ABSTRACT

BUILD MYTUNE: CHILDREN’S REFLECTIVE PRACTICE DURING MUSIC CREATIVITY PROCESSES

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The current study examined how components of reflective practice interplay with children’s music-making and sharing processes. This study employed a qualitative approach with 11 children who played classroom instruments and researcher-designed computer programs (Build MyTune I and Build MyTune II) while attending music classes. Information pertaining to the participants’ music creativity processes and products, peer interactions, visual representations of their music/works (i.e., drawing artifacts), and interview responses about their thoughts and processes were collected and analyzed. The themes associated with the children’s creativity and knowledge sharing processes were merged into four stages: Stage I: making sense of tools, Stage II: developing strategies and approaching goals, Stage III: completing works, and Stage IV: sharing knowledge. The findings show that reflective practice (knowing-in-action, reflection-on-action, reflection-in-action and on-the-spot-experiment) was interwoven with the studied children’s creativity processes, while the occurrence of novelty and reflective practice varied across individuals and situations. Implications for IT/learning and future research directions (e.g., media, cognitive development, domain knowledge skills, coaching, social interaction, changes as external stimuli, and intention/motivation) were discussed with respect to the factors that played an important role in the studied children’s creativity and reflective practice models.
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BUILD MYTUNE: CHILDREN’S REFLECTIVE PRACTICE DURING MUSIC CREATIVITY PROCESSES

BY

CHIA-PAO HSU
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Director:
Wei-Chen Hung
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CHAPTER 1
INTRODUCTION

Creativity is one of the most significant human behaviors, yet it is one of the most ambiguous phenomena in life (Maitland, 1976; Marakas & Elam, 1997; Plucker, Beghetto, & Dow, 2004). Creativity has been identified as a significant force of benefits in the competitive business world, an essential criterion of artworks, a drive to change human lives through discovery and invention, and a focus of the National Educational Technology standards for the next generation of students (Amabile, 1998, 2012; Amabile, Conti, Coon, Lazenby & Herron, 1996; Dacey & Lennon, 1998; Guilford, 1950; International Society for Technology in Education, 2007; James, 1997; Kennedy, 2002; Mumford & Gustafson, 2012; Sternberg, 2001). Creativity can occur as eminence or apply in everyday activities, but a debate continues over whether it can be taught or not (Dacey & Lennon, 1998; Plucker, Beghetto, & Dow, 2004). To think or act creatively means to go “outside of the box,” but how is it possible for one to think and act beyond one’s mindset and experience? This research study explored this issue by reviewing the theories and observing the practice of creativity, knowing, and action.

Even being intentional, a person may still not be able to think or act outside of the box. The study of Nine-Dot Problem solving is one of the examples. Most of the people could not solve the problem required of drawing four straight lines to cross all nine dots, because they assumed that these four lines cannot be exceed the square outside of nine dots; regardless there is no such rule given (Dacey, 1989). Research efforts denote that creative problem solving associates most critically with lateral thinking (opposed to vertical thinking) and divergent
thinking (opposed to convergent thinking) (de Bono, 1970; Guilford, 1950; 1957). In the example of the Nine-Dot Problem, breaking assumptions formed by one’s cognitive schema may be the way to expand possibilities, yet it is a great challenge because many factors, such as personality, social-cultural environment and motivation, play a role in the model of creativity. The theory of creativity involves not only cognitive processes and personality traits, but also relates to socio-cultural factors, motivation and biological features (Amabile, 1993, 1996; Dacey & Lennon, 1998).

Considering how creativity has been discussed and defined in the field of educational technology can help us examine whether this field has an instructional design (ID) model for creativity. In an earlier discussion of instructional design and creativity, Dick (1995) suggested that creativity may be the third criteria for evaluating instruction, after effectiveness and efficiency, and that creativity can be associated with motivation, playfulness, aesthetics and unusualness. This implies that creativity is only an instructional approach to motivate learners. With a different opinion, Rowland (1995) claimed that “design, by definition, is creative” (p.18) as it initiates changes. In this instance, creative design is an elegant and unique way of problem solving, and is inherent in the process of instructional design. Both authors agree that expert designers do not exactly follow the instructional design models (e.g. ADDIE, Dick & Carey Model, etc.) in the real world; therefore, the results of their designs could be unique. The core differences are concerned with the perception and the purpose of instructional design and creativity. Molenda and Boling (2007) introduce a type of creativity that instructional designers constantly employ in informal design processes without consciousness. Although this statement seems contradictory with the concept of the traditional systematic approach of instructional technology, such paradox is possible under the postmodern paradigm, which values the binary of
design and anti-design, and favors reflective thinking (Visscher-Voerman & Gustafson, 2004; Yeaman, Hylenka, Anderson, Damarin, & Muffoletto, 1996).

Having historical roots from literary criticism, art connoisseurship and social science, postmodernism is opposite to modernity, or the belief of ultimate best ways (Stanbridge, 2003; Yeaman et al., 1996). The advantage of a postmodern framework for the context of creativity is that it embraces plurality and allows the building up of instruction and goals during the instructional processes (Merrill & Wilson, 2007). Postmodern strategies, such as deconstruction and non-linear presentation, also enhance critical thinking and unique interpretation since these strategies result in multiple perspectives and personal ways of interacting with materials (Yeaman et al., 1996).

Visscher-Voerman and Gustafson (2004) investigate how current instructional designers actually practice. They found that the classic instructional design (ID) models and their variations, were applied most often, and were found to be the best approach in a range of various situations. Yet, none of the designers interviewed, used an artistic approach, which is underpinned by the postmodern framework and has the strength of resulting in creative processes and products. Another set of studies by Moallem (1998) and Young, Reiser and Dick (1998) show that expert teachers are often the users of the artistic approach described in Visscher-Voerman and Gustafson’s article. Superior teachers only employ the traditional ID model loosely in classroom teaching, and their planning and design strategies involve expertise, past experience, personal beliefs and social context (Moallem, 1998; Visscher-Voerman & Gustafson, 2004; Young, Reiser & Dick, 1998).

Creativity in the business world needs more than thinking outside of the box, however: the usefulness, knowledge development and sharing and change management are important in
determining whether creative ideas turn into creative products (Amabile, 1998; Brown &
creativity, composition, mindfulness, tolerance for ambiguity, etc. that are valuable for both
individual and organizational creativity. In the notion of connecting knowledge sharing to
knowledge creation and with individuals and organization, community-of-practice is a useful
model as it describes the process of how learning and innovation are enabled through the
participation and negotiation during the community based practice in which individuals develop
meanings while interacting with the external world and reflecting on their internal world
(Wenger, 1998). These researchers (Amabile, 1998; Brown & Duguid, 1991; Dick, 1995;
Yeaman et al., 1996; Young, Reiser & Dick, 1998) have established the ground for discussing
instructional design, knowledge sharing and knowledge creation, and support the necessity of
using reflective practice to foster creativity.

My interest in creativity is drawn from my experience of being a musician and a teacher.
As a musician, I learned to always be open to new ideas; listen and respond to the sound
spontaneously; and, to be reflective of myself and my works. As a teacher, I believe it is
important to help students learn musical components; explore various musical cultures; and, use
music to express feelings and construct their own ways of thinking. Therefore, the primary focus
of this research was to study children’s reflective practices while they are making music. I
believe in the importance of artistic creativity in education, and propose a need for teachers and
instructional designers to understand children’s external and mental processes in order to design
environments that foster creativity. It is my goal to learn from individual’s reflective practices
through creativity and knowledge sharing processes.
The following sections present the theoretical foundation of reflective practice and its connection to creativity, the problem statement, the significance of the study, and the definitions.

Theoretical Construct

Postmodern thinking did not only support the artistic instructional design that was used for this project, but also influenced the research design. Creativity and knowledge sharing in the context of music involves a complex process of actions: listening, revising, decision making, and imagining (Kennedy, 2002; Webster, 1990). Since the meaning of music is highly interpretative, it offers freedom and challenges in reflecting and meaning making (Langer, 1953). The value of studying creativity in the context of music is that creativity relates to ill-defined problem-solving and affective domains (Eisner, 2002; Hargreaves, 1986). If the goal of Educational Technology is to improve human learning (Association for Educational Communications and Technology, 2007), then teachers and designers should recognize that human beings encounter ill-defined problems and work with the combinations of different domains in everyday life. Even though music is an artistic activity, however, it does not always promise opportunities for creativity. In classrooms, creativity becomes a tool for learning musical concepts, exploration, self-expression, or critical and creative thinking depends on teachers’ perceptions, goal setting and strategies (Strand, 2006).

Schön’s Reflective Practice

Schön’s reflective thinking/practice has been discussed in the field of education, design, organizational learning, creativity, architecture, health profession and music (Jonassen, 2004; Waks, 2001). Schön’s (1983, 1987) reflective model provides an insightful framework of how
professionals work. Schöns notion of reflection-in-action explains how reflection responds to action simultaneously and possibly changes future actions. The reflective conversations among individuals’ past experience, physical engagement and the constantly changing situations then generate the indeterminate zone, which allows unexpected surprises or intentional exploration. For this reason, the model of reflective practice may lead us to understand the phenomenon of creativity from the perspectives of personal, physical and social levels in everyday practices. Schöns reflective practice model was used as the core model for this research project. The research questions were constructed according to this model and the assumption of its relations to creativity.

Bamberger’s Studies

Bamberger’s studies (1991, 1999, 2003, 2011) have been centered around her interest in understanding how knowledge is developed through the context of musical activities. She discusses the differences of knowing how to do something and knowing about something. Her contention is that knowing is not a static thing; what one knows about something may be developed, evolved and changed. She used the example of hearing music: passive listening to sounds is different than active meaning-making during appreciation. This explains how novices and experts hear differently even when presented with the same piece of music. Bamberger (1991) proposed that hearing is shaped by our daily exposure to the sounds and culture and it can be constructed through working and having dialogs with the phenomenon. To understand the relationship between know-how and know-about, she developed experimental tasks to observe participants’ processes of working on pitch-time relations. The space arrangement and sequence of actions were analyzed to understand participants’ internal processes and hearing. One of these
experimental tasks, in which the participants were asked to use Montessori bells to construct simple tunes, was the basis of my research design framework.

**Amabile’s Creativity Model**

In addition to Schön’s reflective model and Bamberger’s study, Amabile’s (1996) model was useful for understanding creativity. Even though there are various models of creativity, such as Guilford’s creative problem solving model (1957), Webster’s (1990) model of music creative process, and Domain-Individual-Field-Interaction (DIFI) developed by Feldman, Csikszentmihalyi and Gardner (1994), Amabile’s model incorporates both cognitive and social aspects. The components in this model were used to guide the discussion of the findings of studied children’s creativity processes.

Amabile (1996) proposes three essential components for creativity processes and outcomes. They are 1) domain relevant skills, 2) creativity relevant processes and 3) task motivation, and each one of them contributes to different stages of creativity processes. For examples, the task motivation is related to Stage I—problem or task identification and Stage III—response generation, the domain-relevant skills have impact on Stage II—preparation and Stage IV—response validation and communication, and the creativity-relevant processes are tied to Stage III—response generation. Amabile’s model explains why some people who have domain-relevant skills may not produce creative outcomes. In cognitive development, the skills required for building up, storing information, and testing the response possibility are different than the ability of immediate searching for and generating information. The consideration of intrinsic and extrinsic motivation is also important in the initial stage of the creativity processes. In addition to
describing how these components function at the cognitive level, Amabile’s model also examines how the social environments play an essential role among these components.

Research Questions

The purpose of this study was to examine how components of reflective practice interplay with children’s music-making and sharing processes. In light of the reflective practice model and children’s processes of creativity and knowledge sharing, the following research questions were explored:

1) What are the studied children’s creativity and knowledge sharing processes?
2) How do the studied children practice reflective thinking and action during/after their creativity and knowledge sharing processes?
3) How does novelty generation occur during the studied children’s music making processes?

Significance of the Study

Studying children’s processes of creativity and knowledge sharing using a reflective practice model will help educators and instructional designers understand how individuals’ backgrounds, media and the experience of creativity and knowledge sharing are interrelated. In Eisner’s (2002) article, he calls for uncertainty to have a proper position in school education, which currently emphasizes outcomes and quantitative modes. Eisner claims education can learn from the arts. By engaging in artistic activities that encourage creative processes and products, learners practice how to integrate scientific and artistic approaches, work on the inseparable forms and content and learn to appreciate multiple perspectives. By focusing on the processes of
creativity, this study sought to avoid the arguments of origin (whether an individual is born with creativity) and outcomes (appropriate criterion for measurement) and to emphasize creativity as an experience of meaning making on personal and cultural levels.

This study adds to the body of postmodern literature on Educational Technology, which gives value to knowledge creation and supports an artistic approach to instructional design (Visscher-Voerman & Gustafson, 2004; Yeaman et al., 1996). To understand why and how the studying of music creativity can contribute to Educational Technology, one must consider the possibility that 1) Educational Technology needs to borrow theories of creativity from many other domains and develop its own, 2) studying the processes of creativity will help to understand creative problem-solving or problem-solving in ill-defined situations and 3) studying the reflection in/on the processes of creativity will enhance the understanding of how knowledge is shared and created under various settings, such as education or work environment.

As the interest in creativity increases, professionals in educational technology recognize the importance of creativity in technology innovation, media production, organizational knowledge creation, motivation, gaming, teaching and learning (Cook & Brown, 1999; Jonassen, 2004; Kerr, 2004; Krendl & Warren, 2004; Molenda & Boling, 2007; Rieber, 1996; Rogers, 2003; Rowlan, 2004; Seels, Fullerton, Berry, & Horn, 2004). However, there seems to be a lack of connection between the literature in Educational Technology and the traditional creativity theories—Guilford, (1950) and Torrance (1974), creativity intelligence—Sternberg (2001, 2006a, 2006b), assessment—Amabile (1996) and Torrance (1974), social environment—(Amabile (1993, 1996), personality, or artistic creativity. My review of the literature from various domains initiates such a connection, and looks forward to future development of a creativity theory linking media, education, and human potential.
It is important for teachers to recognize children’s potential for creativity. Without understanding children’s creativity processes and the related factors, the goals and strategies of teachers and instructional designers may not allow for critical and creative thinking, with the activities becoming too restraining, resulting in mindless exploration. While researchers acknowledge that the field of educational technology should learn from the arts and music, there is no guarantee that the creative will happen in all general music classrooms. In a survey of Indiana music teachers on using composition in the classroom, the results indicate that only 5.9% of 339 participants used composition often and 39.8% used composition occasionally in classrooms (Strand, 2006). The survey includes using a Likert-type scale and open-ended questions on the demographics, practice and opinions sections (Strand, 2006). Strand also wanted to find out characteristics of teachers who use or do not use composition; the reason for using or not using composition; and teachers’ definitions of composition in their task goals. The results indicate that there were no significant effects on teachers’ characteristics (years of teaching, years at school, classes taught, certified, National Standards used, etc.) and their use of composition as tasks.

The majority of teachers indicated that the goal of using composition is to teach, apply, rehearse or assess musical concepts and skills, rather than promoting creativity itself (Strand, 2006). Although there could be various reasons given about why music teachers teach or do not teach composition in the classroom, one of the difficulties may relate to creativity as ill-defined problem solving. Creativity is considered as ill-defined problem-solving because one does not know what the end result is until it is has been completed (Maitland, 1976). Facing the fast changing world and ill-defined real-world problems, reflective practice is useful because it allows action, reflection and modification to occur simultaneously in authentic environments.
(Schön, 1987). This type of practice is associated with the artistic approach of instructional design, and its strength is identified as leading into unique and creative processes and products (Visscher-Voerman & Gustafson, 2004).

