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Keith R. Webb

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November 14, 2007

A New Approach to Illustration Curriculum Design: Using Bloom's Taxonomy as the Framework for Cognitive and Psychomotor Illustration Studio Objectives

by
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To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Keith R. Webb find it satisfactory and recommend that it be accepted.

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Terms and Definitions

Bloom's Taxonomy, is a classification of the different objectives and skills that educators set for students (learning objectives). The taxonomy was proposed in 1956 by Benjamin Bloom, an educational psychologist at the University of Chicago. Bloom's Taxonomy divides educational objectives into three "domains:" Affective, Psychomotor, and Cognitive (http://en.wikipedia.org/wiki/Bloom%27s_Taxonomy).

Bloom's Revised Taxonomy, Modified by Dr. Lorin Anderson in 2000 the taxonomy's domains now include, Remember, Understand, Apply, Analyze, Evaluate and Create. The knowledge domain is now called out separately and acts to describe the variable abilities of the learner within each of the domains (http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy#Revised_Bloom.27s_Taxonomy_.28RBT.29.)

Cognitive Development, the process of acquiring intelligence and increasingly advanced thought and problem-solving ability from infancy to adulthood (Dictionary.com Unabridged (v 1.1).

Comp or Comprehensive, Comp's are made to see what a prospective design project will look like for example the layout of the image, use of color, the size and the paper that will be used. It is also called a dummy (http://www.graphicdesigndictionary.com/terms-comp-comprehensive.html).

fMRI, Functional Magnetic Resonance Imaging scan. Functional magnetic resonance imaging (fMRI) is a relatively new procedure that uses MR imaging to measure

the tiny metabolic changes that take place in an active part of the brain (Solso, R. 2001).

Metaphor Theory, A theory that suggests that learning and understandin g is done as an individual makes comparisons from experiences. New realities are created as an individual makes new comparisons. G. Lakoff and M. Johnson's *Metaphors We Live By* (1986).

Rubric, A scoring tool that lists the learning objectives of an assignment or task. From it, participants are able to determine what conditions are important in the activity and how they will be assessed.

Thumbnail, The first small sketch of a creative process. It is quick and contains little detail. It is done often as a visual reminder of a creative solution to a problem. A thumbnail is a small version of the original image (http://graphicdesigndictionary.com/t.html).

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Abstract

In 1956 Benjamin Bloom introduced his theory of 'Mastery Learning' and authored the *Taxonomy of Educational Objectives*. His taxonomy identified three overlapping domains: the cognitive, the affective and the psychomotor. Although this theory has been embraced by many educational disciplines, studio coursework in art, design and illustration is still predicated by practices established in eighteenth century traditional psychomotor 'see and draw' instruction. Illustration calls for achievement in the mastery of hand skills and the ability to visually communicate a message to a predetermined audience. This study examines the results of beginning and advanced illustration students by using curriculum designed with *Bloom's Revised Taxonomy*. Literature on the relevance of cognitive learning environments was reviewed prior to a mixed qualitative-quantitative study. This study aims to provide evidence to support the application for this pedagogic method. Findings of this research may help illustration instructors when designing their curriculum and to assist students while creating their illustration work.

Introduction

Assessment and reflection are necessary requirements that must be undertaken in order to improve the performance of the illustration student. Traditionally at the undergraduate level, teachers of this field of study initiate an assignment or project by establishing the parameters of the work that is to be produced and pass that information on to the student who then performs that designated task to the best of their ability. Upon the deadline of the project, the traditional method of assessment of the student's completed work is carried out in presentations, oral critiques and classroom discussions. Research shows that this pedagogy is rooted in the history of the early fine art studio practices. Though the mixture of these long-lived evaluation techniques may vary depending on the teaching style of the instructor, these methods are still the most common forms of evaluative exchange between the teacher and student today. Without question, demonstrations are valuable to students in the studio environment. For example, the student may benefit from learning a variety of rendering techniques or how to use materials correctly as demonstrated by the instructor. There are two areas of concern that can be difficult for both the student and teacher to resolve in this pedagogical model. These areas are miscommunication during the process and the other is subjective evaluation afterward.

This study was conducted in order to test the use of an alternative method to curriculum design pertaining to illustration studio instruction structured by a cognitive developmental pedagogic approach.

A Brief History of Instructional Design

Instructional design began during World War II when the military saw the need to improve the performance of trainees. Psychologists and educators, including Robert Gange, Leslie Briggs, and John Flanagan, began to influence the way the military conducted training based on their instructional principals developed from research and theory of human behavior (Reiser, 2001). A testing methodology began that helped assess which individuals would be better suited for particular training programs. In the study, *A History of Instructional Design and Technology: Part II: A history of Instructional Design*, Reiser includes a personal communication by Gange that describes the situation of the military at one point of the war. "The failure rate in a particular flight training program was unacceptably high" (Reiser, et al, 2001) Psychologists, intervened and were able to evaluate incoming candidates by using pretest methods that help to screen applicants. As a result, candidates scoring poorly were redirected to other areas that better suited their potential aptitude. The percentage of personnel who were then able to complete the program improved (Reiser, et al. 2001).

Following the war, psychologists continued their work in studying instructional problems and how individuals learn. The concept of writing 'objectives' to identify the goals of the learner came about from an earlier behavioral movement of the early 1900's. This form of instruction, combined with the advances made during WWII, found renewed interest and support by the cognitive psychologists in the 1950's. Benjamin Bloom and his colleagues published the *Taxonomy of Educational Objectives* (Bloom, Engelhart, Furst, Hill, & Krathwolh, 1956). As a result of the psychologist's study, a taxonomy or classification of learning objectives was established describing the learner's behavior.

According to the taxonomy, the learner's achievement was thought to be hierarchic and six categorical domains were created identifying the behavior a progressively learned accomplishment. These original six domains included: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.

Skill	Definition	Key Words
Knowledge	Recall Information	Identify, describe, name, label, recognize, follow
Comprehension	Understand the meaning, paraphrase, a concept	Summarize, convert, defend, paraphrase, interpret, give examples
Application	Use information for concept in a new situation	Build, make construct, model, predict, prepare
Analysis	Break information or concepts into parts to understand more fully	Compare/contrast, break down, distinguish, select, separate
Synthesis	Put ideas together to form something new	Categorize, generalize, reconstruct
Evaluation	Make judgments about value	Appraise, critique, judge, justify argue, support

Table 1. Bloom's Original Taxonomy of Educational Objectives 1956.

(Bloom, B.S., Engelhart, M. D., Frust, E.J., Hill, W. H., & Krathwohl, D.R., 1956).

Another important theoretical application pertaining to instructional design came from psychologists like Robert Glaser and Michael Schriven. In 1962, Glaser offered a testing approach referred to as '*Criterion-Referenced Measures*.' This means of testing bases an individual's particular behavior or ability against a pre-established set of criteria rather than ranking one individual against another. Glaser indicated that these tests could be used to assess how well a student performed at the student-entry and student-exit levels of an instructional program (Reiser, et al., 2001).

Later in 1967, Michael Schriven proposed that learning materials needed to be evaluated before distribution. In effect, the tests were tested prior to circulation. Subject matter experts with little or no proof of effectiveness developed content of the materials, prior to this scrutiny. Schriven named his tryout and revision process *formative evaluation* and *summative evaluation*. As the names implies, formative evaluation refers to the instructional material as it is being developed and tested and summative evaluation refers to the instructional material as it appears in its final form (Reiser, et al., 2001).

In the seventies and eighties, the number of instructional models increased building upon the works that came before. According to Reiser (et al., 2001), more than 40 instructional models were identified during this period. Some were developed using the technology and media of the time as a means of information delivery. Business began adopting many of the methods used in academia after seeing marked improvement in the performance and productivity of individuals. Cognitive theory pedagogies were embraced by what was traditionally deemed as the more left-brain fields of study. The Liberal Arts and Sciences found Bloom's theory of cognitive evolution easily applicable in their classroom, while the Fine Arts loyalists maintained tradition.

The questions remains then, can illustration, which falls safely in the category of the Fine Arts, benefit from a curriculum approach that is based on cognitive design theory like that which Bloom offers? Benjamin Bloom has provided higher education an indispensable tool in curriculum development and it seems that his taxonomy has weathered well over the past fifty years without change, until recently.

Dr. Lorin Anderson, a former student of Bloom's and his colleagues published an updated version of Bloom's Taxonomy that takes into account what many believe is an

improved form that may have an impact on teaching and learning (Retrieved from Intel, http://download.intel.com/education/Common/en/Resources/DEP/skills/Bloom.pdf May 1, 2006).

Unlike the 1959 version, the revised taxonomy differentiates between "knowing what" the content of thinking, and "knowing how," the procedures used in problem solving (Intel, et al., 2006). The original taxonomy described knowledge in terms of being an object or possessive while the revised taxonomy sees knowledge as a state of action. This distinction in the approach to this classification now includes four categories within the *Knowledge Domain*: *factual, conceptual, procedural, and meta-cognitive*. Factual knowledge categorizes the learner as being able to recall information. Conceptual knowledge is the ability of the learner to perform classification and understand larger concepts. Procedural knowledge includes algorithms, heuristics or rules of thumb techniques, methods and knowing when to use them. Meta-cognitive knowledge refers to the ability to manipulate these subsystems and classifications (Intel, et al. 2006).

In addition to the separate creation of the Knowledge Dimension, the standard hierarchic classification of the previous version of the Taxonomy has been altered. The revised version now advances from *Remembering, Understanding, Applying, Analysis Evaluation* to *Creating.*

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual	List	Summarize	Classify	Order	Rank	Combine
Conceptual	Describe	Interpret	Experiment	Explain	Access	Plan
Procedural	Tabulate	Predict	Calculate	Differentiate	Conclude	Compose
Meta-Cognitive	Appropriate Use	Execute	Construct	Achieve	Action	Actualize

Table 2. Bloom's Revised Taxonomy. (Anderson, L.W., & Krathwohl, Eds., 2001).

As in the previous version, descriptors help the instructor identify behavior. The change that has perhaps the most impact on curriculum design pertaining to illustration instruction may lie in the new *Create* domain. This was not previously included in Bloom's original Taxonomy but is now considered to be the highest level of learning achievement in Anderson's reordered version. To accomplish the *Create* tasks, learners generate, plan and produce at a *Meta-Cognitive* level, being able to orchestrate the lower domains at will. (Intel, et al. 2006).

This change may describe more accurately the process related to the creation of art, design and illustration. In Bloom's first model, the act of creation was loosely described in the synthesis domain level. In the process of evaluating a problem (like concluding that the image needs to be more green) which is followed by the illustrator's ability to combine (mixing yellow into the blue paint on the canvas) does in fact make a better taxonomical fit. The previous model would have left the illustrator with an evaluative assessment but no option to remedy the problem or for a further means for action. More discussion on the theories of artistic, design, and illustrative thought process will be done later in this study.

With as much existing support as there is for the use of Bloom's first taxonomy in so many curriculums, why isn't illustration curriculum benefiting as a participant of this pedagogy? The answer may rest in the historical and foundational origins of art and design.

The Trouble with Illustration

Illustration it seems is somewhat problematic, in that higher educational institutions have difficulty exactly knowing where to place it as a course of study. Is it art or is it design? Art and design can be seen both claiming it as a component in their curriculum. Within both of these disciplines, illustration may appear as a single course within a program or perhaps an area of emphasis within another. Occasionally, it may show up as its own autonomous entity within a college, as in the case with Parsons School of Design in New York (Parsons, retrieved on April 12, 2006. http://www.parsons.edu/departments/index.aspx). It is a hybrid of both with foundational roots in art but with rationale expressed in design. Regardless of how it is applied into the art and design education construct, illustration shares an important role with both of these entities as well as its studio origins.

The Ecole des Beaux-Arts in France is attributed as being the seed from which art and design studio practice has grown (Cuff, 1991). In the school's esteemed 350 year history the emphasis has been to preserve the classical ideologies for future generations within two curriculum structures, 'Academy of Painting and Sculpture' and the 'Academy of Architecture.' After 1968, the architecture department separated from the school and the name was changed to, Ecole Nationale Superieure des Beaux-Arts

(Wikipedia, retrieved April 12, 2006 from http://en.wikipedia.org/wiki/ecole_des_Beaux-Arts).

The Golden Age of Illustration is defined as being from 1800's until shortly after World War I when newspapers, magazines and illustrated books dominated as media sources and benefited from improved image reproduction technology. Artists were hired to illustrate, via drawings, paintings or photography, imagery that supported text in print. (Artcyclopedia, retrieved on April 2, 2006 from http://www.artcyclopedia.com/history/golden-age.html).

Illustration's purpose remains unchanged as a visual communication tool with an intended message, regardless of whether or not it is used in harmony with other design elements or singularly. Today, the illustrator's palette has broadened to include the digital realm. Illustration remains an important element in advertising design and can communicate a message as easily as type.

In curriculum design, the discipline of illustration may benefit from the cognitive developmental theories and studies that are being conducted today globally. While illustration itself has not been specifically identified per say in these studies, by remembering the connection illustration has with art and design, a reasonable argument supporting the case for the integration of creative cognitive theories can be made.

Historically, coursework considered to deal with theoretical reasoning has benefited from the cognitive theories of intellectual development beginning in the early 1960's. Art and design education curriculum however has been slow to apply these theories and remains overwhelmingly loyal to the traditional studio model of "see and draw" instruction, especially in the areas of drawing, painting and illustration. While it is

not the purpose of this investigation to criticize the traditional model of studio instruction, it is important to note that there have been many significant discoveries in the way adult learners learn and specifically how artists and designers view visual information, process that information and expound on that information to create. This investigation will examine four areas pertaining to teaching illustration to determine if there is evidence to support a cognitive approach to curriculum design for this field of study, they are; studies that support cognitive curriculum re-design in the art and design classroom; the physiological aspects of drawing in the artist/designer's mind; the cognitive aspects of sketching and drawing and the cognitive development of artists and designers.

Support for Curriculum Re-design

Rivka Oxman (1999) discusses the implications cognitive structure has in industrial design in her study, *Educating the Designerly Thinker*. Oxman claims that method of instruction established by he Ecole des Beaux-Arts is the weakest element within the framework of the traditional studio instruction and that the evaluation process rests primarily with the final solution and not the process (Oxman et al. 1999).

The investigator believes that by examining and understanding the way designers think, the student can be better directed to promote a richer creative process. Oxman identifies what she feels to be a better method of instruction or 'Cognitive Design Media.' This method of learning is based on the student's exploration, parameters of the design problem and the foundation of design knowledge structures as it applies to the potential solution (Oxman et al. 1999).

From an earlier study, Oxman used her proposed "Re-representational Theory" as a cornerstone to tested upper level undergraduate students. In this study, she concluded that the designer progressively developed through re-representations to a point that it becomes conscious knowledge and then is used as part of the structure that ultimately supports the design solution. (Oxman 1997) The study also addressed the theory of "Creative Cognition". This term referred to visual and conceptual content in global strategies of design thinking. This theory was based on the graphical, conceptual content and creation of knowledge structures. Environment plays an important role in influencing the outcome to a design solution.

Additionally, Oxman felt that understanding the process of thinking in designers could influence the content of the curriculum. With this understanding, better models for instruction could be created that work harmoniously with the design processes, enhancing the design student's performance. The hypothesis was based on the Constructionist Theory, which proposes that knowledge is obtained through construction or the building of experiences and knowledge schemes; or, through construction representations of design thinking, the more the student's design ability increases (Oxman et al. 1999). Therefore, learning in design could be considered a process of knowledge acquisition. The author created a three-tiered taxonomy involving three blocks of learning that related to designers to support her theories. They included, Issue-Content-Form.

The experiment was conducted at the Technion - Israel Institute of Technology to test the hypothesis. The upper level students were from the industrial design program and were asked to perform modeling tasks online after receiving the introduction to the Issue-Content-Form (ICF) taxonomy. Students were then asked to represent typological

knowledge as a set of generic representations which are associated with specific problem types, and to organize the variables of the type in a hierarchical order of which the highest level is that of the schematically represented class description (Oxman et al 1999). The students were then asked to describe the steps in how they progressed from one possible solution to another.

Based on the findings, Oxman concluded that it is now possible to demonstrate that the deviations in the process development can provide a medium for learning. The author claims to have witnessed depth of learning in the development of the modeling skill and efficiency in improvement in the modeling representation. Oxman suggests that this approach to instruction transcends the conventional methods of classroom and studio and that special design learning environments must be developed which can enhance and supplement formal education and foster personal design learning. The student learns from their mistakes in the process of doing.

