Arts during an Entire School Day*", November, 2012
"Abstract Art: Appreciation through Personal Experience", November, 2011
"Neuroscience and Creativity: Why Every Art Teacher Should Know How Their Students Think and Create", November, 2010
"Neurological Functions, Thinking, and Creativity", November, 2009
"Neuroscience, Self Awareness and Relation to Art: A Specific Look at Adolescent Neurology", November, 2008
"Designing Hawaiian Quilts", November, 2006
"Social Issue Murals", "Linear Perspective", November, 2002
"Personal Issue Posters", May, 2001
"Architectural Gingerbread Houses", October, 2000
"Egyptian Registers", May, 1999

Presentations at All Day Workshops, Cape Cod Collaborative, Barnstable, MA

"Teaching the Difficulties: Ideational Art and Linear Perspective", 2006
"Meaningful and Personal Art Connections: Memorials and Tributes, Social Justice Murals", 2005

Authored Art Education Publications

Krenik, J. (in press). Influences of attention on creativity, intelligence, and learning.
Krenik, J. (in press). Neurological functions, thinking, and creativity. *Art Education*.
Krenik, J. (2005, November). Overcoming difficulties with students. *The Teacher Leader* [Teacher Leadership Academy of Massachusetts].

Krenik, J. (1992, April). Tear into a luminous media. *The Artists Magazine, 9*(4), 46.

Artistic Achievements

Publications Featuring Artwork

Studio Visit Magazine, Summer Edition*, Open Studio Press, Boston, MA, 2010*
Collage in all Dimensions, National Collage Society, Malcolm Llewellyn Publishing, Washington, DC, 2005
Fifty Years of Excellence, Texas Watercolor Society, San Antonio, TX, 1999
"Fifty Years of Excellence" Watercolor 5(19), 112, American Artist Publication, Summer, 1999
"Nauset Art Teachers Exhibit", VHS C3TV, South Yarmouth, MA, December, 1998
"Two Perspectives", VHS C3TV, South Yarmouth, MA, August, 1993
New Visions 1991 Calendar, New Visions Gallery, Marshfield, WI, 1991
"John Krenik's Technique", The Review, Cape Cod's Arts and Antiques Magazine, 4, 46-49, September/October, 1989
The Encyclopedia of Living Artists, Fourth Edition, Directors Guild of Publishers, Renaissance, CA, 1989.

Awards in National Art Exhibits

Peggy Hopper-Sunshine Arts Award, Hawaii Watercolor Society, Open Exhibition, 2013
New Mexico Watercolor Society, Spring Members Exhibition, Award of Excellence Rio Grande Art Association, 2013
Honorable Mention, Mississippi Watercolor Society, Grande National, 2011
Honorable Mention, Cape Cod Art Association, The National, 2009
St Cuthberts Mill Award, Northwest Watercolor Society, 2008
Canson Watercolor Paper Award, Northwest Watercolor Society, Waterworks, 2008
Edgar A. Whitney Award, Southwest Watercolor Society, 2007
Honorable Mention, New England Watercolor Societies Annual Members Exhibit, 2007
Outstanding Achievement, National Collage Society National Show, 2005
Winchester Art and Frame Award, New England Watercolor Society Biennial National Exhibit, 2002
Silver Medal, New England Watercolor Society's Members Exhibition, 1999.
Third Place, Eastern New Mexico University's National Scene/Unseen Exhibition, 1998.
Award of Merit, Texas Watercolor Societies Forty-Ninth Annual Exhibition, 1998.
Best of Show, Southwest Watercolor Societies National Membership Exhibition, Dallas, TX, 1995.
2cnd Place, ART PROSPECT, La Jolla, Ca, 1995.
Honorable Mention, Georgia Watercolor Society, La Grange, GA, 1995.
3rd Prize, New England Watercolor Society, Duxbury, MA, 1995.

Best of Show, National Collage Society (formerly North Coast Collage Society), Seattle, WA. 1994.