Definition of Terms

Creativity. The creativity defined for my problem area is a phenomenon, including the origin, process and product as a whole. It is an everyday activity rather than rare cases of genius, and it relates to creative problem-solving or problem-solving for ill-defined situations. The essential components that distinguish creativity from other phenomena are the novelty and appropriateness based on the social context and personal beliefs (Amabile, 1996; Amabile et al., 1996; Csikszentmihalyi, 1996; Dacey & Lennon, 1998; Maitland, 1976; Marakas & Elam, 1997; Plucker, Beghetto, & Dow, 2004; Sternberg, 2001).

Knowledge. Nonaka (1994) describes information as a flow of messages or signals and knowledge is created and organized by the information, which an individual receives or perceives according to the individual’s belief system. While individuals’ belief systems are dynamically influenced by the experiences, the actions and the environments, knowledge creation or sharing can be categorized into four major dimensions—tacit, explicit, individual and group (Cook & Brown, 1999). My definition of knowledge generally follows the theory of organizational knowledge mentioned above. There will be further discussion in the literature review section about the issues of whether different dimensions of knowledge can be converted and whether new knowledge is generated automatically during the knowledge sharing processes.

Reflective Practice. The model of reflective practice consists of knowing, action, reflection, and outcome (expected or surprised). The detail of how this model works and the description of each
component will be explained in the literature review. The concept of action can be thoughts or external movement about imaginations, repetitions, explorations and decision making. Reflection is an introspective monitoring of one’s states or processes. This notion of reflection can be associated with meta-cognition and it can be synchronized or asynchronized with action. In a postmodern approach of instructional design, reflection is critical and is influenced by personal experience and social/cultural systems (McAlpine, Weston, Beauchamp, Wiseman, & Beauchamp, 1999; Rueda & Mehan, 1986; Schön, 1983; Wilson, 1997).

Glossary

The following terms were used in this study:

**Arpeggio.** Notes of a chord played in succession rather than simultaneously (Oxford Music Online, 2015)

**ASP.** Active Server Pages (W3cSchools, 2015)

**Bell trees.** Chromatic set of small cup bells mounted concentrically one above the other on a handle (Oxford Music Online, 2015)

**Bongo.** Pair of small Afro-Cuban single-headed drums with conical or cylindrical hardwood shells (Oxford Music Online, 2015)

**Boomwhackers.** Tuned tubes in various sizes, lengths and colors (Boomwhackers, 2014)

**Castanets.** Small set of clappers originated from Span (Oxford Music Online, 2015)

**Chimes.** Set of small metal sticks arranged by length, played in glissando sound (Oxford Music Online, 2015)

**Chord.** Two or more notes sounded simultaneously (Oxford Music Online, 2015)
**Conga drum.** Barrel-shaped Afro-Cuban drum usually played with the hands. Conga drum has been adopted as a classroom instrument (Oxford Music Online, 2015)

**CPU.** Central processing unit (Oxford Dictionaries, 2015)

**CSS.** Cascading Style Sheets (W3cSchools, 2015)

**Dominant.** Fifth degree of a major or minor scale (e.g. G chord in the C major scale). One of the three important degrees to function in the chord progression (Oxford Music Online, 2015)

**Dominant seventh chord.** Consists of a major triad built on the fifth scale degree with an added minor 7th; the dominant 7th of C major (or minor) is G–B–D–F. The dominant seventh chord has a strong tendency to resolve to the tonic. (Oxford Music Online, 2015)

**HTML.** Hypertext Markup Language (Oxford Dictionaries, 2015)

**JavaScript.** Object-oriented programming language used to create interactive effects in web browsers (Oxford Dictionaries, 2015)

**Lollypop drum.** Hand drum (in various sizes) with handle, painted as lollypop (Remo, 2014)

**Maracas.** Pair of gourd (or wood, plastic, etc.) rattles with seeds or beads inside the gourd (Oxford Music Online, 2015)

**Metallephone.** Series of removable tuned metal bars lay on top of a wooden box (resonator). This instrument is used for music education Orff method. (Oxford Music Online, 2015)

**Motive.** Short musical idea: melodic, harmonic, rhythmic, or any combination of these three (Oxford Music Online, 2015)

**Orff xylophone.** Series of removable tuned wooden bars lay on top of a wooden box (resonator). This instrument named after Carl Orff for is adopted from xylophone models of many cultures and is used for music education Orff method (Oxford Music Online, 2015)
**Pitch.** Particular quality of a sound that fixes its position in the scale (Oxford Music Online, 2015)

**Pitch-time.** Quality of the sound that consists of pitch and duration

**RAM.** Random-access memory (Oxford Dictionaries, 2015)

**Rattles.** Shaken container in various form, with small hard objects (e.g. dried seeds) inside the container (Oxford Music Online, 2015)

**Scale.** Series of single notes progressing up or down stepwise (Oxford Music Online, 2015)

**SQL.** Structured Query Language (Oxford Dictionaries, 2015)

**Sub-dominant.** Fourth degree of a major or minor scale (e.g. F chord in the C major scale). One of the three important degrees to function in the chord progression (Oxford Music Online, 2015)

**Tambourine.** Small single headed frame drum surrounded by small metal discs (small bells) (Oxford Music Online, 2015)

**Tempo.** Speed of music (Oxford Music Online, 2015)

**Thunder tube.** Tube with spring attached to the framed head of the tube. The vibrations of the spring can transmitted to the head by shaking the tube (Remo, 2014)

**Tonic.** First degree of a major or minor scale (e.g. C chord in the C major scale). One of the three important degrees to function in the chord progression (Oxford Music Online, 2015)

**Triangle.** Metal shaped percussion instrument struck by a metal stick to make tinkling sound (Oxford Music Online, 2015)

**Tubanos.** Set of African drums in contemporary style (Remo, 2014)

**USB.** Universal Serial Bus (Oxford Dictionaries, 2015)

**VBScript.** Visual basic Script (W3cSchools, 2015)
CHAPTER 2

LITERATURE REVIEW

The purpose of this study is to examine children’s creativity and knowledge sharing processes in the context of music activity. In particular, this study examines how components of reflective practice interplay with the children’s music making and sharing processes. The literature review is organized as follows: I will begin with a general overview of creativity theories, with a special focus on Amabile’s (1996) studies, as her model of creativity addresses the issues of motivation, components in creativity processes, criteria for assessment and influence of the social environment on creativity. The second set of literature introduces the discussion about knowledge and ways of knowing by Cook and Brown (1999) and Rowland (2004). This discussion is important for setting up the gaps between theory and practice and leading to the concept of Schön’s (1983, 1987) reflective practice. The final set of literature relates to music creativity. Bamberger’s (1991) study was the highlight, especially because her study captures the essence of discussion regarding creativity, music, knowledge and knowing, which was used as the blueprint for my study.

Creativity

Definitions and Theories

According to Dacey and Lennon (1998), creativity involves studies from different disciplines, including brain biology, cognitive process, multiple intelligence, flow theory,
personality traits, humanism, lateral thinking, creativity processes and motivation, etc. The various debates reflecting the phenomenon of creativity are quite complex (see also Plucker, Beghetto & Dow, 2004). Because of the advancements in these domains that contribute to the studies of creativity, some of which will be discussed below, we are able to examine this phenomenon from different perspectives and understand creativity more than we previously could.

Research on creativity has been studied regarding the definitions (e.g. types of creativity), criteria (e.g. measurement, factors, etc.) and processes (e.g. when and how it happens) about creativity (Dacey & Lennon, 1998; Plucker, Beghetto & Dow, 2004). Guilford (1950) was the first researcher who raised the issue that creativity is beyond domain intelligent (e.g. genius of certain subject domains or high IQ), which was a common belief at the time. Guilford (1950) also pointed out the lack of study in creativity before the 1950s and the difficulty of measuring creativity criteria because the early studies done by Skinnerian behaviorists that applied to animals’ learning behaviors were insufficient to explain complex creative human behavior. Guilford’s advocacy of creativity research and mention of divergent thinking as one of the creativity traits were perceived as landmarks to draw more attention to the study of creativity.

Generally, definitions of creativity are debated among three components—origin or idea, process, and product. Marakas and Elam (1997) note that the definition of creativity has evolved from the ancient concept of genius into two approaches—origin-oriented and process-oriented. The examples supporting the origin-oriented approach focus on how it happens. The process-oriented group of definitions deals with the process of creativity as it can be learned. In addition, the novelty of an outcome is judged by the unusualness, and the appropriateness of an outcome is judged by the correctness, usefulness and quality (Amabile, 1996; Sternberg, 2001). Amabile,
Conti, Coon, Lazenby, and Herron (1996) categorized the organizational innovation into two portions—creativity and innovation. Creativity is defined as the product of original and useful ideas. Innovation is defined as successful implementation of new ideas.

Taking a different way to look at the function of creativity, Maitland (1976) claimed that artistic creativity is different than purposive creativity. The creativity process is parallel to problem-solving strategies; they both involve some kind of exploration, production, search for solutions and evaluation. The main argument is that problem-solving usually begins with identifying or observing a problem or problems, but creativity can begin with removal of individual conflicts, which are presented as problems, or as joyful inspiration that are not presented as a problem at all (Dacey & Lennon, 1998; Marakas & Elam, 1997). Sometimes problems are undefined. For example, an artist may not know what the end product is until he/she begins to engage in the process. The following paragraphs, transcribed by Sawyer (2000) from a documentary film, depict the scenario of an artistic creativity:

In his studio, Picasso is painting free-form, with-out preconceived image or composition; he is experimenting with colors, forms, and moods. He starts with a figure of a reclining nude—but then loses interest, and the curve of the woman's leg reminds him of a matador's leg as he flies through the air after being gored by a bull-so he paints over the nude and creates an image of a bull and matador. But this leads him to yet an-other idea; he paints over the bullfight image and begins work on a Mediterranean harbor-with water-skier, bathers in bikinis, and a picturesque hilltop village.

The free-form inspiration continues. Five hours later, Picasso stops and declares that he will have to discard the canvas—it has not worked. But the time was not wasted—he has discovered some new ideas, ideas that have emerged from his interaction with the canvas, ideas that he can use in his next painting. Picasso says, “Now that I begin to see where I'm going with it, I'll take a new canvas and start again.” (p. 149)

Plucker, Beghetto and Dow (2004) reviewed studies and stereotypes about creativity and concluded that stereotypes are caused by the lack of adequate precision in the definition of creativity. They found that pervasive assumptions about creativity include: 1) people are born
creative or uncreative; 2) creativity has a negative connotation; 3) the concept of creativity is vague; and, 4) creativity is enhanced within a group. These assumptions are seen as pitfalls by the authors. They suggest a definition of creativity that emphasizes not only the novelty and usefulness of creativity, but also the social context from which it emerges. They propose that to address the question of “creativity for whom and in what context” (p.92) will help connect the study of Big C creativity (eminence) and little c creativity (everyday creativity).

**Measurement and Criteria**

The early studies during 1950s and 1960s on creativity have been focused on personality traits and intelligent factors (Amabile, 1993; Guilford, 1950, 1957, 1959; Kettner, Guilford, & Christensen, 1959; Merrifield, Guilford, Christensen, & Frick, 1962). Guilford’s (1956) creativity factors--fluency, flexibility and originality, derived from divergent thinking, were influential to his and others’ subsequent research and measurement practices on creativity, such as Guilford’s creativity test, Torrance’s Tests of Creative Thinking, and Webster’s measurement of creativity behavior in music and selected variables (Hickey, 2001; Torrance, 1961, 1974; Webster, 1979). Guilford’s contribution to the research and application of creativity also includes the use of a factor design approach to study the characteristic and components of creativity. As more factors were found to be associated with the creativity, the model became more inclusive and mature. Guilford’s Structure-of-Intellect (SOI) model was first introduced in 1959 in which factors of creativity were categorized into three dimensions: Content (visual, auditory, symbolic, semantic, and behavioral), Product (units, classes, relations, systems, transformations, and implications) and Operation (evaluation, convergent production, divergent production, memory...
retention, memory recording, and cognition). This model influenced many other inquiries and creativity tests including Torrance’s (Bachelor & Michael, 1997).

Some of Torrance’s research including the development of creativity test (Torrance Tests of Creative Thinking) was guided by the SOI model (Bachelor & Michael, 1997; Torrance, 1961, 1974). In Torrance Tests of Creativity Thinking, the quality of fluency, flexibility, originality and elaboration based on their verbal and figural abilities are evaluated (Torrance, 1974). Torrance was also interested in studying the individual differences of creativity and the different effects of creativity as well as taking a psychometric approach to understand creativity (Sternberg, 2006b; Torrance, 1961, 1970, 1971, 1993; Torrance, Gowan, Wu, & Aliotti, 1970; Torrance & Harmon, 1961). Beside Torrance’s effort on measurement of creativity, Runco and Acar also contribute to the studies of creativity tests (Acar & Runco, 2015; Runco & Acar, 2010). Runco and Acar (2010) questioned whether the divergent tests legitimately measure divergent thinking, considering it as one of the critical creativity traits. In one of the studies, they investigated whether the divergent tests are biased by participants’ personal and social experiences (Runco & Acar, 2010). Runco and Acar’s study consisted of two phases in which the participants were asked to complete the Uses and Problem Generation Tasks during the first phase and asked to self-evaluate their responses as influenced by personal or social experiences. They conducted multiple regression analyses to determine the amount of variance in divergent thinking tasks explained by personal and social experiences. The findings from this study support their hypothesis that both personal and social experiences have significant effects on the divergent thinking tests.

Creativity tests have been adopted to predict the potential of creative individuals, yet the traditional focus on the psychometrics/personality traits has limitations to assess the impact of
components from other areas such as social environment and motivation (Amabile, 1993, 2012; Sternberg, 2006a, 2006b). Sternberg (2001) discusses the relationships between intelligent and creativity and states that wisdom is important in determining when and what is needed for changes without falling into the argument of crowd-defying or crowd-pleasing. Sternberg’s interest in creative intelligence makes ways for him to take an investment theoretical approach in which creativity requires a confluence of six distinct but interrelated resources: intellectual abilities, knowledge, styles of thinking, personality, motivation, and environment (Sternberg, 2006a, 2006b). In terms of validity of creativity tests, Amabile raised an important issue of subjectivity in judgment of artistic quality for creativity (Amabile, 1982, 1996, 2012; Hennessey & Amabile, 1998). A technique called Consensual Assessment, developed by Amabile, was used to examine the social and environmental effects of creativity by using experts’ global and subjective assessment of creative products (Amabile, 1982, 2012). This approach has influenced many field experiments in social psychology and products in educational settings in various cultures (Amabile & Pillemer, 2012; Hickey, 2001)

Amabile’s Creativity Studies

Creativity and Motivation

Amabile’s studies inform very important concepts about creativity processes (Amabile, 1979, 1985, 2012; Amabile, Hennessey, & Grossman, 1986; Hennessey & Amabile, 1998). Her research about motivation and social-cultural factors on creativity has greatly influenced the studies and practices of creativity in the fields of education and business. Amabile’s early studies (1979, 1985), which involved children and adults working on verbal and artistic tasks, focused
on the following: The effects of external evaluations on creativity; contracts-for-reward; and the effects of intrinsic versus extrinsic motivation on creativity. The empirical evidence from these studies suggested that extrinsic motivation could alter states of intrinsic motivation and have negative effects on creativity. While intrinsic motivation may be related to higher levels of novelty and unusualness, intrinsic motivators in the organizational environment may not focus on the usefulness of ideas (Amabile & Pillemer, 2012). Studies by Amabile and others about organizational creativity will be discussed under the knowledge sharing and knowledge creation section.