When applying the ICF model, the author explains that these categorical blocks represent chunks of design knowledge and were used by the student to make metaphorical and analogical relationships during the investigation. Additional study is needed to determine which one might likewise be a supporting taxonomical structure for illustrators like the ICF Taxonomy that Oxman developed for her industrial design students. This may be so given that both share common conceptual practices between both disciplines.

In Connecting Art, *Learning, and Creativity: A Case for Curriculum Integration*, by Julia Marshall, the author discusses the role of teaching techniques in art education and that substantive integration should be an important factor in developing an art

curriculum. Marshall combined theories of cognitive science and metaphor theory to demonstrate how this process promoted learning and creativity. The author's hypothesis was that substantive art integration harmonized with contemporary postmodern thought in art education and represented a strategy for teaching art in a post modern way (Marshall 2005).

To support her hypothesis, Marshall discussed the theories of neural-network theory by Hopefield and Martinade (1995) regarding the physical processes of the brain, Piaget (1963) on how learning occurs in the mind and how learning is an organizational information process by Lakoff and Johnson's (1999).

Marshall also called attention to Freedman (2003) who stated, "Knowledge is no longer thought of as divided into discrete domains, but is seen in terms of an integrated system. Freedman (2003) finds justification in these theories for embracing a visual culture as a conceptual grounding for art learning and views thematic/conceptually-based curriculum as a methodology for exploring art in context. Efland (2002) also found justification for curriculum integration as a way of advancing learning: If the aim of education is to fully activate the cognitive potential of the learner, ways have to be found to integrate knowledge from many subjects to achieve a fuller understanding than would be provided by content treated in isolation.

In regards to creativity and learning, Marshall discussed the theoretical principles of Koestler (1990) and Hummel and Holyoak (2002). Koestler believes that creativity as a juxtaposition between previously unassociated entities, while Hummel and Holyoak propose creativity to be rooted in analogous thinking (Marshall et al., 2005). Learning can be divided into two categories: non-relational and relational. Non-relational learning

is learning about objects as they are in themselves. Relational learning is learning about objects in relationship to other objects (Marshall et al., 2005).

Substantive curriculum integration, then, requires educators to understand how the mind perceives, learns and conceptualizes through analogical thinking, metaphor and schema-construction (Marshall et al., 2005). Marshall believed that in light of postmodern concepts, combined with cognitive and metaphor theories, substantive art integration offered a contemporary pedagogically sound approach to teaching. "Cognitive science and metaphor theory give us clear descriptions of learning and creative thinking that help teachers to recognize these processes when they occur in student work, and to design integrative curriculum that catalyzes and nurtures these processes (Marshall et al., 2005).

Leslie Cunliffe's qualitative paper, *Learning How to Learn, Art Education and the 'Background'* echoed this theme by proposing similar avenues for designing curriculum. (Cunliffe 1999) This researcher recognized the importance of cognitive thinking and what affect it might have on art instructional material in practice, teaching methodologies and assessment and proposed a model for explaining, interpreting and valuing art.

Cunliffe rejected what he described as "privileging risk-taking or the playfulness of primary process thinking" for an approach in favor of cultural and cognitive awareness of backgrounds. (Cunliffe 1999) The author made historical connections to some of what he felt were false dichotomies associated with traditional art education like; culture/nature, cultural/imposition, reason/feeling, left brain thinking/ right brain thinking, to name a few. Cunliffe's study reviewed the idea that schemata are the

cognitive structures that linked the mind to the world, so that new understanding could emerge from previous constructs. A type of bipolar model for approaching curriculum was offered in order to direct the learner through two types of cognitive routes, the *Making Domain* and the *Contextual Domain*. According to Cunliffe, these two types of content for the curriculum should be selected: content for understanding how a variety of art is made and content for understanding why a variety of art has been made in different cultural contexts, and parameters that govern explaining, interpreting valuing and criticizing such art. (Cunliffe 1999). The *Making Domain* and a *Contextual Domain*, each contained four propositions. The Making Domain, described developmental cognitive map for making art and is comprised of; 1) using language and concepts relative to the creator's art and to his 'background', 2) using language and concepts to acquire 'background' meta-cognitive skills for the artist's self evaluation, 3) using a variety of investigation and making processes, techniques, and materials for developing cognitive routes for making art, and 4) experimentation with different elements and their relationships to create meanings (Cunliffe 1999).

In his study, Cunliffe also cites S.E. Mitchell's who concurred that impressionistic methods of assessment are riddled with problems. Cunliffe and Mitchell directly challenged the pedagogy practice founded by the Ecole des Beaux-Arts. Mitchell felt that lectures are allowed, "to exercise god-like power through impressionistically reading motives and values into students' work, resulting in 'discourse being riven with conflict." (Mitchell 1996) It is for this reason why Cunliffe provided his two domain taxonomy for relating to curriculum, pedagogy and assessment. "When all three are practiced in a

mutual and systematic way, they have the potential to create a powerful trinity of learning (Cunliffe et al.,1999).

While there was no quantitative evidence supporting Cunliffe's proposal for this two pronged method for learning and assessment, the need for validating a reconstructive approach to art education remains. There are many studies today that support this investigators theory that cultural influences and history play an important cognitive part in the creation process, regardless of whether or not the artist/designer is aware of them.

While Oxman, Marshall and Cunliffe differ in their rationale for change, all agree that a cognitive method for the dissemination of information, understanding and assessment would improve design and art instruction by incorporating some method of cognitive design. Contrary to the traditional studio methods, the end result is no longer the only phase to be reviewed. These three investigators identify the importance of process and that process is no less significant than the final result. If the purpose of curricula is to provide information and assist the student in developing and advancing their skills from the entry level to a proficiency level established by objectives or standards, it would seem that an understanding of the cognitive mechanisms that take place within the mind of the artist or designer would be beneficial as mentioned by Oxman.

Another necessary element in assessing the effectiveness of the cognitive curriculum design is the rubric. While referred to as a tool for cognitive development, by Cunliffe, the rubric may be useful in assisting the student to understand better the requirements and learning objectives of the illustration lesson. The rubric may also be

used to empower the student, affording them the means to evaluate their own work as they examine the categorical objectives and descriptions.

Oxman and Marshall both include physiological studies to support their argument and draw the connection between cognitive activity, design and artistic process. On going neurological investigations do seem to support their positions. From an investigators point of view, observation of the artist, follow-up interviews and analysis of the sketches are all limiting because the researcher cannot see how, where or when cognition takes place in the mind as it actually happens. Until recently, the observer trailed in the wake, searching for clues as to how the higher cognitive functions of the designer, artist and illustrator worked.

A New Look Into the Visual Cognitive Mind

By using modern technology the cognitive process and artistic execution can be seen working together. Not only is technology helping researchers understand how the mind works in processing this information, it may also be of assistance in understanding the differences between the cognitive process of artists and non-artists.

In the study by Robert Solso, two individual's brain activities, an artist and a novice, were examined as both were given the task of drawing while undergoing a functional Magnetic Resonance Imaging scan (fMRI). Both participants were given the same task for the experiment, sketching faces.

The fMRI scans indicated that, "the artist showed activation of an area of the brain that is implicated in facial processing" (Solso 2001). Solso also cited previous studies that have identified specific areas of the brain that are involved with object viewing, color stimuli, word processing semantically, working memory and other

cognitive processes. These methods involve measuring changes in blood flow and are appropriate for assessing both the structural sites and the functional processes involved in cognitive tasks. (Solso et al., 2001).

The investigator also saw that the area of the brain (right middle frontal area) was more active in the artist. This area of the brain was reported to deal with more complex associations and manipulation of visual forms. From this, Solso concluded that the artist was able to expend more energy dealing with association and processing the features rather than spending energy and time with recognition of the face. The artist "thinks" portraits more than he "sees" them.

Other observations discussed eye movements in that "the fixation of the artist while drawing was twice the duration of those when he was not, and that his patterns of cerebral activity (and other patterns) differed from those of novice painters" (Solso et al., 2001) Solso acknowledged that there are problems with his investigation. The technology is confining to the participants and the sample size of his study currently includes only two subjects.

While this study didn't offer and explanation as to how these differences occurred between the novice and expert, it did conclusively show that there are designated locations devoted to specific visual activities artistic performance and the activity levels between the two study participants was significantly different. The transformation of the inexperienced artist brain into the season professional may someday be seen as fMRI technology is used more and becomes less intrusive to the subject performing these artistic, illustrative or design activities.

Stephen Kosslyn is one of the investigative pioneers using fMRI technology to compare visual mental imagery and cognitive development. Some of his earlier work used Positron Emission Tomography or (PET) in order to monitor blood flow as the subjects performed visual and perceptual tasks . (Kosslyn & Thompson et al., 1997). Using PET, these researchers were able to see the brain increase the blood flow to areas of the subject's brain that were used to perform sketching and drawing activity.

Later, the question of whether or not the brain uses the same space for visual and perceptual tasks was the main question of the investigation conducted by Giogio Ganis, William L. Thompson and Stephen M. Kosslyn and presented in their study, *Brain Areas Underlying Visual Mental Imagery and Visual Perception: an fMRI Study* (Ganis, Thompson, Kosslyn 2004). The hypothesis was that there would be a substantial overlap when the brain performed these two tasks. The researchers' goal was to the degree of shared neural activity by the brain during visual mental imagery processing and visual perception process.

Twenty participants were selected in all. All were right-handed and had no prior history of neurological disorders. The participants mean age = 21 years consisting of 8 males and 12 females. Five results were excluded from the study due to equipment failure or uncorrectable motion artifacts.

The findings of the study supported their initial hypothesis. The researchers found that there was substantial overlapping between areas of the brain that used to perform visual perception and mental imagery tasks. The maximal area of overlapping occurred in the parietal cortices, but the amount of overlapping varied. Surprisingly, the study showed that there were regions engaged by visual imagery that were identified as subsets

of activity during engaged visual perception. Earlier studies performed by Kosslyn and Thompson failed to report this because of the lack in continuity of the tasks performed by participants in earlier examinations. The authors conclude, "the overlap is neither uniform nor complete: visual imagery and visual perception appear to engage frontal and parietal regions in more similar ways than occipital and temporal regions. This finding may indicate that cognitive control processes function similarly in both imagery and perception, but—perhaps counter-intuitively at least some sensory processes may be engaged differently by visual imagery and perception" (Ganis, Thompson, Kosslyn et al., 2004).

Cognitive studies that are using this kind of technology are relevant to this investigation because they demonstrate the relationship between areas of the brain that are used to see, perceive and draw. They also provide a means to see and record the differences between the novice and the advanced artist. In comparison, it would be logical to expect that a student who first enrolls in a weight-training program would have a change in his/her physique by the end of the semester, provided that they participated regularly. Their progress could be recorded because these changes are happening are externally. They are observable and measurable differences in development. Similarly, differences in cognitive activity have not been seen until the application of the fMRI.

Another study conducted by Chris Frith and John Law, *Cognitive Physiological Processes Underlying Drawing Skills*, attempted to show that drawing depends upon the combination of a number of simple and largely independent processes and described what is known about the brain systems underlying them (Frith & Law 1995). The process of drawing is immensely complex. The first distinction is made between the input and

output, what the artist sees, how that information is perceived and how the artist interprets and translates that information in the psychomotor aspect of drawing. The authors also consider the image formed by the "inner eye" of the mind. Frith and Law claim that "neuro-physiological studies reveal that there are not one, but many internal representations present simultaneously in the brain." These areas concerned different aspects of the object or the movement that were represented and occured at different levels of abstraction.

Spatial orientation is relevant in discussing how the eye, hand and brain work together. Frith and Law reported that information enabling us to identify the form on an object is stored separately from information enabling us to make the appropriate movements to reach an object and that, information about the position of the objects in space can guide our movements, even when the information does not reach conscious awareness (Frith & Law et al., 1995). Therefore, it would seem that brain fills a gap from the visual interpretation areas and the psychomotor activity areas of the illustrator, designer or artist. This is a remarkable especially when considering that the mind is also unconsciously affected by other cultural, historical and environmental, in addition to, conscious cognitive decisons simultaneously taking place in the drawing process. Additionally, Frith and Law contend that hand movements in making the drawing may be controlled by information about the scene of which the artist may not be fully aware. The final result may be better than what was intended or worse.

Researchers involved with this kind of investigation using brain imaging are in harmony in singing words of caution proclaiming that more investigation is needed with newer technology as it becomes available. This kind of physical investigation into the

brain's activity continues on today. One area that has ignited great debate in our society regarding the interpretation of fMRI testing comes from studies attempting to determine if there are differences in male and female brain functions.

While it is not the intention of this study to fan the fires of debate regarding differences that may exist between men and women cognitively, it would be interesting to investigate any distinctions that there might be and how they might be relevant in the learning process of male and female artists, designers and illustrators. In order to nullify these differences, if they do in fact exist, coursework objectives should be presented to the students in several forms in order to accommodate the preferred learning style of the individual. More will be discussed on this in the Methods section of the paper.

Sketching and Drawing as an Integral Part of the Cognitive Process

Seeing sketches and drawings provides an opportunity to witness the creative mind of the artist or designer and may help explain the differences between the varying degrees in cognitive abilities from novice to the expert.

In the quantitative study, *Sketching as Mental Imagery Processing*, by Manolya Kavakli, the findings identify differences between the novice and the expert designer and suggest that drawing and sketching is a key facilitator in those distinctions. Kavakli hypothesis is, "the reason for the imbalance in cognitive activity between novice and expert designers in the conceptual design process is the rate of information processing driven by the relative experience in drawing production and sketch recognition" (Kavakli 2001).

Kavakli believes that mental imagery can often function in equivalent ways to real objects and forms. There are many studies to support this theoretical basis as sited in Kavakli's report and like Frith and Law presented in this review. Additionally, Kavakli states that many of same neurological systems are used when we recognize and identify objects as when we implement visual imagery. These systems include visual, spatial, verbal and propositional/semantic. And in the conclusion of her literary review, Kosslyn, as mentioned in supporting her assertion that there are only two ways mental imagery is created, one is through a perceptual image or one can activate information stored in long-term memory (Kavakli et al., 2001).

With this foundation of mental imagery hypothesis, Kavakli conducted a quantifiable experiment using two designers, one novice; a second year architectural student, and one expert; an architect with 25 years experience. Analysis for the study was conducted using the retrospective protocol analysis. Both participants were given the same design task. Using the protocol analysis study and after coding the designer's actions, Kavakli was able to evaluate the sketches using concepts from mental imagery processing.

Kavakli found that the novice's cognitive activity started with a peak and continued to drop during production, while the expert's cognitive activity continued to rise during the conceptual design process. Image generation in the novice was slower and paralleled the cognitive process of the individual. In contrast, the expert's design protocol was 2.85 times as rich as the novice's in terms of actions. The novice focused more on discovery of implicit spaces than the expert. The expert designer was ale to provide three times as many alternatives and pages produced than the novice.

The study suggests that the richer the sketch is during the developmental process, the easier it is for the designer to make functional analysis.

Because mental images are retained only with effort and cannot be retained long enough to reorganize them, the sketch becomes all the more valuable as a tangible lasting representation of the thought. If the novice designer is unable to translate adequately his thought process during development, the designer becomes less prolific in the creation of the sketches and struggles to find alternative solutions.

If Kavakli's hypothesis is correct, then the more advanced the skills are of the artist and designer, the faster the cognitive process of the individual becomes. One might conclude that improving the drawing skills of the artist/designer would improve the cognitive capabilities of these individuals. Training a student to show ambiguity in the first initial stages may be more liberating in making distant associations. Adding more content to the sketches as the designer continues to investigate will assist the designer towards the completion of the final creative solution.

Although Kavakli's study only includes two participants, its findings are in agreement with those observed in Pamela Schenk's qualitative study, *The Role of Drawing in the Graphic Design Process*. (Schenk 1991) Schenk takes a more practical approach by studying the uses of drawing in the graphic design field. These sketches are used for visual communication between; the client and designer, senior and junior designers, visual markers or notes for the designer in the creative process and supports visual literacy, perception and visual memory.

"The importance of a designer's capacity to use drawing effectively was found to be particularly crucial when passing on the information gained during briefing sessions to

other members of the design team" (Schenk, et. 1991). Supporting Kavakli's conclusion about the cognitive applicable differences of sketches, the more advanced the drawing was by the senior designer to the junior, the less creative input was allowed by the junior designer. In addition to the ability to sketch and visually communicate, the majority of the respondents agreed that it was important for the designer to have an understanding of accurate historical styles. "This type of cognitive ability was described as necessary when confirming the relevance and accuracy of visual images, and is in agreement with Garner's finding on establishing 'relationship between graphic ability and cognitive development" (Schenk et al., 1991).