National/International Juried Watercolor Competitions

National Watercolor Society 88th Annual Exhibition, 2008.
New Mexico Watercolor Society National Exhibit, 2002-5, Western Federation, 2011.
Northwest Watercolor Society National Exhibit, "Waterworks" 2000, 2003, 2007, 2009, 2011.
National Watercolor Society's Signature and Associate Members Exhibition, 1999, 2005.
Eastern New Mexico Universities National Exhibition, Portales, NM, 1998.
ART PROSPECT, La Jolla, CA, 1995, 1996.
Southwestern Watercolor Society Membership Exhibition, TX, 1995-1999, 2007, 2009, 2010.
Louisiana Watercolor Society, New Orleans, LA, 1991, 1995.
Georgia Watercolor Societies XII National Exhibition, 1995, 1999.
Kentucky Watercolor Societies Aqueous "94, Bowling Green, KY, 1994.
National Collage Societies Annual Juried Exhibition, 1994, 1997, 2002, 2010, 2011.
Arizona Aqueous IX, Tubac, AZ, 1994, 2002.
Pennsylvania Watercolor Society, Bethlehem, PA, 1992.
Philadelphia Watercolor Club, Philadelphia, PA, 1992.
Pikes Peak Watercolor Societies International Watermedia 1999, 2000.
Texas Watercolor Society, San Antonio, TX, 1992, 1998 1999, 2001, 2002, 2008.
San Diego Watercolor Society, San Diego, CA, 1991.
Oklahoma Watercolor Society, Oklahoma City, OK, 1990, 2000, 2003, 2004.
Mississippi Watercolor Society, Jackson, MS, 1989, 1995, 1998, 2010, 20ll, 2013.
New England Watercolor Societies North American Biennial, 2000, 2002.
Cape Cod Art Association, The National, 2009, 2010.

Recent one Person Exhibits

Cabot House Furniture, Weymouth, MA, 2011-2014.
Old Selectman's Building Gallery, Barnstable, MA, 2004.
Cummaquid Fine Arts, Cummaquid, MA, 2003.
Warwick Museum of Art, Warwick, RI, 2002.
University of Tennessee, Knoxville, Tennessee, 1999.
Thornton Burgess Society, East Sandwich, MA, 1996.
Digital Equipment Corporation, Marlboro, MA , 1992.
Chez David Gallery, Chicago, IL, 1991.
Cape Cod Museum of Natural History, Brewster, MA, 1990.

Selected Group Exhibitions

Cabot House , Weymouth. MA, 2008-2014
Copley Society of Art, Boston, MA, 2006

Artistic Appetites, Hyannis, MA, 1995-2004.
Chelsea Gallery, Cincinnati, OH, 1996-1998.
Gallery at C3TV, South Yarmouth, MA, 1993, 1998.
Rice/Pollack Galleries, Provincetown, MA, 1989-1992.
Chim Gregg Art Gallery, La Puente, CA, 1991.
Helio Galleries, New York, NY, 1990-1992.
Arte de los Noventa, Cozmel/Merida, Yucatan, Mexico, 1990.
Ariel Galleries, New York, NY, 1989, 1990.
Gallery La Merced, Maracaibo, Venezuela, 1989.
DeBerry Galleries, Provincetown, MA, 1988.

Signature Memberships in National Art Societies

National Watercolor Society
National Collage Society
North West Watercolor Society
New England Watercolor Society
Southwest Watercolor Society
Texas Watercolor Society
Mississippi Watercolor Society
The Copley Society of Art, Copley Artist
Cape Cod Art Association

Chairman of Exhibitions

New England Watercolor Societies New England Juried Show, The Cahoon Museum of American Art, Cotuit, MA, 1999.
New England Watercolor Societies 6th North American Show, Federal Reserve Bank, Boston, MA, 1998.
New England Watercolor Societies Annual Juried Exhibition at the Guild of Boston Artists, Boston, MA, 1995, 1997.
New England Watercolor Societies Juried Exhibition at the Provincetown Art Association and Museum, Provincetown, MA, 1997.

Grants

Friends of Pleasant Bay, 2011, 2012, 2013
Arts Foundation of Cape Cod, 2010, 2011, 2012
Local Cultural Councils: Orleans, Eastham, Wellfleet, Brewster, MA, 2010, 2011, 2012
Teacher Leadership Academy of Massachusetts, 2005
Ludwig Vogelstien Foundation, Incorporated, 1989

Museum Collection

Cape Cod Museum of Art, Dennis, MA.

University Collection

School of Art, Kent State University, National Collage Society Teaching Collection, Kent, Ohio.

Selected Corporate Collections

Braunstein, Cohen, and Herman, Hyannis, MA.
Colin Fisher Studios, Cathedral City, CA.
Goodwin, Proctor and Hoar, Boston, MA.
Hale and Dorr, Boston, MA.
Webb Builders, Juno Beach, FL.