Components in Creative Process

In the article—“What Does a Theory of Creativity Require?” Amabile (1993) acknowledges various creativity theories and reinforces that social environment, which contributes to the motivation of the creativity, plays a crucial role in creativity processes. Amabile (1996) categorized four stages of creativity processes: Stage I – problem or task identification, Stage II – preparation, Stage III – response generation and Stage IV – response validation. Three essential components were proposed for creativity processes and outcomes: 1) domain relevant skills (technical skills relevant to the domain knowledge), 2) creativity relevant processes (functional freedom, risk taking, suspension of judgment, etc.) and 3) task motivation (intrinsic motivation, nonsynergistic extrinsic motivation and synergistic motivation). Each of the components contributes to different stages of creativity processes. For example, the task motivation is related to Stage I – problem or task identification and Stage III – response generation, the domain-relevant skills have impact on Stage II – preparation and Stage IV –
response validation and communication, and the creativity-relevant processes are tied to Stage III – response generation.

There are many other models/frameworks describing the components of creativity and/or the relations to the process of creativity such as SOI mentioned above, Webster’s music creativity model (1990), Wallace’s (1926) stages of art of thoughts, Domain-Individual-Field-Interaction (DIFI) by Feldman, Csikszentmihalyi and Gardner (1994), etc. Among these contributors, Amabile’s (1996) creativity model is important to my study because not only was this model adopted by general educators or other professionals (Hickey, 2001, 2003), it offers a comprehensive view of what goes into and comes out of the process, how the components interact with each other and, most importantly, how the factors related to social environment and motivation are considered in this model.

Knowledge Sharing and Knowledge Creation

**Knowing vs. Knowledge**

Cook and Brown (1999) argue that knowledge is a tool of knowing that features both social and physical interaction. They explain how the interplay of knowledge and knowing, which the authors call “generative dance,” can create new knowledge and new ways of knowing (p.393). In their article, research about explicit and tacit knowledge, knowledge acquisition by individuals in an organization, concepts concerning the management of intellectual capital, and organizational innovation were discussed. Cook and Brown (1999) point out that the typical assumption in those studies tends to privilege individuals over organizations and explicit over tacit. They also disagree that tacit knowledge can be converted into explicit knowledge. The
notion of epistemologies—from the four categories of tacit/explicit versus individual/group—is that each form of knowledge is distinct and does the work others cannot (Cook & Brown, 1999).

Polanyi (1966) was an early advocate of tacit knowing. Building from Polanyi’s (1966) philosophy about tacit knowledge, the example of riding a bicycle describes the distinction of tacit and explicit knowledge. Anyone who can ride the bicycle knows how to keep it upright but cannot say when and which way exactly to turn the handlebars without being in the context. This ability is developed from practice and the possession of knowledge is within the individual, even when one is not riding. An expert can describe to a novice how to ride (sharing explicit knowledge); the novice can use this explicit knowledge as an aid, but cannot ride the bicycle until spending time practicing (acquiring the tacit knowledge) (Cook & Brown, 1999).

Taking Dewey’s (1938a, 1938b) theories inquiry, Cook and Brown (1999) state the role of knowing and knowledge in such epistemology emphasizes learning by doing. The authors further suggest a metaphor of “generative dance,” which needs to involve all four forms of knowledge within the interaction of the same activity. The individual level of practice, choreographer’s demonstration, group rehearsal, and performance interact dynamically and provide an opportunity to generate knowledge acquisition or create new knowledge.

Can all types of dance be claimed as a generative dance? Rowland (2004) probes the weaknesses of Cook and Brown’s (1999) article about how new knowledge and new ways of knowing are created. Rowland argues that generative dance does not create innovation automatically; human intention is the key role that enables the dance to become design-like. Through the discussion about generative dance and linking the literature related to learning and performance with design, Rowland (2004) proposes an epistemology of design at an organizational level and claims that intention is the key of generative dance.
Rowland (2004) synthesizes Cook and Brown’s (1999) theory and raises questions about what could trigger and guide the generative dance. Rowland’s notion is that, for dance as a way of expression, music is the external stimuli and guidance for the movement and patterns. The generative dance Cook and Brown talk about should not be any type of dance, but a dance can create a new dance. In Rowland’s opinion, intentionality guided by reflection-in-action and reflection-on-action is required to develop the environment, knowledge, and skills associated with creativity. It is the constant reflection (feedback) that guides learners toward meaning making within the new (e.g. stimuli) and old (e.g. existing mental model). Without engagement or intention, knowledge can only be represented or transferred rather than meaningfully created.

Both Cook and Brown’s (1999) and Rowland’s (2004) articles are essential to my research because they provide a framework of reflective practice and make connections to creativity and knowledge sharing. Rowland (1995) defined the criteria of designing that require reasoning, intuition, action, and the ability of reflection upon action, so a more artistic and creative design process and product would be the result. Rowland (2004) concludes his article with an implication of design competency based on the notion of whether the development of knowledge is a type of design. The competencies list creativity as one of the key components of design.

**Theory and Practice**

Schön (1992) pointed out the gap between thought and action, theory and practice, and the academy and the everyday world. He explained that the gap is caused by the fundamental differences between knowledge and knowing and how people have mistaken them. Failure to recognize such gaps will become a dilemma when students only learn through the curriculum or
instructional design materials based on theories generated from scientific experiments in controlled environments rather than learn from the real-world practice. This dilemma is more evident when it is presented in the field of teacher education.

Young, Reiser and Dick (1998) studied a group of superior elementary and secondary school teachers, examined their instructional planning procedures and decision making, and compared whether their practices used a systematic approach of instructional design. The authors collected qualitative data by using survey questionnaires and face-to-face interviews regarding the detail of planning procedures, the practice of plans and the external factors that might influence the planning decision-making at the yearly, unit, weekly, and daily levels. The participants of this study were nine superior teachers from a single school district located in a metropolitan area in the southeastern United States. This study shows that the major difference between teachers’ planning practice and the systematic approach of instructional design is the objectives. While objectives are the essential keys in instructional design, superior teachers did not emphasize or identify objectives explicitly or create tasks based on objectives.

Another study by Moallem (1998) provides a broader and more in depth literature review, examination, and discussion in the phenomenon of employing instructional design and models from a teacher’s perspectives. In this case study, a naturalistic approach of ethnography combining multiple methods was conducted over seven months to understand an expert teacher’s conceptual and practical model of instruction and planning; furthermore, this model was compared to the instructional system design models and principles. Moallem’s (1998) study focuses on content, process, and relationship among factors—the teacher’s experience, knowledge, planning and interactive teaching, and reflections. The author reports that the teacher as a designer and practitioner brings in practice-centered knowledge situated within the social
context of previous experience, assumptions, beliefs, curriculum, and interaction with schools, parents, colleagues, and students.

The fundamental differences between the model drawn from this expert teacher’s planning and decision process and the systematic instructional design models are 1) whereas social context plays an important role in teacher’s model, instructional design models ignore the designers’ social context as part of the filter and sources in building instructional objectives; 2) the unique and complex situation in classrooms requires the teacher to reflect upon action and making decisions spontaneously; therefore, the design process cannot be reduced to abstract and linear procedures; and 3) the teacher’s model of solutions to problems is socially and culturally constructed, but instructional design models are based on a cognitive construct.

Both studies contribute to Educational Technology research; they disclose an issue that there is a distance between theory and practice. In theory, the systematic approach of instructional design is based on research and is supposed to enhance teaching and learning. In practice, superior teachers only employ it loosely in classroom teaching. Many teachers state that their planning and changing of activities are according to students’ needs and reactions in classrooms. The weakness of Young, Reiser and Dick’s (1998) study is that they do not provide a theoretical framework to explain the teachers’ models of planning and decision making. In Moallem’s (1998) study, the participant’s pre-active thinking/planning happens before and during the interactive and reflective phases. This result can be supported by Schön’s (1987) reflective practice theory. The expert teacher applied her expertise, past experience, and beliefs, along with the social context into the instructional design.
As Schön (1973) stated in *Beyond the Stable State*, to believe in the stable state serves as a self-protection system and is a means to maintain stability. Stability in human life also presents the elements of identities in self, region, profession, and values. However, problems occur when the identity is blurred during the period of change. In the fast changing technological society today, individuals constantly face problems of instability. Sometimes problems even do not represent themselves as a form of problem, but rather as an ill-defined situation.

The statement of *Beyond the Stable State* is powerful because Schön (1973) points out that the rational problem-solving approach is not enough for the complex or ill-defined situation. However, one might ask how a model of problem-solving adds to the creativity process. According to Argyris and Schön’ theory (Schön, 1987) of organizational learning, when learners interact with the constantly changing world, model II (*double-loop learning*) allowed learners to view valid information, to have freedom of choices and to take risks in results that increase effectiveness more than model I (*single-loop learning*), which controls factors in action strategies and minimizes risk, emotion and exploration. *Double-loop learning* is not only a passive adoption of innovation, but it is also learner-oriented and involves creation of new values and action strategies.

Furthermore, Schön (1987) argues that all professions are design-like. He often brings in case studies from various disciplines and draws implications for education. In *Educating the Reflective Practitioner*, Schön provides cases from education in the performance of composed music, psychoanalysis, and management consulting. In the example of learning music, although the musician is practicing pre-composed music by others, the musician needs to comprehend the
written score and construct meaning in terms of the composer’s style and the performer’s own aesthetics. Performers have to recreate the piece by making their own interpretation, so even for the same piece, different musicians perform it differently. By means of the cycle of action and reflection, a practitioner interacts with self and materials and finds what works for the specific situation.

The concept of reflection usually is assumed to be passive; it can be explained by the cognitive psychology of metal-level state that occurs simultaneously with thinking and action. It is a higher level of thinking process that involves seeing larger patterns of content, context, and process (Feinstein, 2006). Schön (1983) proposes a key concept of reflective practice in the process of meaning making. The first component in reflective practice is knowing-in-action, which is tacit in the sense that it is revealed by action but cannot be described. The tacit knowing-in-action can be labeled as intuition, instinct or motor skills. The notion of reflection-in-action is described as executing activity, recognition, decision and adjustment with smoothness (without interruption). The next component is reflection-on-action, which means thinking back on what one has done (Schön, 1987). The following diagrams are how I illustrate these components working together.
Figure 1. Structure of knowing-in-action and reflection-on-action.

Figure 2. Knowing-in-action encounters unexpected situation.
Figure 3. How reflection-in-action works under the situation of surprise.

Our *knowing-in-action* responds to a situation (see Figure 1). When the routine actions produce an unexpected outcome (a mistake or a surprise), the conflicts between the *knowing-in-action* and the unfamiliar condition draw attention and lead to reflection (see Figure 2).

*Reflection-in-action* then questions the structure of knowing-in-action and gives opportunity to an on-the-spot-experiment. In the stage of *on-the-spot-experiment*, new things are explored and lead to the surprise again (see Figure 3). Any past reflection will shape the future actions and strategies. Sometimes surprise happens in the routine action not because of outside change, but because of a new way of seeing things. An expert’s reflection-in-action process can be very smooth during the performance because experts explore and organize a wide-range of contexts and actions as their repertoire, so they respond to *variation* rather than *surprise* (see Figure 4).
Figure 4. Expert’s model of reflective practice.

The framework of reflection-in-action is not only a theory that explains how new values and action strategies can be created during design; it is also an applicable model for teaching and learning in the real world. Since knowing-in-action is tacit, learners need to engage in reflection and action to understand what they need to construct their own meaning. Some might argue that design cannot be taught, but it can be coached (Schön, 1987; Visscher-Voerman & Gustafson, 2004). Schön (1987) presents a model of coaching design in which the coach offers a ladder of reflection during the combination of telling/listening and demonstrating/imitating process. The ladder of reflection has two directions, up goes to critical thinking and down goes to activities. When a student is trapped in confusion during the indeterminacy, it is the coach’s responsibility to dialog with students to lead to reflection and resolve the problems. The coach then encourages
students to make their own judgments and goals. Eventually, the coach’s and students’ practice will be parallel to the real-world situation.

The reflective practice model was generated from many case studies of different domains. Schön (1983) found underlying similar patterns in the ways of practitioners from various professionals used to deal with uncertainty, instability and uniqueness, but he also found differences. Media is one of the variations. The medium of reflection-in-action cannot be separate from the language and repertoire used, and the skills, feeling about the media, and the ways of interaction actually shape the reflection-in-action. For example, the reflection strategies might be different in notating music in staff, using self-invented notation, not using notation at all or using the record/playback feature of music software.

In an earlier study, Bamberger and Schön (1983) observed two adults without musical backgrounds to understand their processes of grouping five pitched bells, using the bells to compose a short piece, and writing down the instructions. By observing and analyzing the participants’ decision making protocols, Bamberger and Schön discovered how participants revealed their internal structures through the arrangement of external objects within the learning space. The generative metaphor in this study is the conversation. They described that when the participants talked to the materials or each other, it created a shift in how the materials were used and described.

Campbell, Schwier and Kenny (2009) discussed how instructional designers played an active role and interacted with the change agency in the higher education environment. This was a four year project that involved twenty instructional designers from six Canadian educational institutions. The instructional designers who participated in the study were from administrative units that supported the faculty-initiated course development. Four types of change agency:
interpersonal, professional, institutional and societal, were identified through a process of narrative inquiry. The data suggest that the participating instructional designers applied critical thinking in their daily practices, which involved dynamic relations among these four types of agencies. Their identities were shaped by the institutional and social environment, yet they were able to build relationships with learners and influence their surrounding environment. The participating designers expressed feeling powerless when their zone of moral coherence was challenged. Campbell et al.’s study supports the previously discussed study by Moallem (1998) that an expert teacher’s instructional design model has to consider social context as part of the framework. In addition, reflective practice and critical thinking are also the critical components in this instructional design framework as suggested by Campbell et al.’s data.

**Organizational Innovation**

A discussion on organizational innovation can probably serve as a review of previously mentioned concepts—a social-cognitive approach of the creativity model, knowledge sharing and creation, theory and practice and reflective practice. As discussed earlier, a model of organizational innovation requires more than creative ideas (Amabile, 1998; Amabile et al., 1996). First, there has to be a distinction between creative individuals in an organization and a collective creative entity within or representing the organization (Hargadon & Bechky, 2006). Although the creative individuals are usually the starting point of the organizational innovation, it does not ensure that the creative idea will be implemented (Amabile, 1998; Amabile et al., 1996). Therefore, the organizational innovation is defined not just by how many creative individuals are in the organization or the extent of creative ideas the members in the organization
come up with, the innovation lies in the process—the actual practice of the organization as a group (Brown & Duguid, 1991).