Schenk observed that drawing was a very significant tool in the beginning analysis of a project and that the form of the drawing is generally less defined requiring less than advanced drawing skills. Designers also included notes, photos and sometimes sketches to help support the sketches meaning. During the synthesis portion of the process, the drawings required a "…greater degree of drawing skill in the conventional sense becomes necessary for the performance of tasks involved…" and that, "during the course of synthesis and development, a shift of attention from concept to format can be seen to take place" (Schenk,1991).

In the process, drawings were produced specifically for evaluation purposes. The majority of those interviewed described the importance of drawing and led Schenk to the conclusion that the use of drawing is paramount in communication because from these sketches, evaluation, adjustment and redirection are possible in the group. Changes in the design solution resulted in additional drawings that reflected a more relaxed style similar to those that were done in the analysis stage of the process. The author states, "Although

right side of the brain activity has become associated with the development of drawing ability, what are commonly termed “whole brain” theories of creative activity have been found to be more applicable in interpreting some of the findings of the study. Drawing is important to visual memory, the designer in this case is able to visually translate memories and combine his or her existing knowledge in analogies. Drawing, in this sense is directly related to what has been established as creativity. As described by Kavakli, (2001) The creative thinking process is defined as the “forming of associative elements into new combinations, which either meet specified requirements or are in some way useful.”

Schenk also used studies done during the late 70’s and early 80’s Hillier, Musgrove and O’Sullivan that offer the theory that a paradigmatic shift takes place supporting an argument that proposes a model for the re-definition of the design process, replacing the analysis/synthesis/evaluation model with one of conjecture-analysis. Schenk feels that this model is better description of the designerly approach of ‘pre-structuring problems…by a knowledge of solution types’ (Schenk et al., 1991).

The investigator recorded the design preparation phases responsible for the conceptualization and recorded rationales for the creative submissions in the sketches. The main creative phase includes analysis, synthesis, presentation, evaluation, and revision. Production, the last phase, includes commissioning artwork and the preparation for dissemination. These last phases of the projects were not the focus of the study here.

In keeping with Bloom’s original cognitive hierarchy, when new information is supplied to the designer, information becomes knowledge. This knowledge is understood and applied. The application of this new information is then analyzed and used to make

abstract correlations in new ways based on the designer's historical, cultural, environmental, educational influences and cognitive efforts. Finally, the conclusion of this new synthesis is addressed and evaluated. Granted, assessment may take place almost immediately and it may appear to the observer that many of these cognitive categories are taking place at once or some not at all, however within the framework of the designer's mind evaluation is based on the supporting building blocks of the cognitive taxonomy.

Design by Re-Representation: A Model of Visual Reasoning in Design, by Rivka Oxman, offers a model based on empirical studies towards understanding the phenomena of how designers think, interact, and build upon their own discoveries.

Oxman labeled the sketch as "the basis of a visual and mental transaction between the designer and the representation, which evokes a discrete graphical response" (Oxman 1997). Supporting this position, Oxman stated that, according to Rudolf Arnheim (1969), cognitive operations in perception is designed to include distinguishing structural relationships of the images in the design representation. This includes the interpretation and conception of such structures of relationships (prototypes) (Oxman et al.,1997). The study used the following constructs to develop its theories in the investigation that frame the relationship between the sketch and the designer: (1) There is a "transaction between conceptual knowledge structures through a visual representation medium. (2) "The Re-representational Theory" is offered to explain the cognitive abilities enabling the sequential evolution of graphical representations. (3) A construct relevant to cognitive and computational approaches to design as Case-Based Design was created, (CBD) and is referred to as "The Re-representational Model" (Oxman et al., 1997).

The study included architectural students who were given a task of reducing an architectural plan by 20%. The number of participants and level of education is unknown. Each designer in the experiment was requested to sketch in detail design solutions. The subjects were also asked to record the rationale for each of the design changes.

From the results the author concluded that designers are able to extract variations based on their own domain knowledge. Also the subjects were able to categorize their graphic manipulations conceptually despite the fact that drawings tend not to provide explicit representational information to support such decomposition. Furthermore, the graphical re-representaion of a design exploits this same knowledge in creating new representations (Oxman et al., 1997).

Oxman's also concluded that designers utilize a personal hierarchical order of underlying conceptual structures such as grids, construction lines and others and that abstract knowledge may be considered in an inter-related system of domain specific representational structures. The author suggests that the designer internalizes an evaluative process with each new sketch prompting new strategies and possibilities.

While Oxman's model does not specifically address Bloom's Taxonomy, it does stress that the designer's methodology and progressive creative advances are based on his/her knowledge, experiences as a designer and knowledge gained from the successive drawings made by the designer's own creative process. Additionally, the investigator concludes that, "the establishment of the right representation may be considered to be a creative act" (Oxman et al., 1997).

In review of the studies discussed so far, the importance of sketching to cognitive development has been bridged. Even though the illustrator is not specifically examined in any of these studies, the overwhelming evidence supporting the important relationship of the sketch and creative process is made clear and the role of drawing and sketching as a fundamental component in illustration is documented virtually throughout the entire foundational coursework in art and design. Thus far, the sketch has been discussed as a visual marker for the creator, a visual language between other designers and clients, the embodiment of a cognitive thought providing path for the means to an end towards a final creative solution. All of these points stress the importance of drawing skills in conjunction with the cognitive ability of the creator. As a result, from this conversation between hand and mind comes the product of innovation perpetuated by one's own collective knowledge.

Cognitive Studies of Artists & Designers

If sketching is accepted as evidence that a cognitive process is happening in the designers search for an acceptable solution to a problem, is there evidence to suggest that the cognitive process likewise occurs in Fine Art? Because the position has been taken that illustration's origins come from Art, this question must be addressed in order to justify the same pedagogy for Illustration. Examples in art history may provide evidence to support the theory that drawing may enhance cognitive development as well.

Roberto Casati (2004) proposes the phenomena of a cognitive cultural awakening in, *Methodological Issues in the Study of Depiction of Cast Shadows: A case Study in the Relationships Between Art and Cognition*.

In Castati's qualitative study, about 1000 paintings and frescoes were examined that included primitive to increasingly elaborate cast shadows. The population of works that were sampled came from Italy, Netherlands and Germany and were painted between 1415-1515. Paintings for the study population were required to include shadows with substantially less luminance from the surrounding areas and a shadow terminator. The terminator was required to work in harmony with the other objects portrayed in the scene.

Castati argued that cast shadows offer an excellent source for insight not only into the cognitive development of the individual artist but also into the collective cognitive development of the artist community. This was determined by the progression of rendering techniques in the one hundred year span. "There was a sustained interest in shadow depiction in the early Renaissance that gave rise to a large number of pictorial experiments shadows are depicted to varying degrees of success…" Castati notes that after the Renaissance, the collective knowledge of having solved the issues associated with shadow casting were resolved and that discovered methodology was shared by the artistic community to the point where it became commonplace. "That is, painters were aware of the fact that there was a specific problem of shadow representation and a canon of techniques was shared that addressed the problem" (Castati 2004).

Obviously it was not possible for the investigator to interview the artist of that time and there were no written documentation were used to support his conclusions, however, Castati contends that the evidence is there to support cognitive development in the collection of works since shadow painting was not prevalent in other global cultures and "is not the automatic byproduct of some painting technique." Additionally, the author believes shadows were assigned to important objects in the paintings of this era and that

the artist must have assigned some importance to the object for it to be awarded with the additional attention cast shadow received .(Castati 2004) In this example as Castati demonstrates, it is possible to examine the evidence of the cognitive process of artists as it develops culturally as it is accepted and later modified by the artist's community.

Inversely, in his paper*, Quantifying the Unquantifiable: An Inquiry into the Design Process*, Robert Jerrard (1998) explained how external influences may effect the final solution in cognitive problem-solving for designers. Jerrard accepted G.A. Kelly's (1955) Fundamental Postulate, "that a person's process of thought is structured, and that the structure within a continually developing cognitive environment produces and conditions specific individual activity". In other words, our environment plays an important part in influencing the outcome of our creative expression. Kelly observed: The techniques revealed overall judgments and the designer's behavior was analyzed accordingly. In order to reveal aspects of judgment about identifiable criteria, it was considered necessary also to consider the individual's social, cultural, and industrial background (Kelly 1955).

The author also described what he referred to as the Personal Construct Theory. This theory attempts to identify outside influential elements in a persons environment that might have an effect on the individual process. This postulate allows for the unseen motivators associated with decision-making that cannot be recorded by the observer. The author refers to these influential internal motivators as "a conceptual 'schema' or structure of thought." (Jerrard et al.,1998).

Jerrard suggested that traditional methods of task analysis were not applicable to popular definitions of design; the level and complexity of cognitive aspects of the design

task defy description as an activity, and so other methods were are used. Here, the investigator argues that there are certain testing methods used for measuring cognitive functions that are better than others. Environmental factors may play a role in the performance of the designer, because as the investigator stated, individuals work with in a personal construct within their own environment. Consequently, everyone, designers included, created individual and unique construct in order to interact and understand their world. Jerrard's hypothesis reasons that it is to be expected that certain commonalities of judgment will occur from designers in a close proximity to the testing site (Jerrard et al., 1998).

In Jerrard's quantitative experiment, 12 textile designers were asked to identify and describe patterns and to explain the associations and differences within sample groups. His findings suggested that "some judgments in pattern groupings were influenced by gender, age and the amount of time spent within the service of the employing company" and that, "…exterior influences were present in the designer's judgments" (Jerrard et al., 1998).

Jerrard propounded the idea that his method of repertory grid testing, construct comparison and analysis can be used to predict the outcomes of other character influences such as education and cultural characteristics (Jerrard et al., 1998).

This issue may be important to consider in the cognitive evaluation of work. If this is true then the curriculum designer could take two paths when developing materials. One is to try to negate the unseen external influences from the designer's environment and the other would be to embrace the cultural and environmental differences. This is noteworthy because the college instructor teaching artists, designers and illustrators must

deal with varying degrees of pre-existing levels of art, design and illustrative achievement. The skills and abilities of the classroom may vary greatly based on experience and previous instruction.

Project Zero is a study founded at the Harvard Graduate School of Education by Nelson Goodman in 1967 that began investigating the skills and abilities, the perceptual and cognitive processes underlying the comprehension and production of art. (Perkins 1974) At the time of its inception, there were no other programs or studies of this nature being conducted. Today, this program investigates a variety of art venues including literary composition, musical composition and artistic skills in both children and adults. The program's mission is to enhance the understanding of critical thinking and promote the cognitive development of the arts and other disciplines individually and institutionally (Project Zero, retrieved February 12, 2006 from http://www.pz.harvard.edu/History/History.htm). Principal members of the project team's studies include self-directed learning, multiple intelligence, assessment and multicultural arts studies.

From this dynamic team of researchers, David Perkins piloted several long-term programs within Project Zero as Co-Director from 1972-2000. His investigative affinity was in the areas of creativity, problem solving and reasoning in the arts. His paper, *The Limits of Intuition*, (1977) discusses the notions associated with intuition and as a result identifies the relationship cognitive reasoning plays in artistic judgment. Perkins identified six different beliefs pertaining to intuition. (1) Intuition involves an unusual or rarely used mode of mental functioning. (2) It provides for judgments where reasons do not suffice. (3) It allows a surety and accuracy that reasoning cannot approach. (4) It

bears a special relevance to judgments about aesthetic effectiveness, a relevance that reasons cannot share. (5) Intuitive judgments dominate the process of art making judgments. (6) And most sweepingly, intuition and reasons are at odds-depending more on intuition implies depending less on reason and vice versa (Perkins, et. al., p.119).

Perkins defined intuition in his study as "those apprehensions for which one has no conscious reason," (Perkins et al., 1977). The study was conducted by videotaping artists and poets and interviewed the participants in the process of working. The author also explained some of the problems with having the artist discuss their work in the making. Initially, the artist was interrupted and often gave longer explanations as to why they were doing what they were doing. The interview practice was stopped and the study was resumed without the artist's working commentary, leaving Perkins to relying on the videotape to make his conclusions.

The author noted that in the decision making process, "protracted periods of manifest reasoning were rare," (Perkins et al., 1977). The artists didn't deliberate on most of the actions asking themselves "why" certain actions were done. "Seldom, did any participant list a number of reasons for or against choices, a process called reasoning," (Perkins et al., 1977).

Perkins states, "The most exotic examples of intuition have parallels in everyday perception and therefore psychological mechanisms of memory and pattern recognition in perception appear to be apt explanations for intuition." And that, "Intuition if it comes, will grow from accumulated experience." (Perkins et al., 1977).

Perkin's study is problematic in that his conclusions are based on the relationship of the work to the painter. There is not framework or evidence for Perkins to observe

other than the painting in process. The artist, in this case, leaves no tangible evidence of any progressive thought that might be taking place. This is different from the sketching and drawing studies discussed earlier in the review.

The reoccurring question of "Why?" would surely be asked when observing an artist at work as the investigator attempted to comprehend an artist's judgment in the creative process. From an observer's point of view, it would seem to be an appropriate question to ask but as Perkins mentioned, it interfered with the creative process itself. This would be a case where the interviewer comes between the artist and the art.

Yet, this is precisely what happens in the traditional apprentice and internship art and design studio environments and the argument could be made that the psychological mechanisms gained from these memories, pattern recognition and accumulated experience, as discussed by Perkins, would influence the cognitive thought processes of the student this way. In essence, Perkins is asking the same questions and making the same observations that a student might have of his/her instructor in asking, "Why did you choose this color?" If the answer from the instructor is, "because by adding yellow to blue, the result is green," then the information gained from this experience becomes knowledge for the student apply later.

Yet when considering the viewpoint of the artist, in the art making process does the artist ask, "Why?" If the concession can be made that painting rests in the *Create Domain* of *Bloom's Revised Taxonomy*, as the artist composes the paint on the canvas, "If – Then" posture may be a more accurate description as to what is taking place in the artist's mind. The instructive artist with higher cognitive ability already understands

what the outcome of applying yellow to blue in the painting will be and has evaluated the image prior to the paint's application.

In conclusion of the three papers of Castati, Jerrard and Perkins the observations regarding cognitive application in the studio environment as follows: (1) The observer cannot casually account for all sources of cognitive actions made by the creator--as seen in Perkin's study. (2) There is quantifiable evidence supporting the theory that cognitive problem solving may include educational, cultural and environmental motivators. (3) There is historical evidence to support the theory that cognitive development between artistic practices and accepted cultural influences occur.

In a perfect unbiased studio evaluation, the assessor would be aware and take into consideration all the influences, historical, environmental, cultural and experiential. Likewise, the student would be aware of their own existing predispositions prior to their actions during the creative process. Obviously, this is impractical and such scenarios do not exist in the framework of the conventional studio classroom, however the acknowledgement of unseen or "passive cognitive influences" might be useful to the curriculum designer.

Indeed, three paths of actions might be considered by (1) Developing educational objectives that attempt to minimize the unseen external motivators and exercise active internal cognition, (2) Developing coursework objectives that exploit the unseen motivators that influence student performance, or (3) Developing coursework objectives that take advantage of both. Artists and designers come with both a treasure trove and a tainted pool of knowledge that effects their actions and outcomes. The evaluation process happens not only with the instructor's assessment but internally from the student artist's

vantage as well. And in the educational environment, assessment can be confrontational and abrasive at times, especially in adult education.

The reassessment of adult educational practices began largely in the 1960's and continues today. Programs like 'Project Zero' supported by Harvard continue down the cognitive investigative path but are no longer alone. Academic institutions like the University of California are networking with others like the University of New Mexico in neurophysiological research. The University of Houston supports the Houston Studies in Cognitive Science Program and the Cognitive Science Initiative (CSI). Organizations like the DANA Foundation and DANA Alliance for Brain Initiatives are also committed to the cognitive research as it specifically relates to arts education. Indeed, it would seem that cognitive studies are coming into fashion in university and medical research. New cognitive theories develop and change as more about our own capacity to reason is understood.

Many of the investigators discussed thus far have had two fundamental questions propelling their studies, "How do artists and designers perceive the world visually and how do they respond to it cognitively in the creation process." It would seem logical that these two questions would be at the forefront of any effort revisiting curriculum design.

In 1999, the Florida State Department of Education reported their finding for educational assessment and enhancement. Bloom's taxonomy is used as the model to describe the assessment findings. Florida's publication cites, W. R. Daggett's 1997 paper, *Planning Rigorous and Relevant Instruction* (Daggett 1997). Daggett compares curriculum models from Asia, Europe, and the United States by the International Center for Leadership in Education. His findings state that the U.S. "objectives are initially

implemented at a very low level in both the knowledge and application continuums. When the curriculum objectives rise to the analysis level of the cognitive domain, real-world and real-life contextual application also rise for students. In addition, the higher the knowledge or thinking level provided through curriculum objective, the more applied is the learning in the U.S" (Daggertt et al., 1997). Daggertt notes that the U.S. does poorly in teaching students to apply real world knowledge.

The problem of insufficient upper cognitive curriculum development plagues not only the U.S. but Europe and Asia as well. "The European graph is similar to the U.S. graph, but their curriculum objectives put a greater emphasis on application at all but the highest knowledge levels." Daggertt also adds that Asian education places emphasis on basic knowledge and basic application with a much smaller emphasis on advanced knowledge and application.

In addition to the overview of status in cognitive development, the Florida State department's report acknowledged the theory of multiple intelligences proposed by Howard Gardner. As of 1999 eight intelligences had been identified: verbal/linguistic, logical/mathematical, visual/spatial, body/kinesthetic, musical/rhythmic, intrapersonal, interpersonal and naturalist.

Emphasis for curriculum design for illustration, art and design obviously rest in the visual/spatial intelligence realm. According to Gardner, "Visual/Spatial intelligence is object-related. The student who learns and has an affinity in this area possesses the unique ability to comprehend the visual world accurately and are able to bring a mental image to life in a concrete form" (Scherer, 1999).

An assessment tool may also be an important support mechanism in the learning process. The Florida report supported the application of an assessment rubric. Rubrics may be helpful to the student as well as to the instructor in identifying and supporting coursework objectives. Knowing what the objectives are can be useful to the student, but when the objectives are accompanied in the rubric, the student might also be advantaged by seeing how he/she will be graded or assessed. By applying the rubric created with the purpose of requiring the student to respond in the higher domains of Bloom's Taxonomy, the student would be encouraged to think and perform in these areas. The student is then provided with a tool to assist in self-evaluation of his/her work relevant to the educator's expected framework in the final project solution.

Cognitive design theory in art and design education is an ongoing issue that has the potential to change the way instruction is approached in the studio classroom. It seems that the momentum to include cognitive education continues to grow as it finds support with psychologists and cognitive theorists, like Nita Sturale. Sturale and others believe that art education is essential to the cognitive development of the student. This flies in the face to what the role of art education has traditionally played, a secondary passive indulgence in cognitive growth of the student. Sturale reports quantitative evidence to support this hypothesis (Sturale 2006). Sturale's vies may be indicative of the more assertive position in education cognitive psychologists are taking in education. The number of schools like the School of the Art Institute of Chicago are offering courses, like ArtED 5012, Mind and Brain, that focus on contemporary cognitive development theories and 'the interplay of thought relative to the artist' (Chicago Art

Institute). Classes like those at CAI suggest that there is an acceptance beginning to take place of cognitive awareness that is being addressed.

Testing Method:

There were two sample groups examined -- the beginning and advanced illustration classes at the University of Central Oklahoma's Department of Design.

Number of Illustration Students Tested	
Beginning A	9
Beginning B	9
Total Beginning Illustration Students	18
Advanced A	6
Advanced B	6
Total Advanced Illustration Students	12

Table 3. Population Sampled

The beginning group consisted of eighteen illustration students. Beginning Illustration students in this class must have already completed Drawing I and II. Each are foundation level preparatory courses in drawing. The coursework in Beginning Illustration focuses exclusively on black and white media, foundational rendering techniques and design principles within the image and emphasis is placed on the illustration as being the vehicle that carries the message to an intended audience. Students were given the choice to participate in this study or perform the traditional illustration project normally assigned in the semester coursework. All participation in the study was voluntary and appropriate Institutional Review Board (IRB) procedure was followed.

Twelve students participated in the advanced group. These students must have successfully completed Beginning Illustration and its requirements. Coursework for this group includes using mixed media and color. This course continues further investigation into design principles within the image, and like Beginning Illustration, emphasis is placed on image creation that conveys a specific message to an intended audience.

Research Design and Procedure

The students in the beginning class were paired according to their grade point average. Starting with the highest ranked student in the class to the lowest, the highest and second highest ranked student were paired with each other, the third and fourth, etc. One student of each pair was randomly assigned an A status the other B. Each pair then randomly selected a number between one and seven. The number drawn represented one of the seven stanzas in the poem, 'T'was the Night Before Christmas' that was to be used as the content of an illustration. The same process of selection took place for the advanced illustration class participants.

Each student in the pair was then instructed to develop one black and white illustration based on the stanza in the poem. All student participants were asked to refrain from discussing their work with each other and avoid any outside assistance from anyone other than the researcher. A project sheet with parameters and project development deadlines were given out to all students at the beginning of the study. (Appendix A) Questions to the researcher were to limited to clarification of the project's guidelines and handout information.

Media use for both beginning and advanced groups was open to the participant as long as it remained black and white. Size of illustration for beginning illustrators, was 8.5

X 11 and 8.5 X 14 for advanced. Each student was required to submit a high-resolution digital image for the final assessment and all deadlines of the project were firm. Participants were given a three-week period to complete the experiment. Deadlines were established within this timeframe to keep participants moving in a timely manner towards the ultimate deadline, the final illustration. All A and B participants were given the same mount of time to finish the project. Any individual not meeting their initial thumbnail sketches, comprehensive drawings or final illustration deadline was disqualified from the study. Table 4 describes the workflow and tasks performed by A and B illustration students for the experiment.

Tasks	***Group A Illustration Students***	***Group B Illustration Students***
Produced 24 Thumbnails	Yes	Yes
Sequenced Thumbnails	Yes	No
Revised Best Thumbnail	Yes	No
Comprehensive Drawing	Yes	Yes
Given 1st Rubric identifying objectives at the comp level	Yes	No
Revised Comprehensive Drawing	Yes	No
Given 2nd Rubric identifying objectives at the final level	Yes	No
Final Illustration	Yes	Yes

Table 4. Illustrator A & B Tasks and Workflow

All participants were asked to submit twenty-four thumbnail sketches representing their initial ideas. The researcher provided a guide containing a template for the thumbnail sketch areas. (Appendix C) Once this was distributed, group B participants worked separately from Group A. Upon completion of their twenty-four thumbnails, all

Group A students were asked to rank order their sketches from worst to best, best being the twenty-fourth. These students were then asked to revise, improve and redraw their last image.

The next step in the study required that each individual provide a comp before beginning the final illustration. Both group A and B participants were asked to provide photocopies of this step in the process and were aware that their submitted comprehensive drawing (comp) would be evaluated. Group A participants were provided with a rubric that identified common visual elements of design in illustration imagery for the comprehensive production (Table 4). Group A participants were also asked to assess their work by the rubric tool and revise their comp once again before proceeding to the final illustration (Table 5). Once their second composition was completed, Group A students were then given a second rubric to assist them in the production of their final illustration. Group B was not. Finished illustrations of both A and B groups were assessed using Group A's rubric (Table 5).

Illustration Objectives using Bloom's Revised Taxonomy.

As indicated in the review of literature for this study, there is adequate research to suggest that there are cognitive processes taking place in design and artistic activity. By examining the hierarchy in Bloom's Revised Taxonomy of cognitive learning, and then modifying tasks that are commonly performed during regular illustration project development, this study attempted to determine if variations in the higher cognitive processes had any significant change in the performance outcome. In other words, can

the application of a curriculum that is designed to effect specific cognitive objectives using this new taxonomy play a role in improving the illustration student's final solution?

One significant change in Bloom's Revised Taxonomy (Anderson 2000) adds the 'Creation Domain' and is placed it at the highest dominion order of cognitive possibility. The revised table also restructures knowledge into its own separate dominion from the previous model. By making these changes, nuances within each dominion in the taxonomy now occur giving the model more specificity in identifying knowledge progression. As seen in the taxonomy, Construct, Achieve, Action and Actualize are now higher action levels of awareness within the Apply, Analyze, Evaluate and Create categories. By intentionally assigning these specific tasks and by structuring the study this way, the participants in Group A may be more likely to engage these levels of Bloom's Revised Taxonomy.

The point at which an illustrator is developing thumbnail sketches, the individual is already working at the Analyze level of the domain of Bloom's Taxonomy, specifically within the conceptual knowledge dimension. The in this study the participant is explaining what took place in the stanza now visually. In order to produce this type of sketch, the participant must developed a working construct from which to begin the rendering process. Remembering the stanza's content, understanding and interpreting its meaning and classifying and ordering elements to be included into the work is a foundational necessity before being able to record or present a visual explanation of the stanza's meaning. By developing a thumbnail sketch, the participant is achieving the ability to explain in the cognitive hierarchy.

Once the thumbnail is rendered, the illustrator then moves into the Evaluate domain of the taxonomy. All participants were asked to produce twenty-four thumbnails before proceeding to the next step. Group A was given a second sheet and asked to rank order their sketches and evaluate them based on the content of the stanza. It can be presumed that this evaluative process happens with all participants, however only Group A participants were formally asked to redraw their best choice as a refined thumbnail. By doing this the researcher provided evidence that this evaluative process takes place. The simple task of rank ordering and re-rendering may in itself assist the illustrator in determining which image solution might be a more suitable path for further examination.

This Analyze, Evaluate and Create process was intentionally cyclical in four observable steps for beginning and advanced Group A participants.

Qualitative Observations and Rubric Assessment Methods

The first step observed was the twenty-four thumbnail development task. The sequential evolution discussed in Oxman's Re-representation can be seen in the sketch work of A and B participant's efforts. Both groups showed borrowing of elements from within their own progressive development as well as combining and reinvention in this initial stage. Some of this Re-representation does not appear to be as evident after Group A students reorganized their sketches in the ranking task of the investigation. In other words, the chronological sequence in development was often disrupted in the final rank order as ideas may have been weighed and reevaluated for their merit. The sketch that was done in chronological order six for example might show up lower in the worst to best ranking even though it borrowed elements from five. This suggests that even though a

Group A evaluator might have been following the Re-representation Theory proposed by Oxman, the participant may have decided that some misdirection on their part might have occurred in the process. Another possibility may have been that the participant settles for one of the thumbnail solutions and the desire to fully investigate other possibilities wanes. Like Oxman's study, the last thumbnail was not the most often taken path to the final solution.

For those participants who were required to revise their best thumbnail, the opportunity to improve or clarify that idea before moving on to the comp stage was available. For the most part, improvement is more evident in the advanced group. Line weight and structure seems to be more confident. Overall, the technical problems were corrected from the advanced Group A participants than the beginning Group A participants. For example, a vanishing point or perspective error was more likely to be corrected by an advanced Group A illustrator than a beginning Group A illustrator at the revised thumbnail stage. Group B participants may have taken this additional step on their own or may have made additional notation for later use but they were not required to provide evidence of this task in the study.

Initial and revised compositions regarding the content in the first rubric allowed for some degree of quantitative assessment. Group A students were required to revise their first comprehensive drawing based on a construct of five design and illustrative developmental principles including, Clarity of Message, Initial Design/Composition, Definable Light Source, Perspective and Comp Planning. Table 5 features the rubric distributed to Group A beginning and advanced illustration students.

CATEGORY	4	3	2	1	Score
Clarity of Message	Message is obvious to the reader. The main elements relate to the quote in conveying the quote's meaning either literally or figuratively with out explanation. If imagery is literal to the quote, the renderings are identifiable. If the image is abstract, the image's association to the message is strong.	Message is pretty clear to the reader. Yes you get it but some elements can be eliminated or others are needed to improve the readability of the visual message. Literal imagery is clear. Abstract imagery is not clear.	Message is pretty clear to the reader. You understand the message but are not sure you would if you didn't know what it meant already. Literal imagery is somewhat unclear. Abstract imagery if used is not clear.	Message is indefinable. Illustration imagery if literal is poor. Abstract imagery if used is poor.	
Initial Design /Composition	Student applies design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) with great skill.	Student applies design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) with good skill.	Student tries to apply design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) but the overall result is not pleasing.	The student does not appear to be able to apply most design principles to his/her own work. Party Pic.	
Definable Light Source	Student shows strong light direction. All elements obey correct lighting properties whether using multiple or singular light source. All cast shadows obey light direction.	Student shows good light direction. Most elements obey correct lighting property. One or two objects might be obscured relating to light source. Most cast shadows obey and are present in the image.	Students show shadows but light sources are undistinguishable. Several cast shadows are missing or are not obeying singular or multiple light sources.	The student does not appear to be able to define where the light source(s) are in the image. The student cannot control directional lighting in his/her work.	
Perspective	Student shows strong perspective control in the work. The location of singular or multiple vanishing points can be determined in the image. All elements in the illustration obey.	Student shows good perspective control in the work. The location of singular or multiple vanishing points can be determined in the image. Almost all of the elements in the illustration obey.	Student shows fair perspective control. The general location of the vanishing point can be determined in the image. Most of the elements in the image obey.	The vanishing point(s) cannot be determined. Elements don't obey perspective rules.	
Comp Planning Evidence	Student shows in detail how the illustration will proceed. The comp looks like a smaller to scale version of the illustrator intends to produce. The illustrator's intention is very obvious.	Student shows a good representation of how the illustration will proceed. The comp is proportionate to the version of the illustrator intends to produce. The illustrator's intention is pretty clear. A few details need to be added.	Student has provided us with a fairly loose comp. The comps general shape is to scale of what the final illustration is to be. The illustrator's intention vague. Student obviously needs to spend more time on the comp. Problems with content planning are present.	Student has thought very little about the project. Is present but is not invested in the product. Much more time is needed in planning out elements. Virtually no detail in the image. Poor planning.	
				Final Score	

Table 5. Rubric for Group A Self-Assessment of Comprehensive Drawing

Clarity of Message, as described by the rubric, involves what may be considered to be the primary responsibility of the illustrator—that of achieving effective visual communication of an intended message to a targeted viewer. Here the Group A participants are asked to evaluate their comprehensive drawing objectively to determine if there is any confusion of the illustration's message conceptually, and if so, to what degree it might have taken place. The intent of his category is to assist the illustrator in evaluating the effectiveness of the proposed comp solution before the final rendering attempt is made. By considering Clarity of Message here at the comp level, the illustrator may evaluate the effectiveness of the creative solution without stylistic or rendering interpretations or misinterpretations clouding the assessment. A student illustrator that may be struggling with final rendering technique, for example, may inadvertently obstruct the meaning of the image by not having adequate psychomotor skills to portray an aesthetic intent later. The ability of the illustrator to control the media of choice may affect the work's communication. This aspect of Clarity of Message combined with the illustrator's rendering competency is addressed in the final illustration rubric.

Initial Design/Composition considers how the illustrator has made elemental design choices. Unity, contrast, balance and the ability to direct the viewer in a visual hierarchy is assessed here. This category deals with the aesthetic design of the future illustration.

The Definable Light Source category relates to the environmental attributes that most of the participants were going to have to address. Being able to describe light and its properties mechanically within an environment is important to form, visual correctness in realism, establishing mood and/or drama. This category was included specifically in

the comp rubric because it is also a foundational element in determining the outcome of the finished work.

Although there were no restrictions requiring the participants to illustrate in realism, it was anticipated that most illustrators would do so given the subject matter—a stanza from the poem, 'T'was the Night Before Christmas.' Perspective may be the most problematic issue for beginning and even advanced illustrators to resolve. The controlled use of this illustrative property enhances the outcome of a work or interferes with its perceived visual validity if it is not used correctly.

Comprehensive Planning dealt with how well the participant attempted to demonstrate a resolution for the final illustration. Participants were asked to provide their work in a clean, concise manner that demonstrated proper scale and form. Both A and B participants were instructed that their comps were to represent an illustration containing attention to detail that would be seen in the finished piece. By definition, comps for this study are to-scale versions of the final illustration that contains all of the necessary information to begin the final illustration. Information that cannot be recorded literally, like rendering style due to media selection, type application, etc. should have been noted on the submission. Effort taken on the part by the illustrator to produce the comprehensive is assessed here.

A good comprehensive illustration may not always guarantee a successful final one. Changes in materials, scale, time and effort, can affect the outcome and the Clarity of Message, therefore, this objective was again listed as an area of concern for the illustrator to consider. Table 5 features the objectives of the final illustration.