Finding the “theory in use” in an organization is the common issue since the ways people actually work are usually different than the ways the organization stated or described in the documentation (Amabile, 1998; Brown & Duguid, 1991). To claim whether an organization is truly innovative or the collective creativity does exist, different methods or instruments of measurement based on the underlying theoretical construct can be used (Amabile, 1998; Brown & Duguid, 1991; Hargadon & Bechky, 2006). An instrument called KEYS was developed to assess work environment creativity in which factors related to the stimulant scales (organizational encouragement, supervisory encouragement, work group supports, freedom, sufficient resources, and challenge) and obstacle scales (workload pressure and organizational impediments) were rated for projects’ creativity leveled low and high (Amabile et al., 1996). The findings support the hypotheses that the work environment stimulant scales rate significantly higher for the high-creative projects than the low-creative projects and the work environment obstacle scales rate significantly lower for the high-creative projects than the low-creative projects (Amabile et al., 1996).

Thinking of creativity as a product or a trait judged by the novelty, usefulness and appropriateness whereas as a process of building up from existing ideas, redefining the current paradigm or integrating divergent ideas as a synthesized one may result in different organizational strategies to promote innovation (Hargadon & Bechky, 2006; Sternberg, 2006b). How does a knowledge-based view explain organizational innovation? Brown and Duguid (1991) proposed a unified view of work, learning and innovation where the knowledge sharing and knowledge creation occur in the community-of-practice (Wenger, 1998). The key is that the
community-of-practice is the actual “theory in use” that the members dynamically negotiate their identity of participation in informal settings embedded in everyday life. Such process of negotiation allows individual members as well as the group to develop new views of their environment rather than follow the steady principles enforced by the formal settings (usually lag in changes). It does not just passively respond to the environment; rather, the community-of-practice continues developing collective creativity through open-minded collaboration that reframes the past-experience and leads to new perspectives, which is a type of model II learning described by Argyris and Schön (Brown & Duguid, 1991; Hargadon & Bechky, 2006; Schön, 1987).

A recent study by West and Hannafin (2011) specifically addressed the phenomenon of collective creativity introduced as Communities of Innovation (COI) framework. Extended from the Community of Practice theory, the COI focuses on shared innovation rather than shared practice. Four instructional design graduate students from three design classes were recruited and examined. Based on the researchers’ observation of participants’ design and collaborative activities and participants’ reflection and reports of incidents that influenced the innovation based on their experiences, several components were described as critical to COI: flow (the works described as interesting or playful that involved high level of enthusiasm and intrinsic motivation), and entrepreneurship (collaborative idea generation, observation, improvisation, sense of community and learning through critiquing), dynamic expertise and idea prototyping in which collaborative idea generation, learning through critique, and idea prototyping were new found elements through this study that were not in the existing COI framework.

Based on West and Hannafin’s study (2011), the most critical components for COI are collaboration/mentoring and interactive idea generation. The designers who participated in the
study received feedbacks from the groups and then changed their design. The participants were also inspired by the creative solutions that other designers in the group produced and provided. Although every studio member/designer worked on different things (having different goals and processes), the group members were willing to assist each other and to solve problems together. Other interesting findings include that the inspiration or feedback that influenced the designers/participants sometimes came from outside of the studio, and using idea prototyping as one of the unique characteristics of COI. Although a model of communities of innovation is beyond the scope of my study, the study by West and Hannafin provides a useful framework for the connection between creativity and knowledge sharing. West and Hannafin (2011) also addressed the limitation of this explanatory study for future research: the nature of group flow and individual flow and how to develop them, how COI designers balance structure and scaffolding with autonomy, the nature of COI and how it is similar or different than the characteristics of other communities, how the knowledge and expertise develop within COI, and the value of COI.

Music Creativity

and teachers’ perceptions and practices of musical creativity (Strand, 2006), etc. Among all these significant studies, Kratus’s (1989, 2001) articles, Barrett’s methods and concept (1999, 2000, 2000/2001, 2002), Webster’s (2003) findings, Wiggins’s (1994, 2003, 2005) research and Bamberger’s (1991, 1999, 2003, 2011) studies are especially crucial because they helped me frame the research methods and design the instruments. The following section will describe these studies by researchers and their areas, and how some of the concepts, methods or findings contribute to my research design.

**Kratus’s Studies of Children’s Creativity**

Kratus’s (1989) analysis of the amount of time children spent on each stage of the compositional processes helped me understand the cognitive development of children ages 7, 9 and 11. In Kratus’s study, sixty children were randomly selected from an elementary school in the suburbs of Cleveland. There were 10 boys and 10 girls from each age group. The study excluded students who had keyboard music learning experience. Each student had ten minutes to work on a composition. The 10 minutes sessions recorded were divided into 120 intervals (5 seconds for each interval) and then categorized as exploration, development, repetition and silence. Kratus had two other independent judges to ensure the reliability of the observation and analysis.

The results of this study show that significant age differences were found in the time spent on exploration, development and repetition. There was no significant difference found between boys and girls in using the four compositional processes. Additional analysis shows that a 7-year-old uses more exploration than a 9 or 11 years old, and a 7-year-old uses less repetition than an 11 year old. One of Kratus’ suggestions is that improvisation is a more appropriate
compositional activity for 7 year old children. Kratus also suggests that the compositional processes of 9- and 11-year-old children are consistent with the adults’ compositional processes. Kratus’s study has high validity and reliability due to the random selection and careful research design. This study was also used as the groundwork for Kratus’s later studies (Kratus, 1994, 2001).

In a 2001 study by Kratus, a 2 by 2 factorial ANOVA was used to investigate the effect of xylophone’s available tonality and pitch options on 48 fourth grade children’s compositional processes and products. The subjects (19 boys and 29 girls) were not randomly selected but were randomly assigned to one of the four groups, and each group was assigned to compose on a xylophone that was set up in different patterns. The independent variables in this study are the available tonality and pitch options: 1) pentatonic with five bars, 2) pentatonic with ten bars, 3) harmonic minor with five bars and 4) harmonic minor with ten bars. The dependent variables in this study are the processes and products, which are further characterized into several sub-items: exploration, development, repetition and silence for process and tonal cohesiveness, metric cohesiveness, use of melodic patterns and replication for product.

The statistical analysis indicates that there is a significant main effect ($p = .01$) between the five-bar groups and ten-bar groups on the amount of time used for exploration. The pitch options (five bars or ten bars) also have effects on the length of the products and whether they are replicable. There are no other main effects or interactions found. Although Kratus (2001) has explained there might be Type II error due to the high degree of variability among the subjects, the interpretations of the results seem logical that the children need to spend more time to explore, and the music can be longer and harder to replicate if there are more options to use. This study has an important implication for my research. It is not suggested whether the design of a
musical environment should contain more or less pitch options or certain types of tonality. It is important for the designers to know what effects may happen when children are given more or less options. Nevertheless, there are remaining arguments about whether children should be provided limited options or more choices in their early creativity activities (Kratus, 2001).

**Wiggins’s and Webster’s Studies about Composition as Classroom Activities**

Webster (2003) describes a scenario in which a small group of sixth graders working on music compositions for a school play. The students quickly completed the task and would not revise the music when the teacher asked them to do so. This scenario may be a typical situation in the elementary level of classroom setting. Two issues are raised here. The first issue relates to how teachers design lessons/learning environments that foster reflection for creative activity. The second issue involves the authorship of works and power of decision making. With these two issues in mind, a teacher as both a designer and a facilitator of learning might ask whether being controlling or letting students randomly explore would limit or add to their creativity activities.

Webster (2003) suggests that since the revision is one of the key elements of creativity process, teachers might suggest students revise their work. According to Webster’s (2003) experiences, elementary students may perceive the revision and spontaneous sharing as an integrated part of the creativity process. They accepted comments and modified works during the creativity process, but did not want to revise once they thought their works were done. If students have finished the work and resist revising, teachers might encourage students to move forward and make suggestions for students’ future work (Webster, 2003).

For the same scenario, Wiggins (1994, 2005) makes suggestions based on her teaching and research experience that teachers should enable the revision and feedback of students’
compositions by building communities for music making and sharing. Individuals in the community gave ideas, communicated, evaluated, and made comments and suggestions and reached collective decisions with each other. Wiggins (2005) also mentions that the nature of the environment, the nature of the tools, types of compositional projects, and teacher/peers scaffolding are influential to the collaboration.

Wiggins (1994) collected qualitative data on how children make music when working with peers. The participants in the study were two fifth grade children situated in general music classes. During the five month period, the two children were asked to participate in composition lessons where they worked as a group to solve compositional problems using percussions, xylophones and electronic keyboards. Wiggins was the researcher for this study as well as the teacher of the music class. The two children were selected from the class for several reasons: they were different in genders, ethnic backgrounds, working styles and preferences. The two targeted children were asked to carry small tape recorders and microphones during the study.

Wiggins (1994) found that the children worked through three stages from holistic planning, developing parts and back to finalizing the whole. The two targeted subjects showed similarity in the compositional strategies. Once they decided the instrumentation and style of music, they tended to work independently to develop ideas and then came together at the last stage. The ideas in the earlier stages seemed to be related to their final products. Wiggins’s finding appears to contrast with other researchers’ results that the children in this study seldom went through the stage of random exploration. But how did children come to agree upon a solution when they moved from the individual ideas to a collective product? Wiggins did not explain how the decisions were made and how these decisions related to participants’ backgrounds, instead the discussion focused on categorizing the strategies and the comparison
with other researchers’ results. Without knowing that, it is difficult to comment on whether working with peers or individually is a better way for children to develop creativity and make revisions during the creativity processes.

**Reflection-in/on-Action during Music Creativity Process**

Kennedy (2002) directed a qualitative study to investigate the compositional process of four high school composers. The participants were two boys and two girls from grades 10 to 12 whose musical backgrounds were varied. Their tasks were to compose two pieces: One using acoustic instruments for a selected poem and another one using an electronic workstation to create their own music. The only instruction for the second task, which was open-ended in style, form and instrumentation, was to introduce and analyze a piece of music. One of the common elements in their compositional processes was *listening*—listening as preparation, stimulation, inspiration and evaluation. According to this study, Kennedy constructed a model of the students’ compositional processes, which begins with *preparation, thinking*, followed by *stimulation* and *inspiration, experimenting*, then considered as finished or *revised* before finishing. The result of this investigation strongly relates to Schön’s model. The essential component—*listening* matches the characteristics of *reflection-in-action* in that it is an active way of observing and evaluating actions and sounds without interruption. *Listening* can also be the source of external stimuli that causes inspiration and influences the composers’ musical style.

Hickey’s (2015) article about free improvisation adds to the discussion about the knowledge sharing and the creativity. Free improvisation, a very new interest of teaching/learning music creativity, may have some parallel to the practice of design, but to the more extreme, in that the situation is unplanned. During the interviews, Hickey (2015) found the
professionals who offered free improvisation in university-level courses do not consider their roles as instructors or ensemble leaders. Their roles are more like a facilitator and coach (someone who has more experience to facilitate, but the music and ensemble can exist without them). The strategies of coaching involve using unique vocabularies or language to describe the sounds (the product of free improvisation) and tools (strategies to explore the musical elements or components), but have no set structure or conventional form (according to any specific musical style). Hickey raised issues that the group size, assessment criteria, student skills and ability to comment and reflect on the experiences and facilitator’s background and characteristics make it difficult to formalize this type of learning in higher education as well as K-12 settings.

Hickey’s (2015) study provides a way to discuss the role of a coach and the strategies of coaching during creativity or design activities. One of the important points from Hickey’s findings was that the coach tended not to place judgment on the quality of the product during the group improvisation processes. Instead, the coaches asked questions about how the participants felt about their own improvisation outcomes and how the music made them feel. This pedagogy is a reflective practice that leads to individual as well as collective meaning making processes.

Barrett’s (1999, 2000, 2000/2001, 2002) studies of children’s aesthetic decision making and invented notation are also useful in examining children’s reflective thinking in two ways: 1) children were asked to draw invented graphical notation to represent the music they heard or created, and 2) children responded to a set of questions describing the music they heard or created. Researchers studying children’s invented notation include studying the symbols, icons or pictorial representations children developed to transfer their aural experience into visual experience (Bamberger, 1999; Barrett, 1999, 2000, 2002). By inventing a graphical notation rather than using conventional notation, one must revisit their creativity products, be aware of
how the elements of music are perceived, and what the music means to the individual. The invented notation can be perceived as mediated memory and can help adults understand children’s cognitive development. These symbols may represent children’s musical thinking as well as musical experience. For example, the invented notation may be produced through the action responding to the sounds (Bamberger, 1991). However, not all the musical experience can be encoded. Sometimes, the musical experience is more complex than abstract symbols can be represented; sometime, the operation of drawing/visualizing has been already separated from their aural experience. Barrett (2000) stressed that when using a visual medium to express an aural world, it is to create a “virtual view,” which is a metaphor of constructed world from reflection rather than the actual view of a “window” (p. 43-46).

As for the understanding of children’s aesthetics’ thinking through their critics of adults’ and their own compositions, a set of questions were used for this qualitative analysis (Barrett, 2000/2001). The responses from the participated children (10 grade-one students) for both adults’ and their own composition were categorized into the following: descriptions/analyses of musical properties or structural features, referential descriptions, expressive descriptions, judgments of quality, descriptions of performance, description of composition procedure, and recognition. The finding (2000/2001) shows that children at age seven are able to make aesthetic comments on the musical properties or structure, express their feelings, analyze, and make comparison and judgment, although there are differences in the way or the types of comments. Appendix H shows the original interview questions, constructed by Barrett (2000/2001) to study children’s aesthetic decision making. A list of interview questions (see Appendix G) for the purpose of understanding the children’s creativity processes and helping children reflect on their decision making processes for my study was generated based on Barrett’s study (2000/2001).
One of the questions, “do you want to change anything in the music (imply the music created by the interviewee/participant)?” particularly associate with the experience discussed in Webster’s (2003) and Wiggins’s (2005) articles.

**Bamberger’s Studies**

**Knowing and Knowledge of Music Making**

In the book—*the mind behind the musical ear*, Bamberger (1991) describes the detailed process of an eight year old boy using Montessori bells to construct, reconstruct and invent notion for a tune. Because the pitched bells are identical, it forced the participant to take action and judge according to the sound but not the shape or color of the bell. The design of this study provides an environment for the researcher to observe the sequence of motion: the sequence of how individuals explore sounds, present the mental structure of the sound, organize the patterns, practice the construction, and be guided by hearing and reflection. The individual internalized these paths of actions which became the personal ways of knowing. Bamberger’s argument is that the changing of mental structure and musical development is not a unidirectional process; instead, the eight-year boy had developed multiple schemas of hearing and viewing during the processes.

This experiment lasted for five months. To repeat the simple tasks of organizing bells, building a simple tune (“Twinkle Twinkle Little Star”) and inventing notation for the tune, the participant’s strategies of problem solving and the researcher’s intervention as a coach resemble the model of reflective practice. The tune—“Twinkle Twinkle Little Star” was what the participant knew from his culture; by matching what he did with what he knew, the participant
needed to reflect and make on-the-spot-changes. The interventions given by the coach when the participant was confused by the unsolved problems was to direct the participant to engage in pitch matching, which forced the participant to focus on the baseline knowledge, or remove one set of the bells, which offered opportunity for new insights to develop new strategies.