CATEGORY	4	3	2	1	Score
Clarity of Message	Message is obvious to the reader. The main elements relate to the quote in conveying the quote's meaning either literally or figuratively with out explanation. If imagery is literal to the quote, the renderings are identifiable. If the image is abstract, the image's association to the message is strong.	Message is pretty clear to the reader. Yes you get it but some elements can be eliminated or others are needed to improve the readability of the visual message. Literal imagery is clear. Abstract imagery is not clear.	Message is pretty clear to the reader. You understand the message but are confident that the message would be understood without foreknowledge. Literal imagery is somewhat unclear. Abstract imagery if used is not understood.	Message is indefinable. Illustration imagery if literal is poor. Abstract imagery if used is poor.	
Final Composition	Design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) are applied with confident skill.	Student applies design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) with fair skill.	Student tries to apply design principles (such as unity, contrast, balance, movement, direction, emphasis, and center of interest) but the overall result is not pleasing.	The student does not appear to be able to apply most design principles to his/her own work.	
Style	Media is applied in a manner very consistent with the creative objective and target market. Student rendering style is strong. The illustrator shows mastery of a rendering technique.	Media is applied in a manner that is reasonably consistent with the creative objective and target market. Student rendering style is good. There is evidence that the illustrator is developing a rendering technique.	An attempt has been made to apply media in a manner that is consistent with the creative objective and target market. Student rendering style is fair. The illustrator is struggling with a rendering technique.	Inadequate attempt has been made to apply media in a manner that is consistent with a creative objective and target market. Student rendering style is poor. The illustrator shows no attempt in technique development.	
Time and Effort	As evident of the illustration, class time was used wisely. Much time and effort went into the planning and design of the illustration. It is clear the student worked at home as well as at school.	As evident of the illustration, class time was used wisely. Student might need to add more time and effort at home to improve this work.	As evident of the illustration, class time was not always used wisely, but student did do some additional work at home.	Class time was not used wisely and the student put in no additional effort.	
Illustration Skill	Application of media is preplanned and done in a logical, sequential manner. Student demonstrates mastery over the material.	Media is applied in a careful, logical manner. Student demonstrates good control over the material.	Control is somewhat lacking. A few drips, ragged edges and failure of certain areas of media/texture may be evident.	Student needs to work on controlling media and preplanning media application. Muddy values, ragged edges, lack of texture, drips and/or blobs are evident throughout the work.	
Value Range (Grey Scale)	Choice and application of value shows an advanced knowledge of value relationships. Value choice enhances the idea being expressed.	Choice and application of value shows knowledge of value relationships. Values are appropriate for the idea being expressed.	Choice and application of value shows knowledge of value relationships. Values are, however, NOT appropriate for the idea being expressed.	Student needs to work on dealing with value relationships and using that knowledge in his/her work.	
				Final Score	

Table 6. Rubric for Group A Assessment of the Final Illustration

Like the Design/Composition section in the first rubric (Table 5), the final composition considers the design elements of the finished image and how well they work together. Compositional corrections, new element additions and subtractions new errors are again considered in the rubric. It was anticipated that students would make additional changes after the comp phase of the experiment to the final image.

In the Style category, the illustrator examines the method of which the media is applied and the level of mastery of that style in the finished work. Competency in the rendering style is assessed with the creative objective in mind and the intended target reader. A quasi-cubism style for example, as extreme as it might seem for the illustration assignment, might be acceptable provided that the illustrator was able to strike a balance between aesthetic and message legibility.

Time and Effort, while this might seem to be very subjective category to include in the rubric, it was thought to be a necessary one. The success of this study depended upon the documented process of the participant. Time and Effort can be generally assessed by thumbnail completion, revisions or redraws in any phase, comp detail and notation, and final illustration method and technique. Group A participants who were aware of his condition in the rubric may have committed more time in the creative process and as a result improved the final illustration.

The Illustration Skill category was intentionally included to evaluate the psychomotor hand-eye skills of the participant. Control of the applied medium on board, whether it was wet, dry or mixed was assessed and special consideration was given to the application of the material and how it was treated. Evidence that the illustrator had knowledge of how one rendering property material could be used on the board and how it

might react with other was considered. Mistakes resulting from media mishaps were deductions in the assessment.

Participants were evaluated on their application of value and how it was used in relationship to the intended creative rationale. Unless called for by the implied light source or style, full gray scale values from 0 – 100% were generally expected. Highlights, shadow, mid-tones and line weights were examined to determine if the illustrator possessed procedural knowledge in differentiating grey scale values. Likewise, participants were expected to demonstrate their ability determine value relationships in the image, for example, demonstrating that a highlight appears to be brighter if a contrasting darker area accompanies it.

Granted, there are numerous other conditions that could have been included in either rubric for investigation, but by limiting them to these categories, it was felt that the participants were given the necessary framework overall to evaluate and improve their work reflectively and in progress. Grading was on a 4-0 scale for each category. The assessment was done for all A and B participant comp submissions and final illustrations. There were eighteen beginning students or nine pairs of A and B participants for the beginning illustration population.

There were nineteen advanced illustration students forming nine pairs that were initially sampled in the study. Three of these participants failed to submit a finished illustration for the final assessment. Because the comparison of their counterpart could not be discussed, the number of advanced pairs presented in this study was lowered to six or twelve individuals. This resulted in a smaller sample size than what was originally intended.

Quantitative Results

Beginning Illustration –
First Group A & B Comprehensive Drawing Average Scores

Group A (First Comp) and B Comp Scores:

Group A Comp Score Average	55.55
Group B Comp Score Average	56.10
Difference in mean scores	00.60

18 participants, 9 A & 9 B

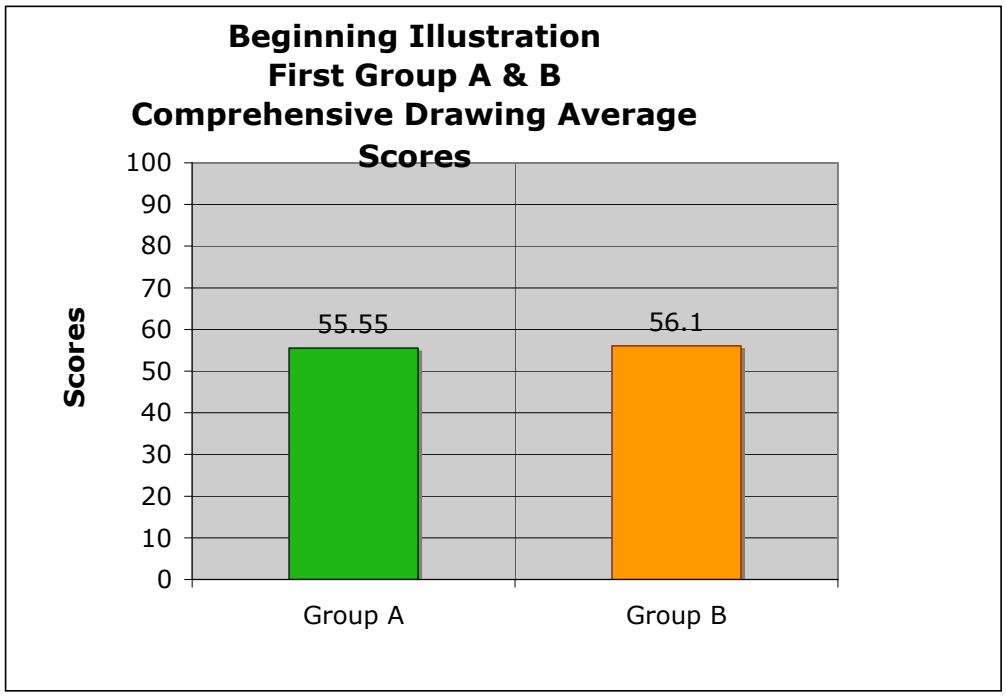


Figure 1.

Figure 1 describes the results prior to any rubric distribution. The difference between the average scores of Group A students and Group B students was extremely small, 0.6. This appears to positively support a fair distribution of participants into the two A & B groups. All comprehensive drawing submissions were assessed by the objectives listed in the Table 5 rubric.

Beginning Illustration –
Group A First & Revised Comprehensive Score Averages

Group A Comp Scores First Comp	55.55
Group A Comp Scores Revised Comp	78.33
Difference in mean scores	22.78
9 participants	

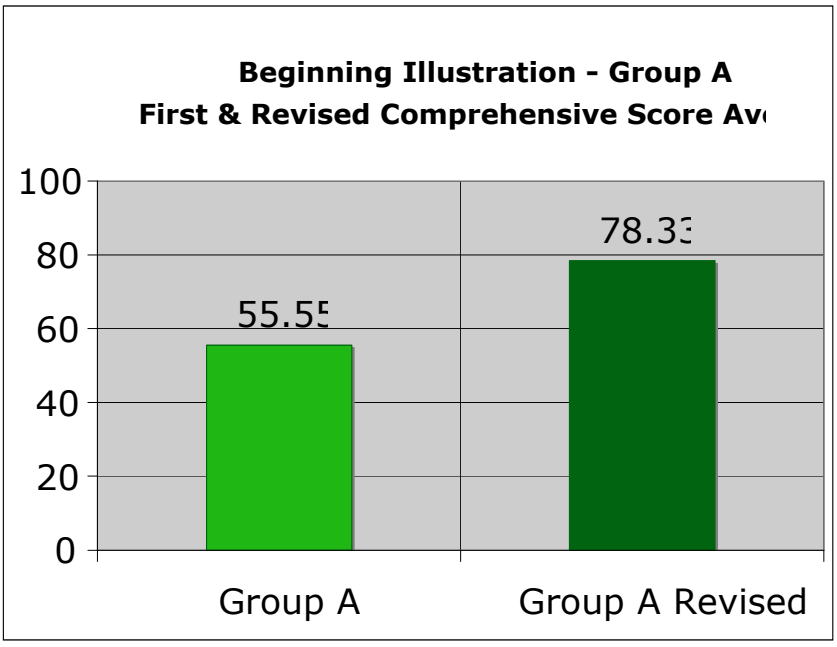


Figure 2.

Figure 2 presents the differences in outcomes for Group A's assessment scores prior to the first rubric application and the score of the same group's revised comp after the rubric distribution. The difference in comp performance was a 22.78% improvement in the planning and execution of the revised submission.

Beginning Illustration - Group A First, Revised & Group B Comprehensive Score Averages

Group A First Comp	55.55
Group A Revised Comp	78.33
Group B Comp Score	56.10

18 participants, 9 Group A & 9 Group B

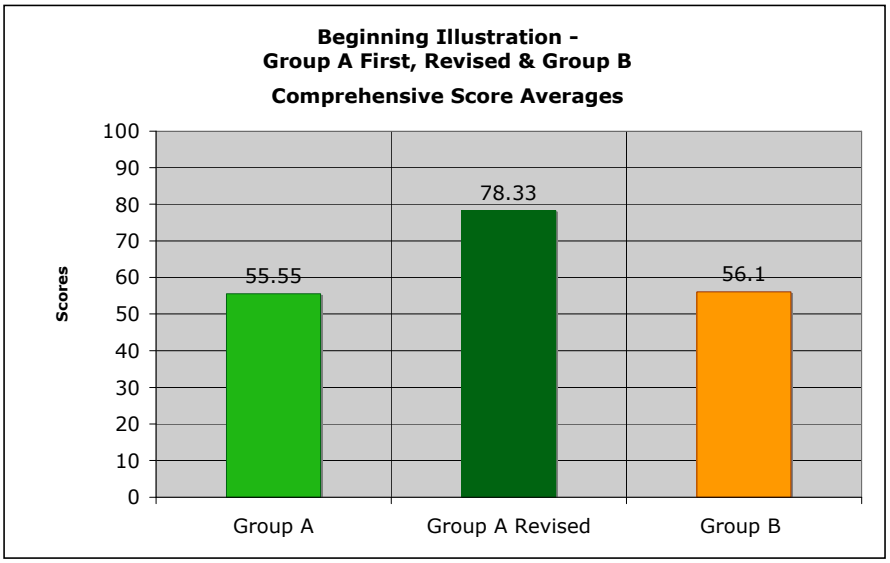


Figure 3.

Figure 3 denotes the relationship of all three assessments, Group A's first and revised comp and Group B's comp submission. There is a 22.23 difference between Group A's second submission and Group B's comp submission. Although it was not a requirement in the investigation, there was evidence that some Group B participants did revise their comps on their own volition before beginning the final illustration. These changes were seen in the complete process work submitted by the Group B participants.

Beginning Illustration –
Comprehensive Drawing Scores Comparison of Individuals in A& B Pairs

Group A participants outscoring Group B participants	7
Group B participants outscoring Group A participants	0

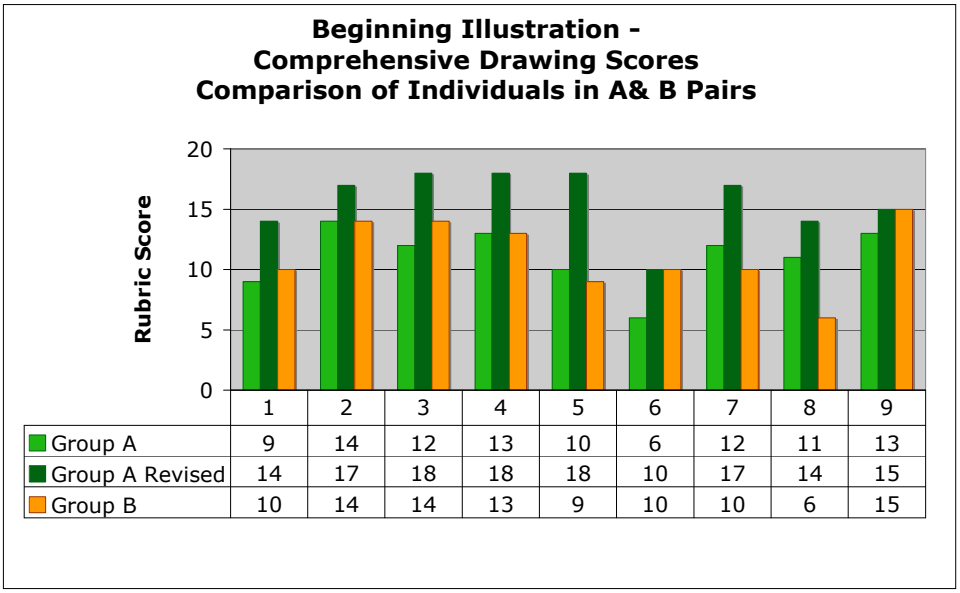


Figure 4.

Figure 4 shows the results of the comp scores for all A and B individuals. Scores show the A and B relationship in their stanza pair. Results from the first rubric revealed that after revisions Group A participants out performed seven of nine Group B participants. Two pairs were tied after each A individual resubmitted their work. No Group B individual outscored a Group A participant in the comp process.

Beginning Illustration –
Individual A&B Comparison Final Illustration Scores

Group A participants outscoring Group B participants	7
Group B participants outscoring Group A participants	2

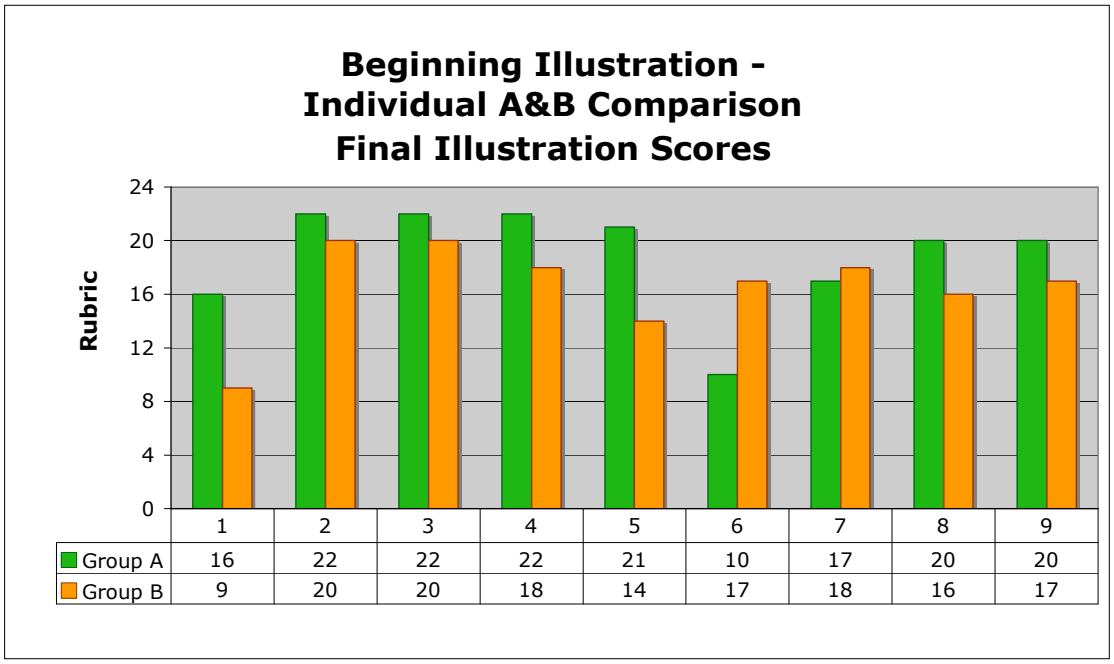


Figure 5.