**New Ways of Knowing and Action**

Bamberger’s (1991, 1999) studies provided opportunities to gain insight into children’s learning processes and musical development by observing and analyzing their graphical representation and spatial organization of the sounds and strategies of actions during the music making processes. From the works she collected over the years, Bamberger (1999) categorized two ways (pathmaking and mapmaking) that children make meaning of how they see things and how things work. The pathmakers seek the sequence of events in which the representation and organization of the objects have a function as following a specific path of action and trigger a specific condition. For the mapmaker, the meanings of the objects are fixed according to the maker’s mental structures and independently form their sequence or function in a song. Bamberger (1999) further gave an example of how a child used Montessori Bells to build a tune—“Hot Cross Buns” in a forty-five minute session. This child chose five bells and then organized them into two groups—E, D, C and D, C. The first group of bells was used to play the first, second and the last phrases of “Hot Cross Buns.” The second group of bells was used to play the third and fourth phrases of the song. Bamberger describes how this child starting as a pathmaking tune builder became a mapmaking tune builder. Inspired by another child’s different route of making “Hot Cross Buns,” this child discovered the three bells were enough for playing the entire song. The new ways of seeing and actions were then developed. An important
intervention that Bamberger used to help this child understand why both ways work is to ask the child to find the bells that matched in the same pitch. This activity allowed the tune maker to separate the pitch properties of the bells from the structural function that was embedded in the tune.

Bamberger’s (2011) study examined how new ideas were created and how ideas changed over time in a collaborative setting with diverse views also helped me gain insight into how children develop new ways of hearing, seeing and thinking through revisiting their past experiences. The study of a small group of five children (8-9 years old) took place in the Laboratory of Making Things (LMT) where there were gears, pendulums, Lego blocks, pattern blocks, foam core, hot glue, drums, and 10 Apple computers. Building musical ideas using the materials was part of the activities embedded in the project of making things at large. The interesting part about the findings is not only how children collaboratively completed the tasks assigned (solving a particular problem together), it is also how they changed the ways they understood things as they reflected on and had conversations with others about their past experiences. Eventually, they were able to compare and connect two different occasions to explain a common problem (e.g. understanding the case of two people walking or playing beats at different speed/paces of 2 against 1 and ending up together resembles the two gears in different sizes rolling together producing a cycle of 4 against 1).

The findings from these studies (Bamberger, 1991, 1999, 2011) are powerful because they reveal that knowing is not a static thing. The process of making the implicit knowing explicit involves negotiation and conversation and leads to a deeper understanding and a new knowing. The fact that the processes of negotiation and conversation involve reflection and
group interaction also provides a ground for considering how reflective practice and knowledge sharing can affect creativity.

**Interactive Computerized Music Environment as Affordance**

Bamberger’s (1972, 1974, 1975, 1979; Bamberger et al., 1981) early studies built upon her interest on understanding how knowledge is developed. These studies include how making intuition of knowing explicit and how reflection relate to the practice under the context of teaching and education (Bamberger et al., 1981), the strategies children used to make sense of rhythmic figures (1975), the students’ development of music skills via computerized instructional systems (1972), how teachers understand students’ knowledge and ways of learning (1979), and students’ strategies and decisions on making music and making representation of a melody (1974). These research interests were extended with Bambergers’ (Bamberger, 1991, 2003, 2011; Bamberger & Schön, 1983) later studies investigating the relations between tacit knowing and explicit knowledge by observing participants’ processes of arranging materials and making representation of their hearing or thinking.

In one of the recent studies, two college students who had no musical training were asked to perform creative problem solving tasks using an interactive computer interface to produce archetypal tonal melodies (Bamberger, 2003). The students were asked to log and track their strategies and decisions. Their musical works and logs were commented on and then analyzed. This case study shows some interesting findings: when given opportunities and environment (objects and work space in a computer), the untrained adults were able to work on an ambiguous problem (the original total melodic patterns represented as blocks in the interface were unfamiliar to them) and to redefine the problem (the ability to access details and to modify the
pattern as they wanted). The work space and the immediate sound feedback allowed the participants to reflect and design in and on their actions. The decisions they made to produce the archetypal tonal melodies revealed their knowing-in-action, meaning that even without formal training, their internal hearing was inherited from their cultural experiences.

This study and Bamberger’s other research have implications for the education settings and for my research design (Bamberger, 1991, 1999, 2011). The concept of providing concrete materials (Montessori bells, blocks, objects in computer interface, etc.) that enforced exploration and action (the visual property of the object does not represent the auditory property), and working/design space that allowed participants to organize the materials inspired the way I designed instruments and environments for my participants. I also adopted methods from Bamberger’s (1991, 1999, 2011) and Barrett’s (1999, 2000, 2002) studies asking students to draw invented notation of representation of their music, and modified interview questions from Barrett’s (2000/2001) study to gain understanding of participants’ aesthetic decisions and to provide participants opportunities for reflection. Having these research designs as models provided me ways to examine and compare my findings. In addition to Bamberger’s design, I took Kratus’ (1989) design of studying children ages 7 to 11 as the choice for selecting my participants.

Although there is a wealth of literature (e.g., Dowling, 1999; Hargreaves, 1986) that discusses children’s music creativity from the developmental psychology point of view, the studies focused on the developmental psychology were perceived as beyond the scope of my study as I did not intent to explore the cognitive differences of the children’s musical ability. Rather, children’s compositional processes in school settings described in Kennedy’s, Webster’s, and Wiggins’ are closer to my interest as I proposed to learn from these cases and my study of
how mixed aged children interact in the classrooms as well as work independently. Furthermore, examining learning and doing through the lenses of reflective practice and epistemology explaining the interaction among knowing, knowledge, individual and group was the core of my theoretical framework because views from Schön, Cook, Brown, Rowland, Bamberger and others were how I constructed my perspectives to observe and interpret the phenomenon of creativity.
CHAPTER 3

METHODOLOGY

This study investigated how children reflect on their creativity and sharing processes. Since 2007, I have been searching the literature for theories and models related to creativity and knowledge sharing. This search is reflected in the literature review found in Chapter 2, and can be succinctly summarized as follows: 1) Everyone creates differently (Sloboda, 1985; Wiggins, 2003); 2) the model of reflective practice is used by various types of practitioners, including teachers and musicians (Kennedy, 2002; Schön, 1983, 1987); 3) reflection and revision have been found in most of the creativity models for adults (Amabile, 1996; Bamberger, 2003; Bamberger & Schön, 1983; Schön, 1983, 1987) and in some models for children (Bamberger, 1991, 1999; Webster, 2003; Wiggins, 1994, 2003, 2005); and, 4) age, social interaction, and proficiency levels influence children’s music creativity processes and products (Bamberger, 1999; Kratus, 1989; Stauffer, 2002; Wiggins, 1994). Based on these findings in the literature, the design of this research project was to provide an environment similar to an educational setting, where children could participate in group or individual activities, practice music, interact with others and share their ideas.

Erickson (1986) used the term “interpretive” (p.119) to refer to the family of qualitative, ethnographic, case study, participant observational approaches that focus on ascertaining the local meaning of actions. Compared with using a quantitative approach to identify general linkages between “outcomes” and “treatments,” a qualitative approach in educational research answers “how” and “why” students do certain things under certain circumstances at specific times (Erickson, 1986). In addition to the knowing of meaning-perspectives of particular people
in particular settings, the interpretive approach is also appropriate to find out the multidirectional causal relationships that were not identified, or cannot be controlled for when using experimental methods (Erickson, 1986).

The methods of participating, observing, documenting, transcribing, coding and analyzing implied by the interpretive approach helped me gain details of such meaning-perspectives and identify key components in the children’s processes of creativity and learning (Emerson, Fretz, & Shaw, 1995). Erickson (1986) argued that, despite its idiosyncrasies and hidden facts (e.g., taboos within a culture), everyday life is invisible to us because of its familiarity. That is, we tend not to be able to see the patterns in our actions (e.g., outsiders who do not grow up in the culture, and do not know the taboos would find it easier to discover the differences). Therefore, only a thick description of the research site, with a focus on the “local meaning (p.121)” would really help understand what happens concerning particular actions in particular settings (Erickson, 1986; Geertz, 1973). In addition, these idiosyncratic patterns are cultural specific, and cannot be generalized. For example, the behavior of asking a teacher questions in the classroom for one culture means that a student is actively engaging in the learning process, whereas, in another culture, it means the student is challenging the teacher’s authority. For these reasons, the question of “what happened” in everyday life for particular settings is significant. It is by studying these culturally specific meanings, that researchers can understand issues and imply improvement in social or educational systems (Erickson, 1986).

From 2007 to 2008, I continued preparing the research framework and designing and evaluating the tools and instruments for the study. The data collection period was September to October of 2008, and was followed by the process of transcribing, coding and analyzing data. The following sections of this chapter include descriptions of the tools, participants, data
collection processes and analytical procedures that were used to examine, discover and characterize reflective practice, and to identify relationships among the models, the phenomena, media attributes, and the participants. Before discussing these methodological characteristics, it is important to acknowledge the subjectivity of the participants’ perspectives, as well as the investigator’s role as a researcher and an instructor at the research site (Shank, 2002; Trochim & Donnelly, 2007).

Design of the Study

Instruments and Tools

Several multimedia tools were used to provide opportunities for children to create, share and reflect on their music, and for me to observe and document the studied children’s processes of creativity. These multimedia tools included two computer programs utilizing interaction and simulation, computer screen recording software and two video cameras. Because each of the computer programs and the screen recorder needed to be integrated in the same computer environment and work simultaneously, selecting appropriate software for the design, development and implementation required research on existing technology, testing the functionalities, assessing the possibilities of integration and considering the costs. The tool features and tool design decisions used in this study are discussed in the following paragraphs.

Interactive Computer Program: Build MyTune—1

Build MyTune I is a simulation inspired by Bamberger’s (1991) study in which the participants used Montessori bells to construct, reconstruct and invent notation for a tune. The
original purpose of the Montessori bells was to help develop aural skills. The participants had to differentiate pitches by playing and listening to the bells rather than relying on the cues such as size, shape or position of the bells. In *Build MyTune—I*, there are two sets of bell icons in the kiosk system on which participants can click to make sounds. Each set of icons is in one color (blue or red) and represents eight bells in an octave of C major scale (from middle C to high c in which the capital letters represent scale in middle range). The small letter “c” means the high c (one octave higher than middle C). These bell icons were a simulation of the Montessori bells. Because these pitched bell-icons are identical, it forces the participant to take action and judge according to the sound not the shape, size, or color of the icon. The position of the bells is set to random in the Preparation Area (see Figure 5) each time the participant logs in to the system or clicks submit (to save the setting) or reset buttons. There is a square area, used as Working Zone, located on the left side of the screen next to the Preparation Area. Participants were asked to drag the bell icons from the Preparation Area, place them in the Working Zone, construct a tune, and share the tune with another person. In addition to drag and drop, the participants were required to give a title to the setting he/she constructed before saving this setting. The settings were saved as each bell-icon’s specific ID; the position, the pitch, the date-time, and the participant’s login ID were documented and stored in the database.

One of the benefits of using computer simulation for children to create music was to know how the users’ spatial perceptions reflected their interpretation toward the sounds as the Montessori bells were converted from a 3-D environment into a 2-D virtual world. Using the advantage of information technology, the saved data became an extension of the users’ memories and allowed the users to retrieve their saved settings for future playing or reflection. In addition,
information technology made it convenient for me to document and organize the users’ information for comparison and analysis.

Figure 5. Interface and the function of Build MyTune—I.

Interactive Computer Program: Build MyTune—II

According to Stephens (2003), building a musical composition is like constructing a house. The fundamental components suggested for compositional activities are “sound” and “silence” (p. 122). The foundation contains elements of pitch, duration, tempo, dynamics, articulation and timbre. By exploring and understanding elements at the foundation level, individuals can create melody, harmony, counterpoint, rhythm, texture and orchestration by combining the elements at the foundational level.
The design process for *Build MyTune—II* originated from the idea of building a sequencer that allows users to change pitches during the looped patterns (see Appendix F). The computer program *Build MyTune—II* required actions to make sounds or to change routine. There is an On button and an Off button so that the participants can turn the looped sounds on or off. Initially, the pitch sliders are all set to middle C and the users can adjust each slider up or down to assign higher or lower pitches. The range of the slider’s pitches is two octaves of C major scale. *Build MyTune—II* allows the participants to make decisions about how fast (tempo), how many beats per cycle (meter), how high/low (pitch), what instruments to use (timbre) and the direction of the sequence. It also provided a feature to save settings or erase the saved settings. I, the researcher/designer, intended for the participants to have more musical choices and to combine these saved settings as they extended their compositions (see Figure 6.).
The development of *Build MyTune—I* and *Build MyTune—II* involved different types of software, tools and programming languages. *Build MyTune—I* is a web based dynamic application that involved HTML, CSS, JavaScript, ASP, VBScript and SQL and Microsoft SQL Server. During the development of this web application, I also consulted a senior software programmer to ensure the program’s functionality and to resolve any programming issues. I developed *Build MyTune—II* using a max/msp 4.5.3 by the Cycling ’74 company. Max/msp 4.5.3 provided me ways of using a high level graphical programming language (C language) to create interactive musical environments.
Screen Recorder

While participants used the interactive computer programs for making music, the screen recorder was used to capture the screen activities. *Huelix ScreenPlay* allowed me to set up the region of recording, select the device used for audio recording, use hot keys to turn the recording on and off, provide flexibility in adjusting the recording quality, automatically assign names for the file saved, and save the recording as a Window Media Video (WMV) file. It was simple and practical for me to record during the classes.

Implementation

The selection of hardware was determined by the criteria of software implementation and the classroom situation. Because the classroom used for the research project did not have internet connections, each computer needed to have its own database system. Other factors considered were that max/msp is compatible with MAC and PC and the *Huelix ScreenPlay* screen recorder is a window utility only for Windows XP/2003/2000. Thus, the research/designer arranged four laptops that each had a Windows XP Professional system installed, along with SQL Express Server, Max/msp 4.5.3, and *Huelix ScreenPlay* screen recorder. The hardware implementation for each computer included a USB mouse, headphones and audio cables.

Pilot Study

To improve the design and ensure the usability of the tools, *Build MyTune*—I and *Build MyTune*—II were tested prior to the research study. During the pilot study, the most obvious technical issue regarding the implementation was the speed. With running multiple programs
simultaneously, the actions and response of sounds were often sluggish, and the recorded quality was poor. The users experienced frustration due to this technical problem. This problem was a combination of RAM, speed of CPU, speed of hard drive and speed of transmission of data. After the pilot study, I made several improvements accordingly: 1) used computers with Intel Core Duo or Intel Core 2 Duo Processor to improve the processor performance, 2) increased RAM to improve overall performance, 3) used an external drive to store recorded video files to distribute load of storage and retrieval over two hard drives to improve the videos read/write performance and 4) minimized the screen recording quality to 4 (the full range is 20) degrees toward the smallest file size, which required less write operations to the hard drive and less overall utilization of resources.

Description of Context

For eight weeks, three groups of participants met once a week in a music department classroom at a Midwest University for the *Build MyTune* music classes. This classroom is designed for music education students or pre-service teachers to learn about general music pedagogy. One side of the classroom is cabinets full of all types of classroom instruments that are primarily for elementary or middle school levels. These instruments include various sizes of Orff xylophones, metallophones, children’s Conga drums, bongos, Tubanos (set of African drums in contemporary style), tambourines, maracas, rattles, bell trees, chimes, triangles, lollypop drum, castanets, one thunder tube, etc. There were some colorful boomwackers tuned diatonically in the room. There was also an upright piano by the door.