Group A participants were given an additional rubric to consider before beginning production of the final illustration. Group B participants were not given the rubric. An the final illustration scores revealed that 7 Group A students out scored their Group B stanza partner and 2 Group B beginning students performed better than their Group A counterpart in the pair. The significance of the 7:2 ratio findings strongly suggest that the distribution with the illustration objectives via the rubric assisted the student in producing a more successful final image. There were no ties in the final analysis of the illustration submission.

Beginning Illustration –
Group A & B Comparison Final Illustration Averages

Group A Final Illustration Score	77.50
Group B Final Illustration Score	68.81
Difference between Group A and B Final Illustration Scores	8.69
A and B Final Illustration Score Averages	73.15

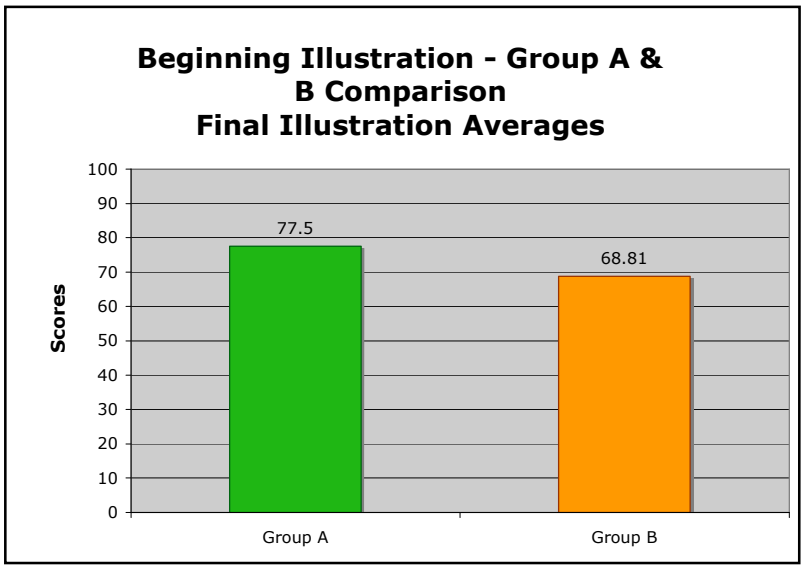


Figure 6.

The final illustration demands the highest form of communication and psychomotor skill from the illustrator. Group A's final illustration average score was 77.50 while Group B's average was 68.81 with a difference of 8.69. These results suggest that by providing a rubric at the comprehensive development and final illustration levels beginning illustration student performances can be improved significantly. Students as a group improved almost a full letter grade if scored on a traditional A – F grading scale.

Advanced Illustration –
First Group A & B Comprehensive Drawing Average Scores

Group A First Comp Score Average	56.65
Group B Comp Score Average	65.00
Difference in mean scores	8.35
6 Group A participants	

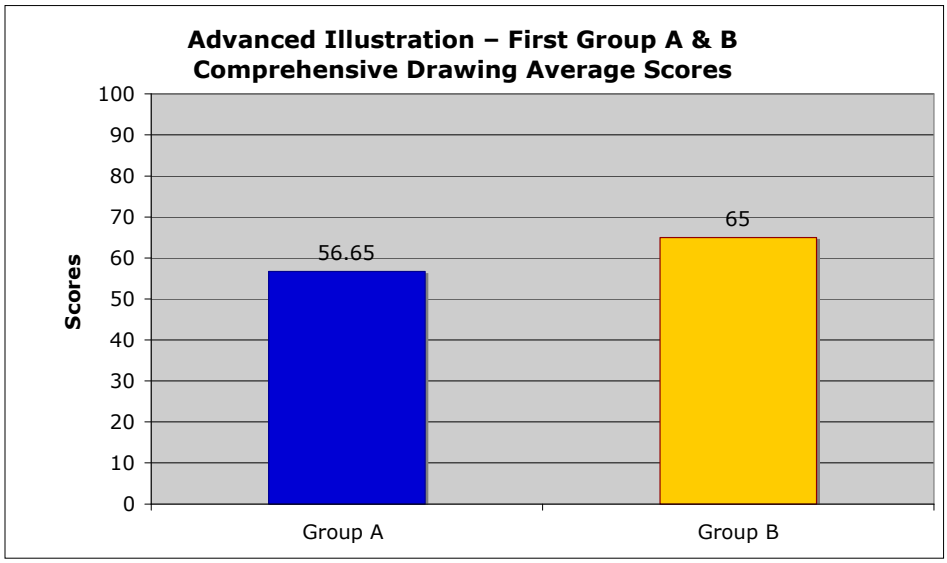


Figure 7.

Figure 7 shows the assessment of the advanced Group A and B participants prior to the distribution of the first rubric. Although the selection method was same as the beginning illustrator group, there was a significant difference in the two advanced A and B group mean scores, 8.35. The reason why this might have occurred is that the advanced illustration's population is smaller. A radical deviation, whether higher or lower from an expected mean in a smaller population will affect the final average more adversely. Eighteen beginning illustration students participated compared to twelve advanced students. One participant in Group A did score considerably lower in the first comp assessment. All comp submissions were assessed using the first rubric.

Advanced Illustration –

Group A First & Revised Comprehensive Score Averages

Average Group A Comp Scores First Comp	56.65
Average Group A Comp Scores Revised Comp	81.65
Difference in mean scores	25.00

6 Group A participants

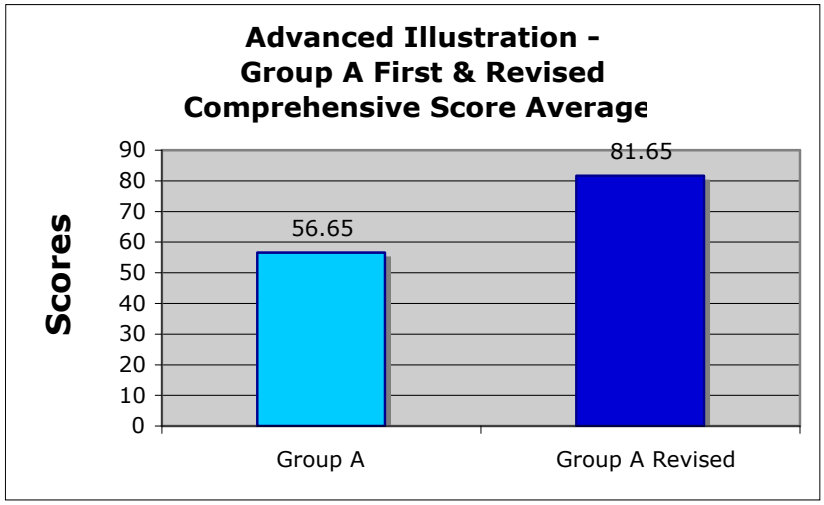


Figure 8.

Figure 8 shows the relationship between Group A's original comp score and the revised score. There is a 25% improvement in the comp revision after the distribution of the first rubric.

Advanced Illustration –
Group A First, Revised & Group B Comprehensive Score Averages

Group A First Comp Score	56.65
Group Revised Comp	81.65
Group B Comp Score	65.00
Difference in A Group Revised and B Group	16.65
12 participants, 6 Group A & 6 Group B	

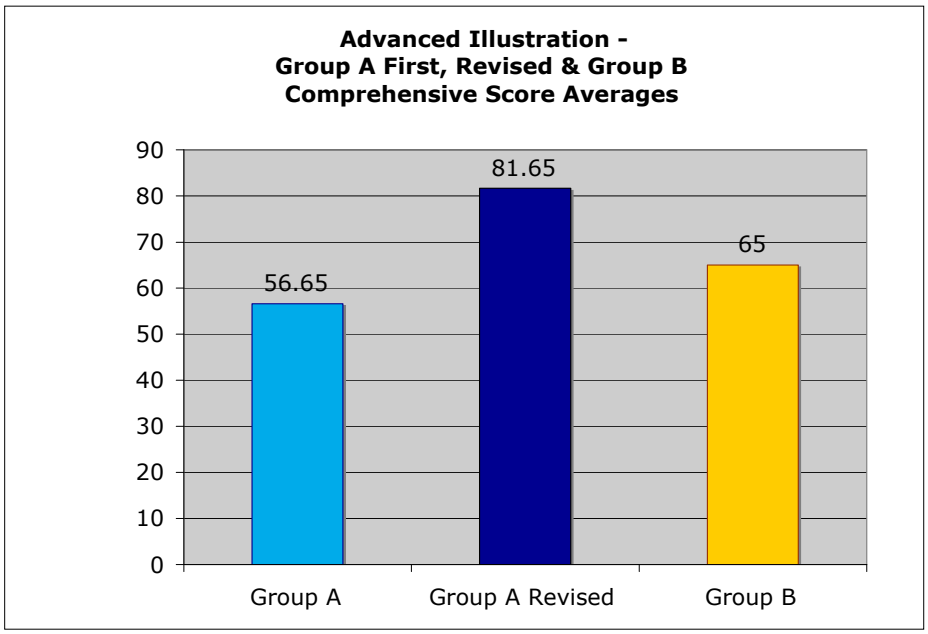
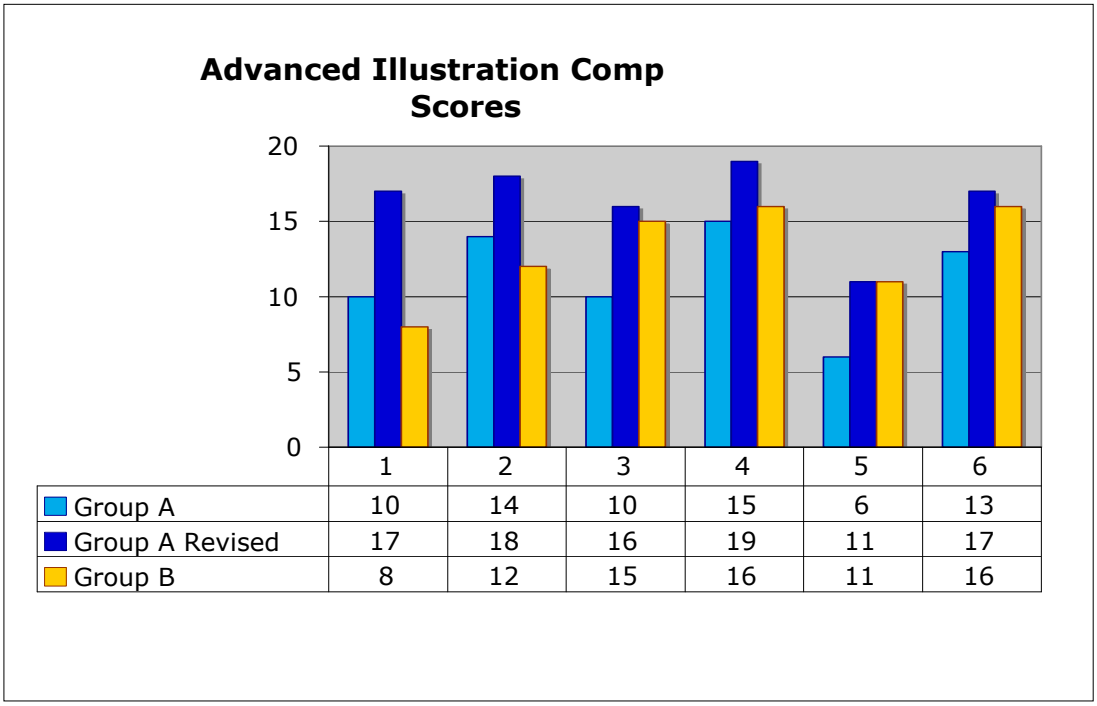


Figure 9.

Figure 9 shows the relationship of all three advanced comp assessments. As mentioned earlier in the Figure 7 discussion, one participant performed very poorly in the first comp assessment results. This however does not necessarily discredit the relationship of the revised Group A and Group B results. The difference between the revised Group A and B averages was found to be 16.65, with Group A scoring higher than group B.

Advanced Illustration –
Comprehensive Drawing Scores Comparison of Individuals in A&B Pairs

Group A participants outscoring Group B participants	5
Group B participants outscoring Group A participants	0
Group A and B participants tying in the comp score	1



	1	2	3	4	5	6
Group A	10	14	10	15	6	13
Group A Revised	17	18	16	19	11	17
Group B	8	12	15	16	11	16

Figure 10.

Figure 10 shows the results of the comps scores for all Advanced A & B individuals using the same comp rubric the beginning illustration population used. As the data indicates, there were five instances where the revised Group A participants out scored the Group B participants, and one example where one A and B pair tied. It would appear that the distribution of the rubric comp aided in the development of the comp. As in the beginning illustration sample, no Group B student outscored a Group A participant in the comp process.

Advanced Illustration –
Individual A&B Comparison Final Illustration Scores

Group A participants outscoring Group B participants	3
Group B participants outscoring Group A participants	3
Group A and B participants tying	0

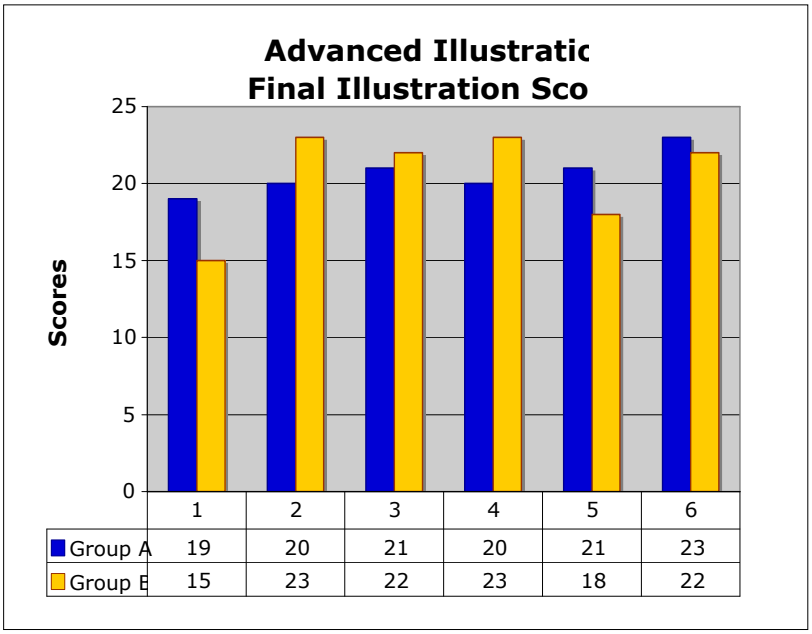


Figure 11.

Like the beginning population, Group A participants were given the second rubric that identified areas to be specifically considered when producing the final illustration. However unlike the first beginning group, there was not a distinct improvement in performance of Groups A over B. When comparing each advanced illustrator's score to in the pair, there were three instances where the Group A participant scored higher than Group B and an equal amount of Group B over Group A participants. Evidence would suggest that at the advanced level, the rubric makes little difference in the success of the final image.

Advanced Illustration –
Group A & B Comparison Final Illustration Averages

Group A Final Illustration Score	85.40
Group B Final Illustration Score	84.75
Difference between Group A and B Scores	0.65
12 participants	

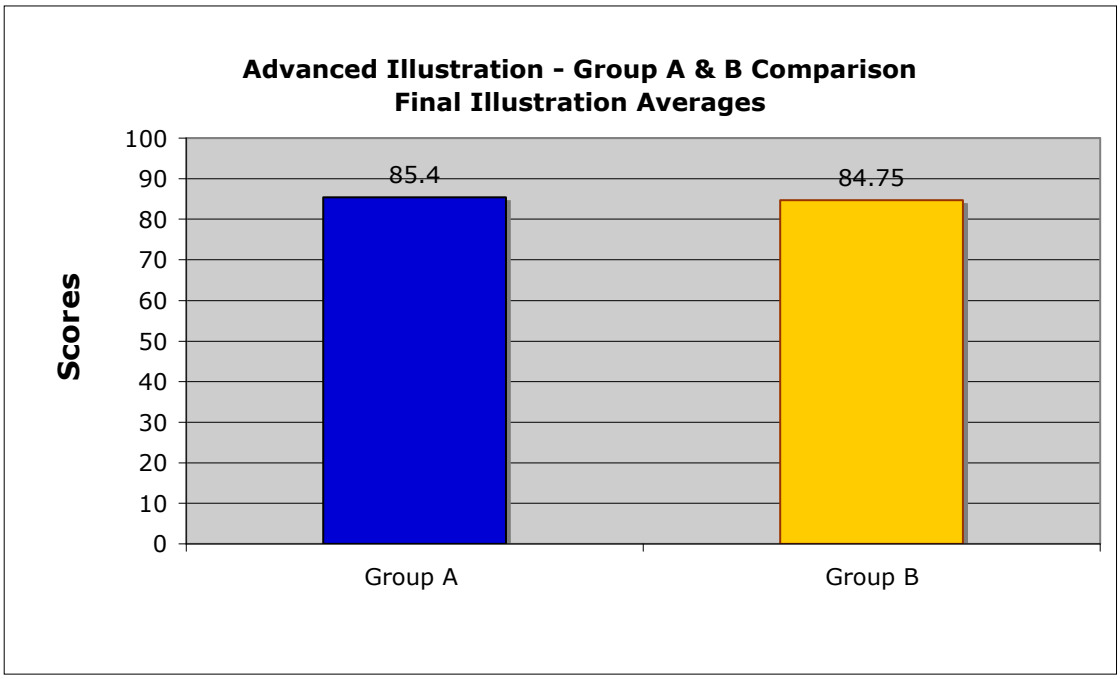


Figure 12.

The data indicates that despite the steps taken with Group A, rank ordering thumbnails, revising the final thumbnail, revising the first comp with the rubric guidelines and the distribution of the final rubric to establish the production guidelines, little difference was made in the final outcome between the two A and B groups.

Beginning & Advanced - Final Illustration Scores

Beginning Illustration Group A Score	77.5
Advanced Illustration Group A Score	85.4
Beginning Illustration Group B Score	68.81
Advanced Illustration Group B score	84.75

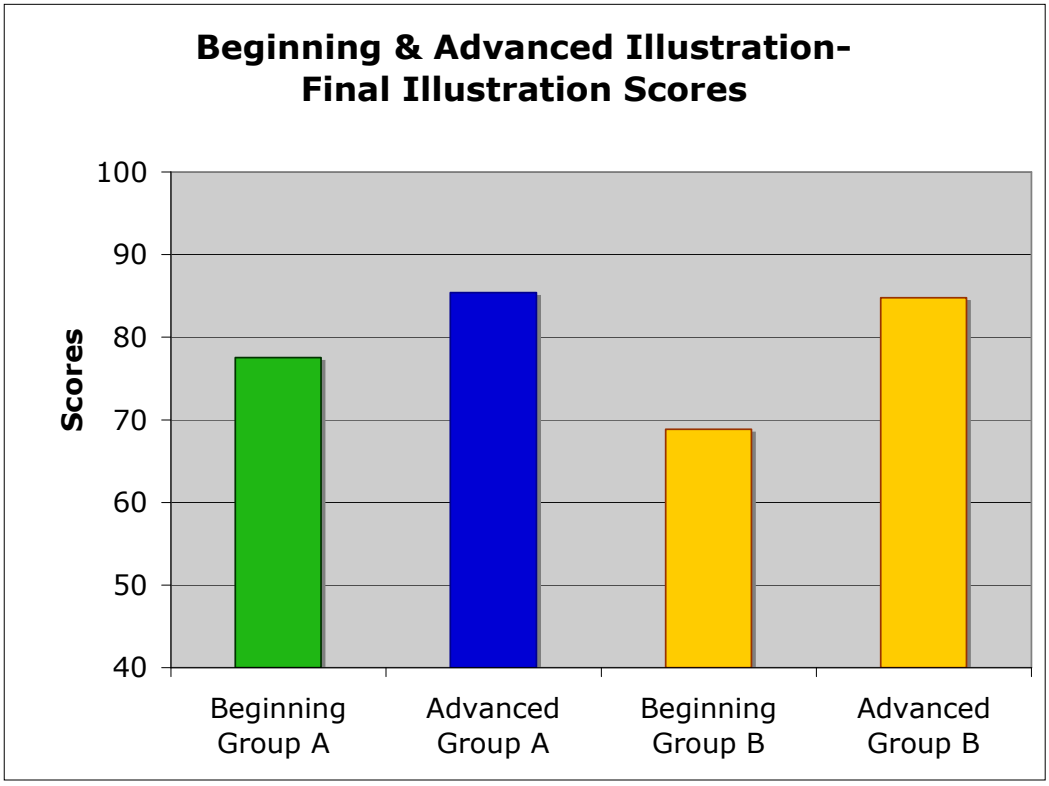


Figure 13.

If the theories of progressive cognitive development are correct as stated by Oxman in the review of literature, then there should also be an expectation that the advanced illustration pool would score better on both A and B averages than the beginning illustration population. This happened to be the case. When comparing A to A Group and B to B Group, the advanced pool scored higher using the same rubric.

Conclusion

The results imply that there is a significant improvement with the application of cognitive assessment tools for beginning illustration students. According to the study, if an instructor applied the same instructional methods in the classroom that were used in this investigation, the instructor should expect that the overall class average to improve by about 8% on project coursework. This could affect, in some cases, a student's performance by one letter grade.

However, that is not the case as concluded from the findings of the advanced illustration population. While there was evidence to suggest that students did perform better on the revised comp task, there was no evidence to suggest that the final illustration of the advanced student improved by using the same method.

A concern noted in this study was that the sample size may be too small to make a valid conclusion based on the used advanced population data. As mentioned earlier, three students failed to submit a final illustration nullifying the opportunity to make a comparison of their three paired counterparts and limited the study to six A & B sets. However, the three tabulated scores can be useful in a general A & B examination by considering the A and B average scores of both groups without the necessity to make an A to B comparison.

After tabulating all recorded Group A scores, the average was 20.5 using the final rubric scale or 85.41% on a 0-100% standard grading scale. The Group B average score was found to be 20.25 or 84.37% on the standard grading scale. The difference between the two average scores is 1.04%

In comparison to the initial twelve individuals, or six group findings, the margin of difference between the averaging methods (.65%) is still within 1%. This seems to

support the original conclusion that there is virtually no difference in using this method of curriculum design for the advanced illustration population.

Limitations of the study.

Every attempt to remove preferential subjectivity was taken by using the construct of the rubric for the revised comp and final grading assessment. It is impossible to eliminate all human preference, subjectivity and error from an aesthetic evaluative process. The rubric serves the evaluator well as a reminder to focus on the predetermined objectives and guidelines during the grading process within the categorical framework of the rubric. Therefore, the rubric is not a perfect evaluation tool.

Additionally, the evaluation scale selected for the rubric could have been improved by expanding the value range beyond a 4-0 scale. Because the range was small, the evaluator may have felt that the rubric was limiting in that it did not allow for an as accurate account in the adjudication.

Additional arguments for the validity of the study.

This study bases its findings on a convenience sample of students at the University of Central Oklahoma and was performed at the end of the semester. Throughout the beginning illustration semester, all of the terms and categorical topics included in both rubrics are discussed in great detail. Exhaustive discussion of black and white illustration rendering techniques was also done. Beginning illustration, in theory, served to level the factual and procedural knowledge as well as psychomotor skills of the students enrolled in the course. The intention of the advanced illustration course is to continue to build upon that knowledge obtained in the beginning illustration class and achieve a higher level of psychomotor and conceptual ability. Throughout the semester, all participants in both classes are expected to routinely performed thumbnails, thumbnail

revisions and comps when working on coursework.

Questions remaining to be answered.

If this study is correct in determining that there is an advantage to applying a cognitive approach such as Bloom's Revised Taxonomy towards curriculum design, as seen in the beginning illustration results, why then was the difference between the advanced Group A and B final illustration scores inconsequential? One explanation for this event might be found in the Frith and Law study discussed in the review of literature. They suggest that the areas of the brain's cortex that are stimulated when we see real objects are the same areas used when images are created by the mind's eye. Likewise, the Kosslyn's fMRI study also offers a significant amount of evidence that this takes place.

If this is so, then the necessity for a documented revisited resolution in the comp form may take on less importance to the advanced illustrator. This might explain why there was a significant difference in the first comp score and the revised comp score but no difference when comparing the A and B Group final illustration scores. Group A participants were required to submit a revised comp. Simply, the advanced illustration study group may have internalized the assessment of their own work, while the beginning group was more dependent on the tangible one provided by in the study. More investigation is required.

There is significant evidence supporting the hypothesis that illustration students, particularly beginning illustration students, can benefit from curriculum designed using a pedagogical cognitive approach based on Bloom's Revised Taxonomy.

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APPENDIX A
Experiment Instructions

Color Scheme: Black and White
Media: Open as long as it is black and white
Topic: One stanza from the poem T'was the Night Before Christmas.
Objective: Communicate the message of the stanza visually.
Size: Illustration I – 8.5 X 11, Illustration II and III – 8.5 X 14, no extensions outside the frame of the image.
Illustration surface: Watercolor board, hot or cold press.

- Students must work independently without collaboration during any point of the illustrative process.
- Students must follow the guidelines of this project to the best of their ability.
- All participating students must comply to the guidelines of this project.
- All students must provide a high rez. digital image on CD to the instructor and a photocopy for final analysis.

Deadlines:
Nov 20 – Assignment is given and information is reviewed. Quotes are drawn and groups created. Thumbnail Sheets are given to the class.

Nov 27 – 25 thumbnails due. Group B proceeds onto the comp stage. Group A is asked to rank order their thumbnails 1-25 (the best being 25^{th}) and restate their last thumbnail.

Nov 29 – Comps are due. All students are to provide instructor with a copy of their comp. Group B continues on with their work while Group A is given a rubric that outlines specific attributes of common illustration to consider. Students in Group A are asked to refine their comp for the beginning of the next class. Students are asked to grade both of their comps based on the rubric.

Dec 4 – Group A students turn in second comp with rubric instructions that pertain to comp development. Both rubric scores are collected. This day is a production day for all. Group A students are given a second rubric in order to assist the student during the final illustrative production stage. Students are also asked to submit this second rubric with their final work.

Dec 6 – Production day.

Dec 13 – Illustration II work due at 9:00am.

Dec 13 – Illustration I due at 1:00pm.

APPENDIX B
T'was the Night Before Christimas

by Clement Clarke Moore (1823)

1.
T'was the night before Christmas, when all through the house
Not a creature was stirring, not even a mouse;
The stockings were hung by the chimney with care,
In hopes that St. Nicholas soon would be there;
The children were nestled all snug in their beds,
While visions of sugar-plums danced in their heads;
And mamma in her 'kerchief, and I in my cap,
Had just settled down for a long winter's nap,
When out on the lawn there arose such a clatter,
I sprang from the bed to see what was the matter.

2.
Away to the window I flew like a flash,
Tore open the shutters and threw up the sash.
The moon on the breast of the new-fallen snow
Gave the lustre of mid-day to objects below,
When, what to my wondering eyes should appear,
But a miniature sleigh, and eight tiny reindeer,
With a little old driver, so lively and quick,
I knew in a moment it must be St. Nick.
More rapid than eagles his coursers they came,
And he whistled, and shouted, and called them by name;

3.
Now, Dasher! now, Dancer! Now, Prancer and Vixen!
On, Comet! On Cupid! On, Donner and Blitzen!
To the top of the porch! to the top of the wall!
Now dash away! dash away! dash away all!

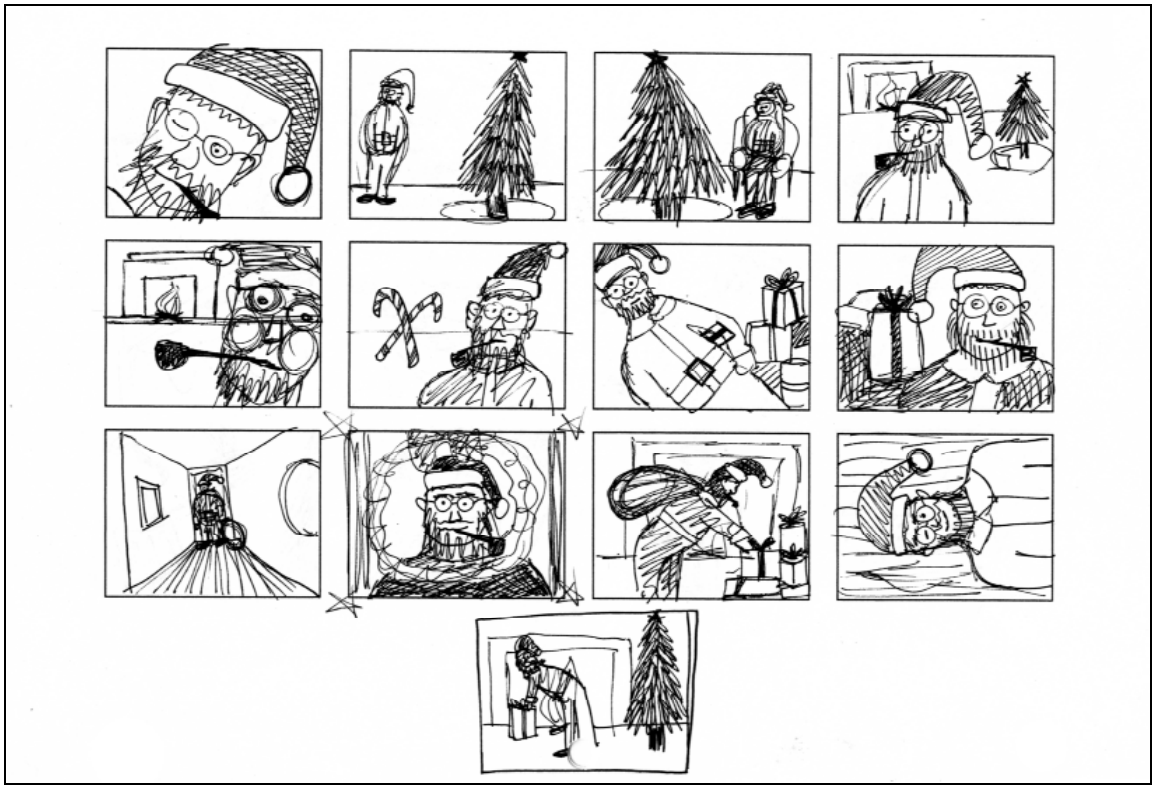
4.
As dry leaves that before the wild hurricane fly,
When they meet with an obstacle, mount to the sky,
So up to the house-top the coursers they flew,
With the sleigh full of toys, and St. Nicholas too.
And then, in a twinkling, I heard on the roof
The prancing and pawing of each little hoof.
As I drew in my hand, and was turning around,
Down the chimney St. Nicholas came with a bound.

5.
He was dressed all in fur, from his head to his foot,
And his clothes were all tarnished with ashes and soot;
A bundle of toys he had flung on his back,
And he looked like a peddler just opening his pack.
His eyes -- how they twinkled! His dimples how merry!
His cheeks were like roses, his nose like a cherry!
His droll little mouth was drawn up like a bow,
And the beard of his chin was as white as the snow;

6.
The stump of a pipe he held tight in his teeth,
And the smoke it encircled his head like a wreath;
He had a broad face and a little round belly,
That shook, when he laughed like a bowlful of jelly.
He was chubby and plump, a right jolly old elf,
And I laughed when I saw him, in spite of myself;
A wink of his eye and a twist of his head,
Soon gave me to know I had nothing to dread;

7.
He spoke not a word, but went straight to his work,
And filled all the stockings; then turned with a jerk,
And laying his finger aside of his nose,
And giving a nod, up the chimney he rose;
He sprang to his sleigh, to his team gave a whistle,
And away they all flew like the down of a thistle.
But I heard him exclaim, ere he drove out of sight,
"Happy Christmas to all, and to all a good-night!"