The classroom was carpeted and the students usually removed their shoes before they began the activities. There was plenty of space for children to play instruments and run around.
Every week before the class began, I selected several instruments from the cabinets and placed them in the center of the classroom. Sometimes children came to the classroom and began to play instruments right away without asking. When the class began, children were asked to use these musical instruments to improvise musical sounds individually or collaboratively. They were also asked to complete the tasks using *Build MyTune—I* and *Build MyTune—II*, to draw pictures and to give a title for what their music compositions were about. Finally they were asked to share their music or drawing with the others.

The design of tasks and activities of this research was based on the theories described in Chapters one and two and my teaching experience. The tasks designed for *Build MyTune—I* were a modified version of Bamberger’s (1991) study that participants were asked to build a tune and invent a graphical notation for the tune. The differences between the modified version for this study and Bamberger’s design were that 1) the participants in my study were asked to create their own music, 2) the participants were asked to interactive with the simulated Montessori bells using the computer programs, 3) the participants could save the settings (bells selected and moved to certain positions) and recall settings at a later time, 4) the participants were asked to give a title of the bell settings they created while they decided to save the settings, 5) the processes and works that my participants created were recorded in the computer and could be played back as wanted, 6) there were tasks to assess participants’ ability to listening skills (matching and differentiating pitches) using the simulated Montessori bells, and 7) the participants were also given opportunities to reflect by sharing music with someone else and making visual representation of their music but not necessary notation like requested in Bamberger’s study.
The participants were using the interactive computer programs, *Build MyTune—I* and *Build MyTune—II*, to make a new song that “they have not heard before.” A screen recorder was used to document participants’ sequence of motion and placement of icons during this first phase of activity. I, the teacher/investigator, played back the recorded screen activities and conducted interviews with the participants after the participants create their music. After completing the first phase, the participants were asked to give a title to the music, and use paper and color pencil to draw a picture “in their own ways” to present the music so “somebody else can understand the music”. During the second phase, the participants in the same group (three or four children in a group) were asked to share their music with another participant. In helping to deliver the music making, sharing and reflection activities, laptops, microphones, speakers, and some classroom instruments were necessary. Two video cameras placed on two sides of the classroom were used to collect data from observations and interviews.

There was minimal demonstration of the tasks assigned. There was also no instruction for how to use the computer simulation programs to create music. One of the structured activities was to ask the children to match the same pitched bells in *Build MyTune—I*. This activity allowed me to assess the participants’ levels of musicianship, whether they could distinguish the different pitches and rhythms and how long it took them to complete this task.

**Sheet for Graphical Notation**

The tasks of asking participants to invent graphical notation and teach another person the music created can be considered as a strategy of enhancing reflective thinking. Researchers studying children’s invented notation include using symbols from other systems, pictorial representations and icons (Bamberger, 1991, 1999; Barrett, 1999, 2000). When using a visual
medium to express an aural world, it is to create a “virtual view,” which is a metaphor of the constructed world (Barrett, 2000, p. 43). By inventing a graphical notation rather than using conventional notation, one must revisit his/her creativity products, be aware of how the elements of music are perceived, and what the music means to the individual. However, according to Cook and Brown’s (1999) theory, tacit knowledge cannot be simply converted into explicit knowledge.

Knowledge sharing involves both physical practice and social interaction. By teaching another person, expert teachers may reflect on their own learning experience and personal beliefs and constantly adjust the strategies and conceptual frameworks during the communication (Moallem, 1998). There is also evidence that children develop revisions and new strategies through peer interaction during music making processes (Bamberger, 1999; Wiggins, 1994).

### Interview Questions

Appendix G is a list of the interview questions, which were constructed according to my research questions and Barrett’s (2000) study of children’s aesthetic decision making (See Appendix H). These questions mainly inquired as to the studied children’s perception of their works and processes (what do you hear and see? how did you create the song? how do you feel about your processes? etc.), and tried to guide them to reflect on their processes of creativity (what were you thinking when you made this?). Barrett’s original question –how the children feel about the music (e.g. happy, sad, etc.) was not included in my interview questions because Barrett intended to study children’s aesthetic decisions about the children’s own and adult’s compositions, whereas the purpose of interview process for my study was to investigate the studied children’s compositional processes and help them reflect on their creativity processes rather than have them evaluate their compositional outcomes. So, my interview question asked
the studies children how they felt about their compositional processes instead. One of the questions—Would you change anything in this music—and its subsequent question—What would you change—are derived from both Barrett’s (2000/2001) questionnaire design and from the concern mentioned in Webster’s (2003) and Wiggins’s (2005) articles that children tend not to revise their works when they think it is completed. The interview questions were asked after the participants watched playback of their music making processes and participants shared their music.

Conduct of the Study

Recruitment

The participants of this research project were 11 children, ages ranged from six to twelve. These participants were selected from a suggested list provided by a local Community School of the Arts in the Midwest United States. Prior to the recruitment, the appropriate Institutional Review Board (IRB) procedures were implemented. After obtaining the IRB approval, I sent out a letter (See Appendix A) to explain the study and invite whoever was interested to participate in the music course called Build MyTune. Parents/guardians and the participants were asked to sign the consent forms (See Appendix B and Appendix C), and participants filled out an initial survey questionnaire (See Appendix D). The information about individuals’ general backgrounds, musical experiences and computer experiences was collected through this survey. The 11 children were divided into three groups with each having a different time slot. However, I had very limited control of how to group these participants due to availability of participants and the classroom schedule. I also had no control over participants’ attendance for each session. The
participants volunteered to attend this weekly music class *Build MyTune* for two months. Each session lasted for an hour. During each session, I asked participants to improvise musical sounds using instruments and computer simulation and then to share their music with individuals in the group. Qualitative data were collected including participants’ works, screen recordings, observation notes and interviews.

**Participants**

Although selected participants may or may not be representatives of their population, the fact that the participants and their families had been involved in the music and art classes and activities held in this Community School reflected their interests in music or art and familiarity with participating in extracurricular activities. Some participants were home schooled and others went to public or private schools. Some of them had computer skills and some did not. Their musical backgrounds and preferences were varied. Some had no formal music training but some were actively involved in school band, choir or orchestra. The following paragraphs briefly describe each participant’s age, characteristics and their musical backgrounds, and their interactivities within the group.

**Group A**

There were four children: Alex, Phil, Rachel and Erin in Group A that met every Friday afternoon for one hour in September and October 2008. Not everyone came to every session, but the attendance was consistent for the first four sessions.

**Alex:** Alex was an eight-year-old boy. In class, he was shy in the group activities but was good at completing all the assigned tasks. He had no formal training on any musical instrument.
He liked reading, watching TV, swimming and playing video/computer games. The average time he spent on computers for homework and games was 2-4 hours per week. He often listened to soundtracks from children’s movies or cartoons. His favorite cartoon character was “Aviator” and favorite song was “Dragon Tail.”

**Phil:** Phil was only six years old but was able to understand and participate in every activity in the classroom. He was very versatile in expressing what he knew and what he felt when playing instruments or during the interviews, and was very determined in making musical decisions. Although he has never learned to play instruments formally, he has been exposed to classical, pop and children’s music and has explored musical instruments in a children’s’ museum. He usually spent two and half hours per week browsing the internet, playing games and drawing/designing using computers. He liked “Picachu” (the cartoon character) and his favorite songs were Vivaldi’s “Spring” (from the “Four Seasons”), “Kazzot (?) Song” and “Juanita Spanish Lobster.”

**Erin:** Erin was Phil’s sister. She was eight and has been playing piano for one year. She spent approximately three and half hours per week practicing piano. She enjoyed reading, playing sports, playing video/computer games, making artwork and listening/playin music. Her favorite cartoon character was “Bugs Bunny” and her favorite songs were “All You Wanted,” “Dumb Dog” and “It’s a hard Knock Life.”

**Rachel:** Rachel was also eight years old. She could play piano and violin. She had studied violin for one year and usually spent two and half hours in weekly practice. She liked pop music and enjoyed playing sports, watching TV, playing video/computer games and making artwork. She used computers for homework, internet, games and drawing/designing. Her favorite songs were “Home on the Range” and “Grandfather’s Clock.” Rachel was very outgoing in class and
was interested in finishing work rapidly and playing on her own. Rachel was absent from the last several classes.

**Group B**

Group B also met on Friday afternoons for eight weeks, but Bob was the only one who participated in all eight sessions. Connie and Leo, from the same family, missed several classes but participated in both the beginning of *Build MyTune— I* and *Build MyTune— II*. Because of the age differences, the participants often went different directions in terms of the group activities and even in the process of sharing music.

**Connie:** Connie was nine years old and was able to articulate her thoughts well while playing instruments and during music sharing processes. She had studied harp for three years but did not participate in the school band, orchestra or choir during the period of this research study. Her leisure activities included reading, watching TV, playing video/computer games, making artwork, listening/playing music and playing outside. She was an experienced computer user who usually spent four to six hours per week browsing the internet and playing games.

**Leo:** Leo was an active seven-year-old boy. He is Connie’s younger brother. He had just begun to learn guitar when he participated in this research project. He liked reading, playing computer games and watching TV and usually spent four to six hours playing computer games. His favorite cartoon character was Ernie and his favorite songs were “the Sweet (band),” and “Chihuahua Song.”

**Bob:** Bob had just passed his twelfth birthday before the class started. He played piano and violin beautifully and his performances had been awarded many times. He had studied both instruments for five years. Besides spending many hours practicing on his own every day, he had
also joined the school orchestra and choir. He liked a variety of musical styles: classical, pop, jazz, R&B, heavy metal and others. By himself, Bob was generally interested in playing every instrument and engaging in every music activity, but he was careful not to take the lead in the group. He has strong musicianship and good techniques playing instruments. I recalled my interaction with Bob prior to the Build MyTune class. I accompanied him on the piano on a violin concerto for a competition. He played very musically. After we ran through the piece, he would make comments, change ways of playing or tempo, etc. to make it sounded better musically. He was curious about the programming aspect of how the interactive computer programs were created. His maturity in terms of age and musical background led him to have very different opinions, development and reactions to the activities than the others.

Group C

Group C had an interesting combination of participants. The four children in Group C were all eight-year-old girls. Three of them attended the same elementary school. Two of the girls were twins. One girl was home schooled. This group met once a week on Thursdays or occasionally Saturdays.

Kate: Kate talked gently but sometimes insisted on her ideas/ways of doing things. She was eight and had played piano for one year by the time of this research. She had also learned to play the recorder at school. Kate seemed interested in these two instruments and spent about one and half hours per week practicing each instrument. Her computer experience included spending one half to two hours per week for homework. Her favorite songs were “Be a Rock Star,” “Once Upon a Time” and “This is Real.”
Tracy: Tracy was one of the twins. A very energetic eight year old girl, she liked classical music and playing computer games. Most of her music experience was from daily activities or general music class at school. She did not describe herself too much in the survey but liked to express her thoughts in class. Tracy came to almost every class.

Jessica: Jessica was Tracy’s twin sister. She was very active in class and liked classical music and computer games. Most of Jessica’s school activities were the same as Tracy’s, but they had very different ways of reacting to things. They were very close yet independent in terms of dealing with their individual tasks on the computer programs.

Mindy: From Mindy’s mother’s response to my recruitment letter, I learned that Mindy was home schooled. She was taking piano lessons and had played for about one year. Mindy usually practiced about fifteen to twenty minutes five or six times a week. Although Mindy was home schooled, she sang in Children's Worship at church and had music twice a week at a local school. Her mother expressed that Mindy probably liked children’s religious music and light rock and listened to Christian music on radio. She seemed to work well with Kate in the class activities.

Researcher’s Role

I have been working with children for many years in teaching general music classes, teaching studio instrumental classes, accompanying school choirs and conducting group activities for school events. From my teaching experience in both Taiwan and the United States, I found that creativity was one of the most challenging tasks for general music teachers and consequently was often ignored in the school music curricula. With the limited class time and
available resources, teachers instead focus on performance based curriculum activities and only touch the issue of promoting creativity on the surface level.

Believing in that creativity is a necessity in music curriculum and can be approached through various activities, I have designed lessons for first and second graders, using just a few notes they learned, to compose songs in groups. I have also assigned my fourth grade students to improvise musical sounds using classroom instruments such as recorders, drums, bells and tambourines. I found that lessons enhancing creativity for individual students were not easy when the class size was big. Some of the challenges for classroom teachers include how to design classroom activities to enhance creativity which varied by different school or cultural settings, how to provide tools for individuals to work on their own ideas without being interrupted and how to evaluate and save the results. These tools have to function as an affordance that enables individual students to connect their abstract ideas and tangible symbols. An affordance for making music should allow students to manipulate the different aspects of these ideas/symbols and be able to hear/see what they change.

My understanding of these issues was the main reason that I designed research on children’s music creativity processes. In this study, I was the investigator and also an instructor and designer/developer of the tool. Because of my experience as a music teacher and instructional designer, I had a vision of what the tools should achieve and what the lessons should convey. However, the disadvantages of being both an instructor and an observer in the classroom were that I could not pay attention to all of the students in the classroom in terms of observing their detailed behavior and reactions to events, and I could not exclude my input/influence during the participants’ creativity processes. Therefore, my reflection became another important source adding to the observations and recordings of the classroom activities.
Data Collection and Analysis

Because the selection of the participants was a convenient sampling recruited from volunteers, the most important principles for enhancing credibility, transferability, dependability and confirmability in this qualitative study were to accurately document the activities and conversations, describe the research context in detail and state the conceptual framework, carefully examine the relationships among participants’ action/reflection, their unique experience and their social interactions, and to draw examples from various case studies that are related to the context (Trochim & Donnelly, 2007).

The data collected included the video recording from class activities as well as the children working on the computer programs and their interactions and conversations, the screen recordings of how the children interacted with the computer programs, the children’s works including their music compositions, drawing or writing about their music/works and my reflective notes. Several types of transcripts were developed from these data sources: transcript of class activities from the video, transcript of children’s processes of using computer programs from screen recordings, and transcript of music as staff notation from children’s compositions and classroom activities. The works created using Build MyTune—II tended to be complex patterns in constant repetition, therefore there was no transcript for works using Build MyTune—II. Instead, short excerpts of the music were analyzed based on the characteristics.

Data were organized chronologically by groups and by individuals. As I reviewed their processes and artifacts, codes pertained to context, concepts, processes, strategies, activities, interactions, and perspectives were developed. I used QDA Miner Lite V.1.2.2, a free software for qualitative data analysis, to manage the documents, codes, and frequencies of the thematic
variables (based on the coded activities/events).

Profiles based on each participant’s classroom activities, the individual processes working on the computer programs (from screen recording), the conversations and interactions among the participants and the instructor, and the creativity products (screenshot of layout of their works, the choices they made, compositions transcribed as music score) were developed. The transcripts were read line-by-line and broken down into discrete parts according to the themes; new codes were also added as I examined and compared the parts. Sometimes, one activity can be coded for multiple themes. For example, the participant might be arranging the bells between the working zone and the preparation zone while listening to the results and changing ideas, these movements represented as being exploring/experimenting as well as a status of uncertainty. Moreover, the coded processes and activities were analyzed according to the components of reflective practice, and connected with individuals’ profiles to obtain a comprehensive view of how these elements were interwoven together.

The children’s classroom activities, conversations, screen recording of their processes using the computer programs were transcribed and coded. These codes were first grouped under the following categories: context/design (classroom settings, instrument settings, design of the activities, etc.), music abilities (the ability to differentiate pitch, rhythmic patterns or timbers, understand and building structures, retain memory, etc.), music activities (individual or group activities dealing with music, such as group practice, individual improvisation, playing a known song, playing a new song, etc.), and music making processes (actions and events toward creating works when using Build MyTune—I, Build MyTune—II and some classroom instruments).

Specific themes were developed relating to the children’s perceptions and views, the role of teacher, the role of technology, and children’s background. The coded processes pertaining to the
children’s creativity and knowledge sharing were further analyzed according to the components in reflective practice.

During the data analysis, I often asked myself questions about the similarities or contradictories found in the patterns. Then memos of cohesive themes were developed to support discussion of the findings. Each analytical memo was provided with examples of data which could be common experiences among the participations’ processes, or something that uniquely stands out. This was a process of understanding children’s creativity and reflective practice by means of making sense of what happened in the Build MyTune classroom, the children’s creativity outcomes and what the children described or revealed about their processes and thinking.

Limitations

The primary focus of this study was the process of children’s creativity and knowledge sharing rather than their product of creativity or their creative potential. So, I did not intend to apply any assessment tools to measure children’s creative potential or the levels of creativity in their products. The assumption was that creativity can happen in everyday life for everybody. Because of the context of this study is to create music and artwork, the types of creativity that happened could be the novelty in all or parts of their works, new ways of doing things or understanding things, children developing their own ideas and constructing works accordingly, etc. The novelty is judged by me (as a musician and music teacher) or the children themselves (e.g. If the children think or feel they created pieces of new work). The evaluation of appropriateness or usefulness of their products or processes is out of the scope of this study. The only criterion for selecting the participants for my study was the age range.
The age range criteria was based on Kratus’s (1989) findings of children’s compositional processes in which he found children from seven to eleven years old used exploration, development, repetition and silence differently according to their age differences. Although there could be other factors such as prior knowledge and social belief that influenced how children create and share their music, prior music learning experience was not a criterion and there was no control over the participants’ demographics for this study due to the voluntary nature of the participant recruitment. I also had no control over how the children were grouped because of their schedules, the limited numbers of computer laptops (each group had four computer laptops) and/or the availability of the classroom.

There were also limitations to the computer programs. For example, the simulated Montessori bells in Build MyTune—I were presented as 2-D images on the computer screen and I could not assume the children perceived these icons as the simulated bells. The Build MyTune—I program only allowed users to save eight settings at the most per class period; if the users wanted to save a new setting after the eighth setting, they were required to erase a previous setting. The options provided in Build MyTune—I and Build MyTune—II were limited: Build MyTune—I only has a narrow pitch range in bell tone; the Build MyTune—II has no capacity to produce harmony/chords; the fidelity of the simulation (graphical icon, recorded sounds, digital sounds, etc.) might not be authentic to users, etc. Also I could not assume all participants understood the labels for the selection in Build MyTune—I, as some of them might not have adequate knowledge of what the labels meant. Furthermore, although I designed the same classroom activities and tasks for each group, the actual activities and time spent for tasks in each group were different due to the different level of prior knowledge, interaction among participants and the instructor, etc.
CHAPTER 4

FINDINGS

The paradox of learning a really new competence is this: that a student cannot at first understand what he needs to learn, can learn it only by educating himself, and can educate himself only by beginning to do what he does not yet understand. (Schön, 1987, p.93)

Here, to learn, means to learn design: it does not mean to merely learn facts or to imitate the action. To learn design means to obtain or to develop the ability to see things even when it is unknown (Schön, 1987). That is why Schön advocates that if professional education only provides sets of rules and structured scenarios, it is hard for the students to go out to the real world facing many unknown and complex issues (Schön, 1983, 1987). The paradox of learning something students will not understand until they begin to do it is also Dewey’s theory of inquiry, which emphasizes learning by doing (Dewey, 1938b). Design, creative activity, and problem solving can be variations of this underlying concept: although different in terms of context, media, professional discipline, and process, they share some common elements. By bringing in the notion of paradox of learning, I set the stage of representing children’s creativity processes for my readers.

For almost two months, 11 children, who were arranged into three groups, came to my classes to play the classroom instruments and the computer programs. Alex, Phil, Erin and Rachael belonged to one group; Connie, Leo and Bob were together; and four girls – Kate, Jessica, Tracy and Mindy – came for the same session. Some of the children had no formal musical training other than general music classes and experience from school or church: Alex,
Phil, Tracy and Jessica. Some of the children have been learning instruments for few months to few years: Bob (played violin and piano), Connie (studied harp), Rachael (piano and violin), Mindy (piano), Kate (piano), Leo (guitar) and Erin (piano).

During my classes, children worked on many given problems either designed me or implied by the context of the classroom environment. They also worked on problems they created themselves or through interaction with others. In many cases during the Build MyTune music classes, children faced the paradox of learning described above. When the task was to create something (either a musical phrase, a song, a pattern of their preference or a graphical representation of their ideas) using the computer programs, the ideas and decisions had to come from themselves. Their paradox of learning was apparent in many cases when my participants initially encountered the computer programs or new instruments. They did not know how or what they were about to do with them, not to mention what the final production would sound like. After trial and error, they found or developed sounds, patterns or ways they liked, and then they saved the settings.

How do children learn to design something they do not know? The research questions for this study sought to discover such processes:

1. What are the studied children’s creativity and knowledge sharing processes?
2. How do the studied children practice reflective thinking and action during/after their creativity and knowledge sharing processes?
3. How does novelty generation occur during the studied children’s music making processes?

I did not intend to generalize answers for these question as children entered my classroom with various backgrounds, and any scenario/answer might have only applied to one child at one
time/space for a specific situation. Yet, some interesting moments that highlight the relationships among children, classroom settings, the tools and the products did help me understand the phenomenon as a whole as well as the complexity of these issues. I was able to learn about the variety of ways these children created music through the observations, interactions and interviews with my participants. These findings are presented in this chapter as selected stories and scenarios, and are introduced by themes. Following is one of the examples of children’s creativity processes.

Alex, an eight-year-old boy, sat in front of the computer and looked serious during the session he first used Build MyTune—II. He explored the sliders, chose a couple of different instruments, and then drew bars in the window (the window above the sliders was designed to display the high and low tones of the pitches controlled by the sliders). Without clicking the “On” button, he did not hear any sound. The changes he made only had a limited effect (might be some visual effect) to him. He kept selecting different instruments and drew bars in different lengths for almost two and a half minutes. Suddenly, he discovered that he could hear the sound by clicking the green button marked “On.” He heard a consistent repeated bell tone (in pitch middle C) in a steady tempo. He began to change the sliders from a left to right order. Initially, the changes he made on the sliders were just moving all of them to the same height (to the top), so the bell tone was repeated on high C. He turned his interest to two instruments (piano and bell) and decided to stay with the bell tone while he explored more on the sliders. For the following two minutes, his pattern of exploration was to alternate selections of different pitches and instruments. He explored all of the different instruments and added changes to the sliders, and finally went back to select the woodblock with all eight sliders set to different pitches. After a few seconds, he turned his head and said with confidence, “I am done.”
Rachael (was also eight-year-old) and I came to Alex’s station and listened to his work. Rachael put the headphones on and began to dance to the sounds. Alex smiled when Rachael said, “Woo!” I asked him, “Alex, can you tell us how you made this (I pointed to the screen)?” “I liked the woodblock.” Alex said. I asked him to demonstrate for us his process of creating his work; he showed us how he drew bars in different heights without touching the sliders. He tried to reflect on which instruments he had chosen during the exploration: “piano, organ,… (paused for thinking), drum…. I don’t remember.” Rachael seemed into listening to Alex’s work, she also shared her knowledge of how to save the setting. “You touch this button…that saves your whole thing.” Alex saved the first pattern with the woodblock and saved the second setting using the same pitch pattern with the electronic sound. I asked Alex if he wanted to draw a picture of the musical patterns he created; he said, “No.” “Do you have a title for your song?” I asked. He said, “I want to name it Alex.”

From Alex’s example we saw that he explored the functionality of the computer program, discovered some functions, listened to the sounds from his actions of selecting different options, changed ideas, made decisions, interacted with others, reflected on what he did, and took ownership of the product. More examples of children’s creativity processes will be presented in this chapter to introduce a vivid picture of children’s creativity processes with rich details, while drawing parallels and comparisons with the components in reflective practice model and Bamberger’s and many others’ research findings. These themes provided new insights to analyze how children viewed and used tools, their ways of developing ideas and strategies, what these products and processes meant to them, and how media/technology played roles during these processes.
Making Sense of Tools as the Beginning of Music Making

These children’s music making processes began with making sense of the tools. The tools referred to the musical instruments in the classroom and to the computer programs (Build MyTune—I and Build MyTune—II) the children used to complete the tasks assigned and to create new songs or patterns. I noticed when they encountered new tools, they first explored what the tools could do or could not do, which sometimes depended on their initial perceptions of the tools: Was it a toy? Was it an instrument? Did this new tool have functions similar to something they knew? In comparing the new tools with familiar objects, the parallel might be what they looked like, how they sounded and what they could do with them.

For example: Leo, a seven-year-old participant, was fascinated by the thunder tube at the beginning of the first class session. Without anybody introducing him or assigning him to the instrument, he tried several instruments and picked up this colorful but strange looking tube. For fifteen minutes, he touched it, held it in different ways, explored different ways of playing it, walked to different corners of the room, listened and kept playing although his mother tried to get his attention back to her. This example showed when Leo began his curiosity about the shape and sound of the thunder tube, exploring this instrument became an important problem to solve for him at that moment.

**View of Tools—Visualization**

So, what do you see? I asked. Tracy replied excitingly: “I see monsters.” Jessica said: “I see trees with…” This was during the session when Build MyTune—I was first introduced to them. I asked the children what they perceived the blue and red bells on the computer screen
looked like. They all gave me different answers. Leo commented that the bells looked like “a kind of umbrella.” Tracy later used these bells arranged as a square like using Lego toys to build a castle. Not only were these bell icons in the computer screen analogies to their daily lives, the musical instruments sometimes had resemblance to their experiences. Jessica came to the classroom one day and started to line up the boomwackers (bigger tubes in varied lengths), each of which is tuned in different pitches. She organized the boomwackers from the right to left on the floor in ascending order. She told me these were like the organ in the church. Later in the class, she would reorganize the boomwackers whenever the order of the lengths was disturbed by the others. A more important mission for her was to get the boomwackers in place instead of playing them.

Children also built imagination from looking and arranging the musical instruments. Tracy once created a “Musical Robot.” She positioned the hand drums, lollipop drums, triangles, a tambourine, gongs and boomwackers around her and announced: “This is my Musical Robot.” She began with a few instruments and gradually added more after she experimented with the sounds, shapes and the convenience of her playing position. The “Musical Robot” had visual meaning as well as a function as a musical instrument to her (she appeared to be creating a percussion station). The “Musical Robot” was played during our ensemble. Tracy kept coming back to refine the position of the instruments. She was very proud of her invention and asked people not to move or destroy her creation.

From the observation of bell construction processes (Build MyTune—I) and the interviews afterwards, I understood Alex’s construction might be related to the visual more than the sound. Although he must have heard the pitches of the bells when he clicked or dragged them, his decisions on the placement of bells were based on narrative stories. Without playing
and listening to the bell tones first, he placed these bells in the desired positions. He neither
played nor listened to them after he built the settings. He often separated the bells into two
groups: blue and red. He even placed the bells with all of them overlapping with each other so it
looked like a single bell on the screen. He did have some goals in mind which were more related
to the visual. When he explained to me, these bells spread or scattered around the working zone
were like the avatars he played in the computer games. These bells had roles: they were in a war
between avatars of fire (red bells) and water (blue bells) (See Figure 7).

![Build MyTune — I](image)

Figure 7. Alex’s work using *Build MyTune—I*.

**View of Tools—Its Sound**

The class usually started with activities of improvising on the classroom instruments for
about twenty or thirty minutes and then the children would go to the computers. These activities
were designed to observe how they explored instruments and sounds, how they interacted with
each other and how they developed and described their musical ideas. In an activity called
Walking game, the assigned person was asked to pick up an instrument. Everyone could walk
when he/she played the instrument and then stopped when the sound stopped. The person could
ask one of the group members what he/she heard. This activity allowed me to see how they perceived the sounds of the tools. In one case, Bob picked up an instrument—thunder tube, which he had never played before:

(Bob picked up the thunder tube and tried to make sounds.)
Bob: How does it work?
Connie: You just shake it.

(Bob began to play the thunder tube. Everyone walked around in the classroom. Bob suddenly stopped, and then everyone froze.)
Bob: Leo.
Me: What did you hear?
Leo: Uh…Uh…I don't know.
Me: What did you hear? What does it sound like...
Leo: It sounds like…a bad TV (laughing)?
Me: O.K. (Everybody laughed) OK. Keep going…
(Bob kept playing the thunder tube…) 
(When Bob stopped, we also stopped.)
Bob: Connie.
Connie: Ha, ha… (Leo also laughed) Uh, I heard, a string that is vibrating in a very low tone.
Bob: Great!
Me: Keep going.

(Bob began to play again and everybody ran around. He stopped, and pointed to me)
Me: My name is Chia-Pao. I heard the ocean rumbling.
Bob: Wow. (Me laughing and said: O.K.)

View of Tools—Function and Constraint

Bob was the eldest and had the most musical training among the participants. He soon found what the tools could do and could not do. The second time Bob played MyTune Program, the task was to find pairs of bells with matched pitches. After he completed the task, I asked him:

Me: Last time, you made something using the computer program, were you very clear what to do?
Bob: I was kind of clear…because I have the notes to work with, the notes out of it, so…there are limited notes you can drag from, dragging the low notes, high notes, or notes in the middle,
Me: You dragged them to the place (point to the working zone). What is this square area mean to you? Like you drag them into the place. …how does it help you or what does it mean to you?

Bob: It's like you are drawing in the paper, you have color pencils and paper, you add things like that…It's like your table you can work on…

Me: So, if I give you a paper and a pencil, you might do the same thing, that putting some of the notes there… (Bob: nodded his head.) …How is this computer program experience different or the same as your other instrument experiences? You play so many instruments, how do you feel that they are different or the same…?

Bob: You have the limited notes here, you have the paper like thing, but you cannot read the notes here. You have to click on. If you have the paper [with the notation], you have to play the instrument…But here [the computer program] you just click and drag.

Bob understood each bell in Build MyTune—I produced a pitched sound that he could use to play music, just like the “notes” (keys on the piano or certain part of the string on violin to produce a pitch/note). Bob came to the class remembering exactly the song he created in the previous week and what the song sounded like. I was surprised how he remembered it. None of the other children remembered how they created the songs or what it sounded like after a week. (I asked him to play for me his music again. He played through from the beginning with no hesitation or interruption. It was exactly like the music he created last time. I was curious how he could remember the song.)