APPENDIX C
Example of Beginning Illustration
Group B completed thumbnail worksheet



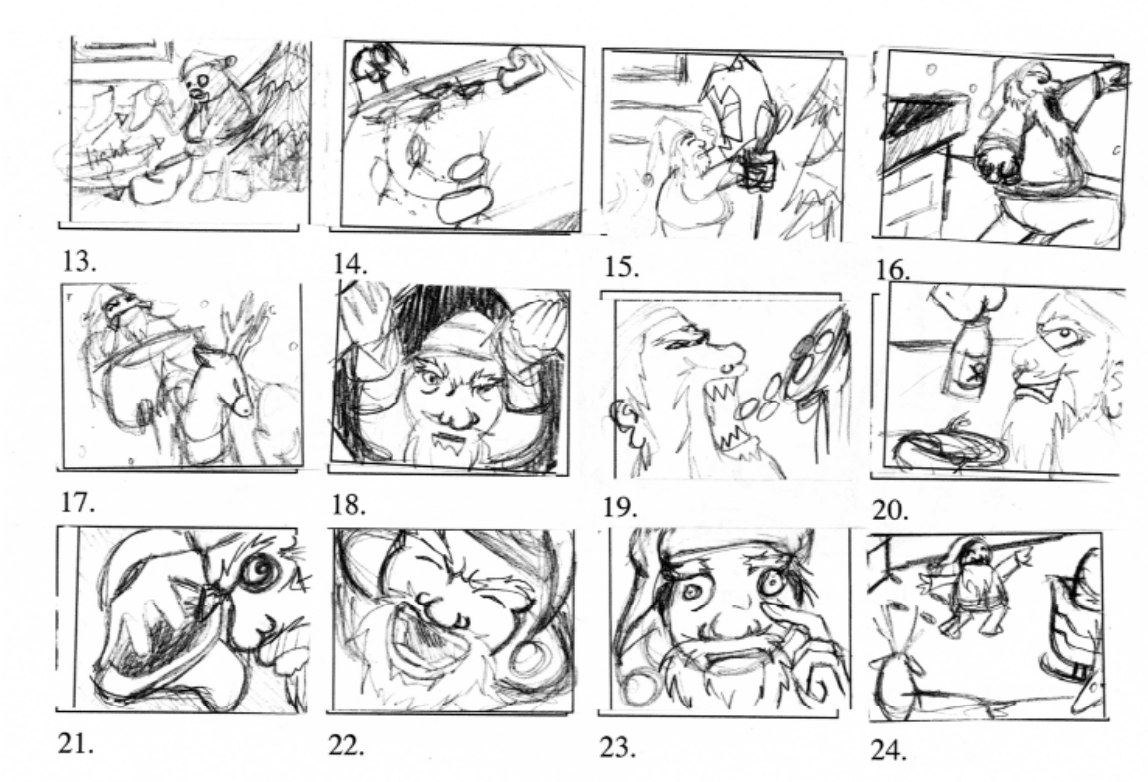
Stanza 6

APPENDIX D
Example of Beginning Illustration Group B Comp and Final Illustration

Beginning Illustration Group B
Stanza 6
Comprehensive Drawing

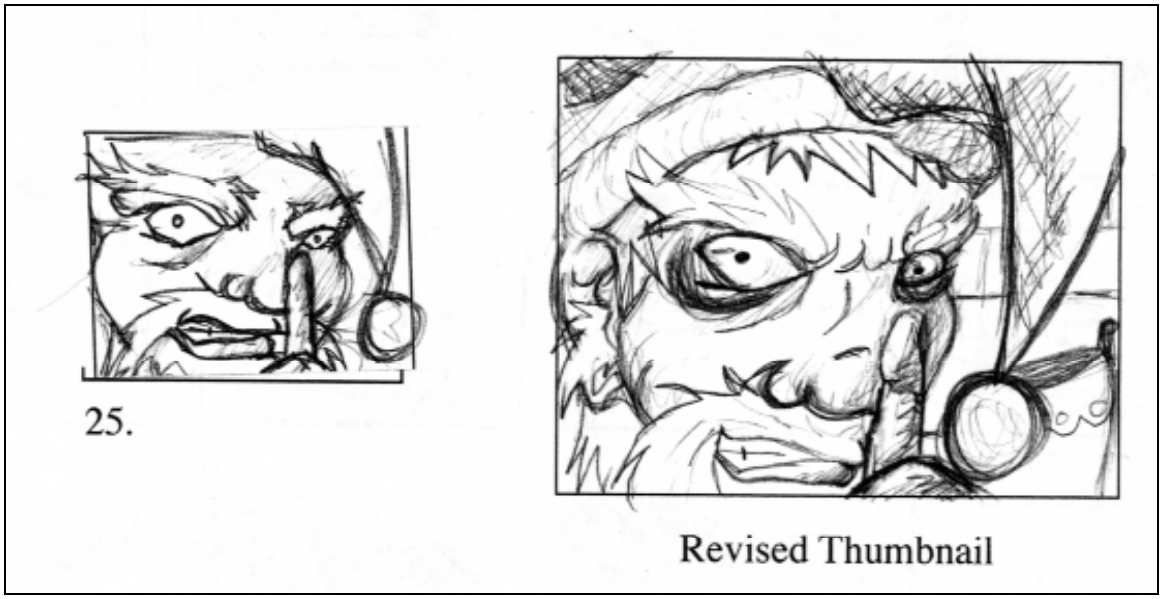
Beginning Illustration Group B
Stanza 6
Final Illustration

APPENDIX E
Example of Beginning Illustration
Group A sequenced thumbnail worksheet



Stanza 7

APPENDIX F
Example of the Beginning Illustration Group A
Revised thumbnail sheet



Stanza 7

APPENDIX G
Beginning Illustration Group A First and Revised Comprehensive Drawing

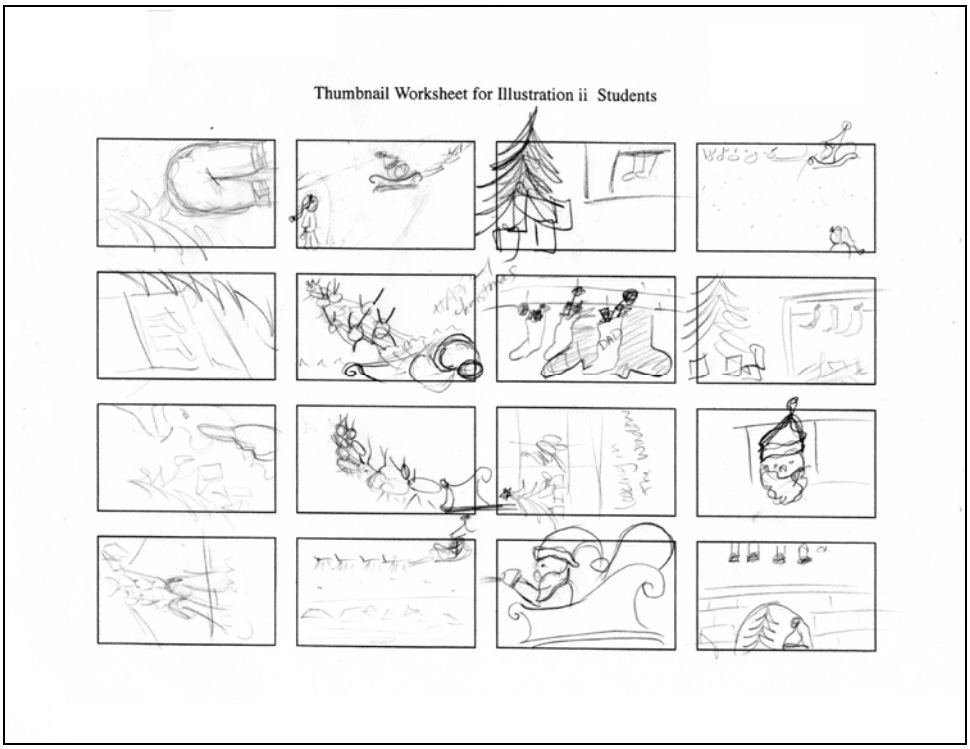
First Comprehensive Drawing Stanza 7

Revised Comprehensive Drawing Stanza 7

APPENDIX H
Beginning Illustration Group A Final Illustration

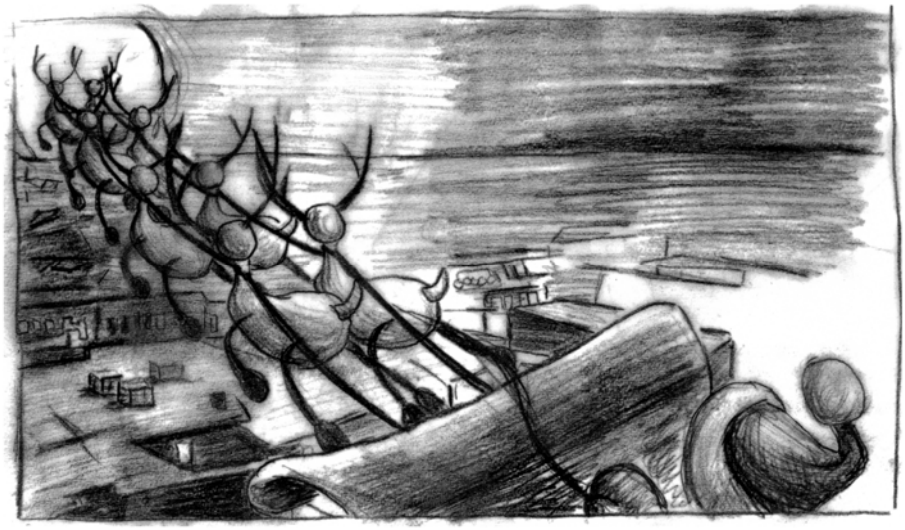
Beginning Illustration Group A Stanza 7

APPENDIX I
Example of Advanced Illustration
Group B completed thumbnail worksheet



Stanza 7

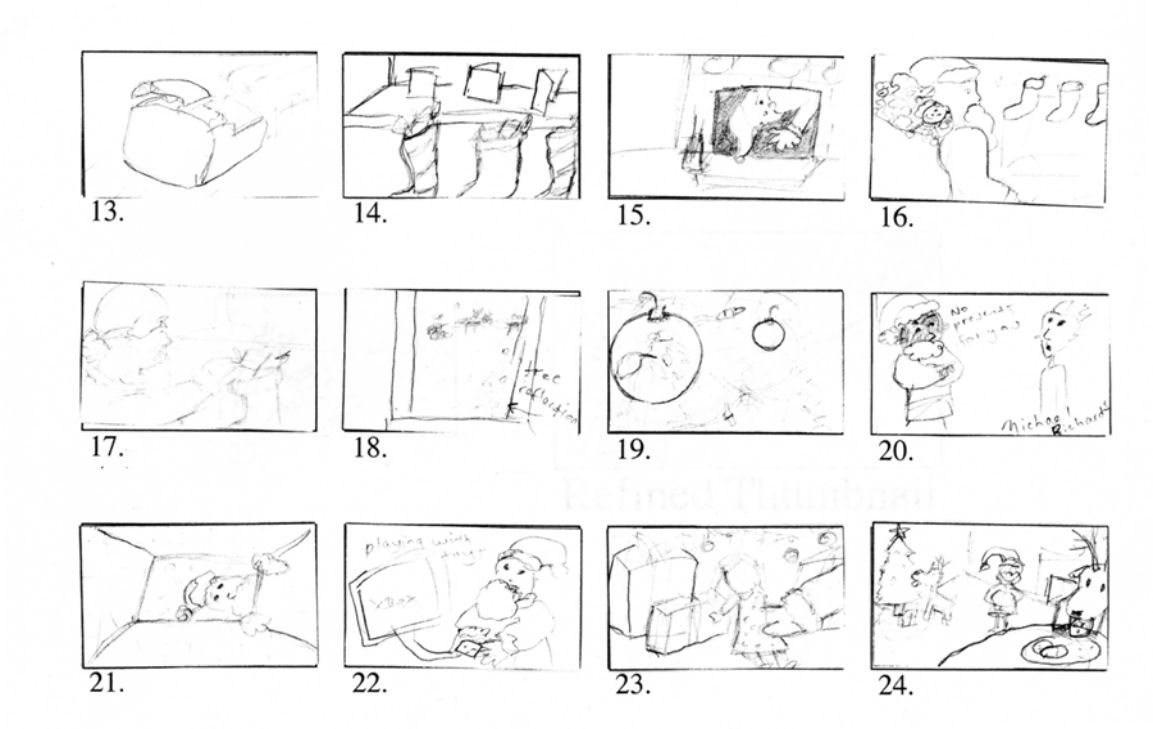
APPENDIX J
Advanced Illustration Group B
Comprehensive Drawing and Final Illustration



Stanza 7
Comprehensive Drawing

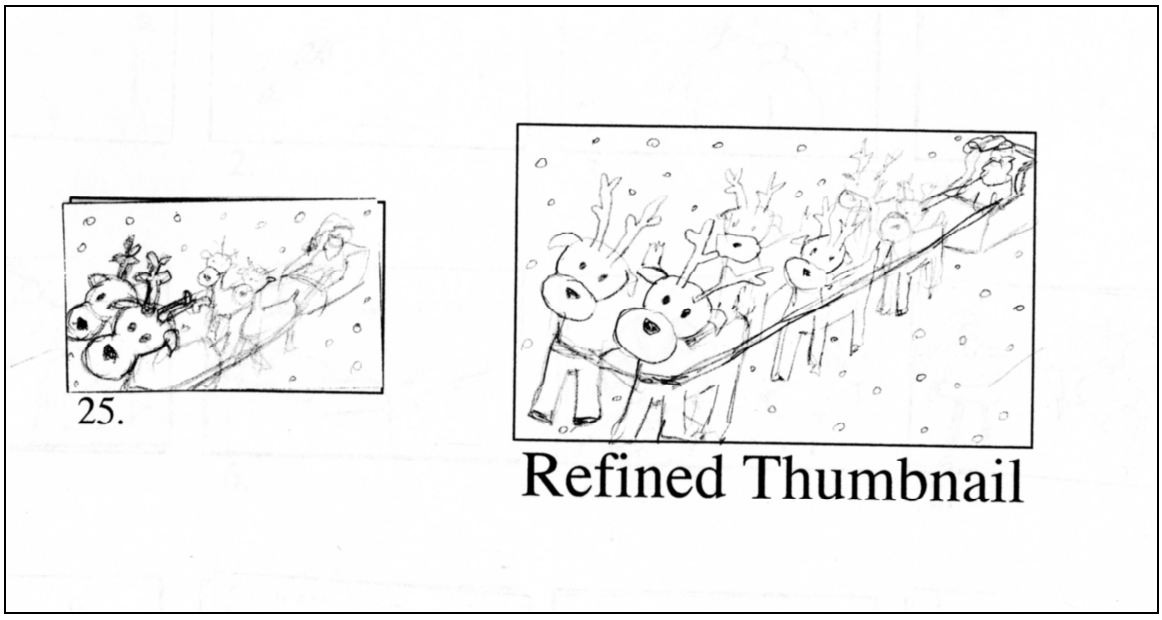
Stanza 7
Final Illustration

APPENDIX K
Example of Advanced Illustration
Group A sequenced thumbnail worksheet



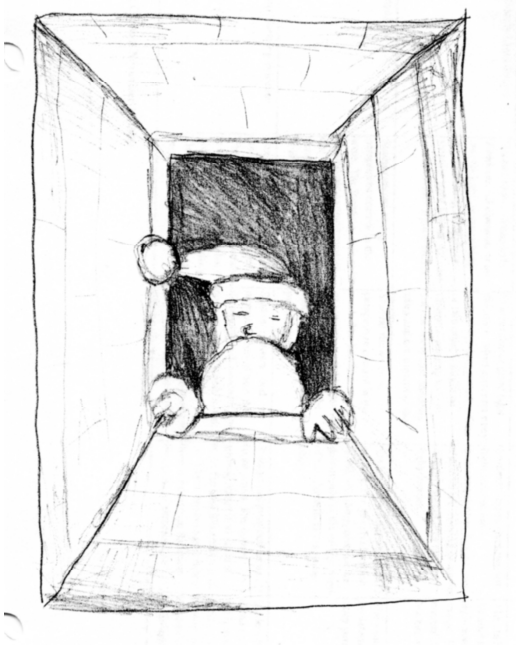
Stanza 7

APPENDIX L
Example of the Advanced Illustration Group A
Revised thumbnail sheet



Stanza 7

APPENDIX M
Advanced Illustration
Group A First Comprehensive Drawing and Revision



First Comprehensive Drawing
Stanza 7

Revised Comprehensive Drawing

Sanza 7
APPENDIX N
Advanced Illustration – Group A
Final Illustration

Stanza 7