Me: Did you think of the music at all this week?
Bob: Yes,
Me: Really?
Bob: I sang it in my head all the time. (Me: How come?) I don’t know, it just happened.
Me: Did you, have you heard this melody before (Bob: No) Just from last week you created it?
Bob: Yes, just coming into my mind.
Me: Did you try it on something else?
Bob: Violin, I tried it and it worked (timidly smiled). (Me: Really!!! Very cool)

In addition, Bob understood these bells have limited pitch options (only one octave of a major scale). So, within a short time, he could think of what he could do with these “notes.”
Tracy also recognized the parallels and the differences of the computer programs and other instruments while she put the matelophone side by side with the computer station. Previously, she was trying to learn to play “Mary has a little lamb” on the matelophone, a song she had learned using recorders at school. She tried to sing and play to capture the right notes for creating the song. When she compared the matelophone with the bell tones in Build MyTune—I, she tried to find which bar (pitch) on the matelophone resembled the pitch on the computer program. “Do they sound like each other?” I asked her if she found the same pitches in these two instruments. She answered me, “No, they sound different.” “How?” I wanted to know whether or how she could tell the differences. She said, “One is lower,” she pointed to one key on the matelophone, “and this one is higher.” She meant that even though these two instruments both could produce a C major scale, the simulated bells sounded higher. For her, that meant these two instruments have different pitches because of the voice range.

In the above cases, the views Bob and Tracy developed about the computer programs might be related to their intention to recognize that the common properties of Build MyTune—I and other musical instrument tools. Whether they were able to transfer the knowledge between different tools would depend on their musical ability. In the cases of viewing the tools as representation of visuals, sounds or musical instruments, their views reflected their past experiences and their understanding of the problems/opportunities using the tools. While acknowledging the importance of children’s past experience could contribute to their perception of tools, I also recognize that media attributes have played an essential part in the reflective practice as Schön (1983) indicated. There will be a separate discussion on the role of technology and how as it may change the processes and products of reflective practice in the later sections.
Developing Strategies and Routines to Approach the Goals

In Amabile’s (1996) model of creativity, the process of creativity is described as a series of stages: 1) problem or task identification, 2) preparation, 3) response generation, 4) response validation and communication and 5) outcomes, which interact with the components of 1) domain relevant skills, 2) creativity relevant processes and 3) task motivation. My approach to the analysis of children’s creativity processes was to consolidate the stages into a practice as ideas and strategies development. The research design of asking them to perform specific tasks or replicate the same tasks allowed me to see what happened during their practices, which varied by individual and by tasks. They exhibited different ways of exploration, developing ideas, evaluation, fine tuning results, and decision making. In Amabile’s (1996) model, creativity process begins with problem identification in which the types of problem can also include artists’ emotional needs of self-expressing. Unlike this model, children in my classes initially did not begin with problem and task identification during their creativity activities because the problems might not have been apparent to them until they explored it. Some of the children were motivated to created new works once they like their creation and the experience of creative activity. Their repeated practices assured me the development of strategies to approach their goals existed.

Affordance and Utilization of the Tools

In the analysis of View of Tools section, I used Bob as an example to show how the participant perceived the working zone in Build MyTune—I. It served like a blueprint or music score, but more than that because the bells draw on the paper would not make sounds but you can “drag and click” the bells in the computer program. Each bell has its property: a pitched
sound, a bell shaped icon, size, and color. When moving the bells into the working zone, the position of bell was added to the property. The working zone hold the characteristics of bells and their relationships, and the selections and placements were adjustable before they clicked the “save setting” button. In Schon’s (1983) analogy, media created “affordance” for the users to perform actions. In this case, the working zone gave affordance for children to reflect on their actions and choices. It supported their memories and the processes of differentiation and exploration. Most of the children placed the bells they selected inside the working zone as the sole outcomes of their creativity, or sometimes part of the outcomes because the outcomes might involve the ways of playing.

Children selected bells, placed them in the working zone, evaluated the results and saved the settings they liked. In order to save the setting, they needed to give a title to the setting and then click the submit button. This rule of requiring a title/name was the intention of design, which enforced children to take ownership and to think about the meaning of their works. Children soon found that they had to give titles to the settings they created otherwise the submission would not go through. Few of them (Connie and Bob) would check the settings after they saved them. For Phil, he did not bother to check the setting he saved, he would name the work after him, save it and then quickly move on to create the next piece. For the purpose of confirming and understanding whether this naming process related to their meaning making of the works, I asked them to draw their music. There was a text box on the top of the drawing sheet where they could write down the title of their music. They were accepting the routines of naming, saving and drawing—putting down the same titles on the drawing sheet as what they typed in Build MyTune—I.
By the second or third week, children were used to the routine of the class. They knew to go to their workstations and construct music using the computers after the warm-up activities and then ask me for paper for drawing. When these participants were used to these routines in my classroom including the activities and tools, they expected or assumed other tools to be maintained in place with the same functions. After four weeks of working on Build MyTune—I program, we began to use Build MyTune—II in the fifth week. All the children in the class asked me where they could type the title for their pieces/settings when they first used the Build MyTune—II program. Unfortunately, this function was not included in Build MyTune—II. They seemed disappointed but quickly learned to use the buttons to indicate each saved setting.

Unlike Build MyTune—I that the bell tone only occurred when users clicked or released the bell (after dragging), Build MyTune—II featured a function that users could hear a looped feedback if the program is “On.” The looped feedback in Build MyTune—II allowed children to hear the result of their decisions/actions and changes instantly. Some children read the words on the button and understood the function; they usually clicked the “On” buttons within the first minute of the exploration. Some others found the playback function by accident; they tried exploring many other functions but did not “hear” any sound until they clicked “On.” In Build MyTune—I, if the participant did nothing, there would not be any sound; but in Build MyTune—II, the sound would keep going if the “On” button was active. Bob and Connie took the advantage of this looped feedback function; they changed the musical elements while listening and enjoying the instant feedback. However, it was overwhelming for some other participants that they could not think with this constant playback sound. They had to stop the sounds, make changes and then bring back the sounds again. In such case, the listen/evaluating was made after they made action and enabled the sounds.
Listening during Exploration and Evaluation

During the first session, I asked them what the simulated Montessori bells in *Build MyTune—I* looked like. I, then, explained and demonstrated to them how they could click on the bells and drag the bells to the working zone, and save and name the settings. The task was to create a new song using these bells, but there was no instruction given for how the new songs should sound or what the bell settings should look like. The children had a lot of freedom to create something they considered a new song/music.

Listening and Evaluating

The design of *Build MyTune—I* enforced a rule of rearranging the bells to a randomized setting once they clicked the “save” button. The two sets of bell icons were identical in terms of shape and size, except for the color--blue bells and red bells. Each set is consisted of an octave of C major scale. Once the bell setting was randomized and set back to the preparation area, children could not tell which bell had a certain pitch. This design rule was to ensure children explored the bells each time they started a new piece. This design also allowed me to observe whether children explored the sounds of the bells prior to dragging bells to the working zone.

Although this rule of resetting the bells to a randomized setting was intended to force children to explore the sounds of the bells, not all the children did that during the creativity processes. But from the activity of matching pitches, I confirmed their ability to differentiate the pitches and to use listening during their strategy of exploring, comparing, evaluating and decision making. During the second session of the *Build MyTune* class, I assigned a task for the participants to use the *Build MyTune—I* to find matched pitches. For the purpose of assessing
their ability and observing the process of differentiating sounds, this task required them to compare and pair the blue and red bells of the same pitches. The design of this task was actually the original purpose of the Montessori bells—to help children explore and develop listening skills. The task of matching the bells forced some children to listen to and compare the bell sounds intensively.

This intensive listening was found in most of my participants’ processes during the matching pitch activity. Rachel seemed to be able to complete this task very well. She had a strategy of selecting one bell at a time (dragged to the working zone), and then compared it with the bells in the outside area. Kate knew to focus on one bell, dragged it to the working zone, and then compared other bells with this bell. In the beginning, she would clicked this bell (blue A), then followed by several bells in the preparation area. Later on, she found this is still difficult, she would forget the sounds after several bells, so she developed a strategy that clicked the blue A bell once and then clicked another bell to compare. The first one took most of the time, but she learned this strategy worked for other pairs as well. When she found the matched bells, she would play them several times and drag the one that matched the pitch of the targeted bell to the working zone. Alex, Jessica, Tracy, Connie and Bob were all able to develop strategies to select the paired bells to the working zone, using methods of comparison, evaluation and decision making.

Listening and Musical Memory

The matching pitch activity required convergent thinking, which was to focus on the pitch being selected for the comparison. In Bob’s case, his strong musical memory helped him focus and complete the task faster. Instead of clicking the selected bell and other bells to be
compared back and forth, he would click the selected bell once (remember the pitch) and then go
to the preparation area to click through the bells until he found the bell with the desired pitch.
And sometimes, he remembered the pitch and position of the bells he played. He would pair
them and drag them into the working zone without clicking them again. When he made a
mistake, he would click and listen to the bells several times and move the unmatched one back to
the preparation area. When there were only two bells (one blue bell and one red bell) left in the
preparation area, He seemed very sure that the single red bell (in c) would match the pitch with
the single blue bell (in c) in the working zone and the single blue one (in G) would pair with the
single red one (in G). He did not listen to them first (usually he did); then he dragged the bells to
make the pairs. It was like completing a puzzle; the last piece must fit. It also meant that he
understood the relationship between the set of blue bells and set of red bells.

For the matching pitch activity using simulated Montessori bells, a state of attentive
listening, thinking and evaluating while acting seemed to exist in these children’s processes. It
appeared that they understood the goals and most of them could develop ways to complete this
task. But whether the strategies they developed became routines in their creativity processes and
whether the listening skills were applied while they creating music using Build MyTune—I and
Build MyTune—II remained as interesting issues to be further explored. When it came to creating
something of their own, I found the strategies and listening skills for the convergent thinking
might or might not apply when the goal changed or the goal was ill-defined. More complicated
models involved multiple ways of hearing, seeing and playing, somewhat related to their views
of the tools, which will be discussed in the following sections.
Although this rule of resetting bells to a randomized setting was intended to force children to explore the sounds of the bells when they used *Build MyTune*—I, not all the children explored the sounds when they created a new tune (or product). I examined how they constructed the tune, how they placed the bells, and how they played their tunes, and found the goal of “creating a new tune” seemed to have different meaning to various participants. Like described in the previous sections that children began with making sense of the tools, some might treat the simulated bells as visual objects, letters/words, notes for music scores, or keys in an instrument. These views seemed related to how they developed strategies to create their works. Some might use the bells to construct visual patterns, some might construct their tunes by lining up the bells like writing a paragraph of a story, some might play their tunes like walking in a maze, and some might play their bells like playing an instrument. Nevertheless, it could not be assumed that each participant possessed only one way of creating their works. In fact, some showed they had multiple ways of seeing, hearing and playing.

**Tracy’s Process: The Way of Seeing and Playing**

Like Alex, Tracy moved the bells without listening to them first. She constructed a picture (e.g. a square, a cross, or a scattered pattern in the working zone) using the bells. After she finished the construction, I listened to her play her piece, which she never played through it after she constructed the picture until I asked her to played for me. She played the “owl” (shaped like a square) clock wise and then played the two bells in the center. For the piece called “wert,”
(insert figure number) she played the top line, then the right vertical line, and then diagonally, like walking in a map, tracing the bells until she played through every bell.

**Connie’s Process: A Playful Way Relates to Images and Sounds**

In a tune she named “Funny Guy,” Connie sometimes clicked and listened to the bell tones before she made decisions, yet sometimes picked the bells without knowing how they sounded at first. She played the bells in the order from the left–top line, diagonally towards a blue bell, three red bells in the next line, then the blue bells on the bottom lines, then the red bell on the left-bottom, etc. The two red bells remained in the preparation area, “do not fit,” she said. She drew a picture showing a person happily climbing a hill up and down, with ribbons and fireworks in the background. Connie’s work might have some indication of how bells should sound like, but the visual patterns were equally important. Following pictures show the arrangement of the bells with her way of playing, and the visual representation of the tune.

![Build MyTune – I](image)

**Figure 8.** Connie’s construction of Funny Guy and its visual representation.
Phil’s Process: Organizing the Bells Line by Line

The first time Phil played with Build MyTune—I, he clicked on each bell (without particular order), then began to drag some bells to the working zone. Interestingly, he dragged these bells, without listening to them or trying to see whether they fit for each other. But after he dragged three blue bells, he played them in the left-right order, then he carefully chose the fourth one (listened to two red bells to see which one is better). He played through these four bells several times in the left-right order—D, F, G, B, sounding like an arpeggio in dominant seventh (V7th) chord. In Phil’s case, even he did not explore the bells initially, he had a process of evaluating which bell could fit into the previous three bells. The way he played the tune was like reading a book left-right and top-down. The notes in the final work sounded like—D, F, G, B, E, c, A, E, A, c, B, C, D, F, G, C (with no pause in between the notes).

Figure 9. Phil’s work named “Phil 4” and its graphical representation.
Bob’s Process: Cognitive Skills Enable Multiple Approaches

Bob was very different than the other participants because of his age and musical background. His actions toward Build MyTune—I were different than the others in several ways: 1) he always clicked and listened to the bells before dragging them, 2) every once a while during the construction, he would played the bells he lined up in the working zone before he searched for the next bells to fit, 3) he went back to search for the bells he needed either had a goal in mind or would compare which bell fit better, and 4) he showed sense of rhythm (differentiate time) when playing the sequence of these bells. The following is an example of how Bob explored the bells and created the tunes using Build MyTune—I.

![Figure 10. Bob’s process of constructing work using Build MyTune—I.](image)

Bob first dragged a red bell to the working zone (Figure 10). Then Bob explored the other bells in the group. When Bob accidentally clicked on the blue bell (pitched in G) in the second left row of the group, he hesitated a little bit (seemed to be discovering something). He went back to click that blue bell again, decided to drag that bell into the working zone and placed it next to the red bell. Bob kept searching for another bell he wanted. After dragging these two bells, he played the remaining bells again from the left to the right and then top-down until he
found the bell pitched in A, which he dragged to the working zone. At this point, he played through these three bells in sequence: first red bell (twice), blue bell (twice) and the second red bell (once) (Figure 11). The melody sounded like $C C G G A$ at this point.

Figure 11. Bob’s construction of first three bells.

Bob was actually playing the beginning of “Twinkle Twinkle Little Star” (C-C-G-G-A-A-G-). This was a tune he was familiar with. I asked him what his tune sounded like, and he immediately said, “Twinkle Twinkle Little Star!” He told me he was trying to create “Twinkle Twinkle Little Star” in the beginning and then changed his mind to create something else. “To create something like it, but not totally like it,” he said. After the bells (C, G and A), he dragged a bell in pitch $B$ to the working zone. $B$ was not a note in “Twinkle Twinkle Little Star.” Every time when Bob added a new bell to the working zone, he would play through the melody from left to right and top-down once. The sequence was not always linear because some bells were played twice and some bells were played back and forth. At the end, Bob used all sixteen bells. The final piece looked like the following figure. Bob’s tune had phrases and followed the musical structure. The ending of the tune had a cadence from dominant seventh leading to tonic (B to c). The total time of the Bob’s construction of this piece was about four minutes. After he finished, he named this song “The Lily” and drew a beautiful picture of lily flowers and leaves in a pond (Figure 12).
The second week of the class, I asked all the participants to play their songs again. Many of them totally forgot how they played the tune they created the previous week. Phil and Bob remembered how their songs should be played. Phil remembered it because he always placed the
bells from left to right and top-down. Bob remembered how the song was played because he was self-motivated to practice the same song using his violin back home.

Ways of Hearing, Seeing and Playing

Bob’s patterns of constructing the bells, remembering the tune and practicing the same tune using another instrument show how a twelve-year-old musically inclined child perceived the tool Build MyTune—I and could transfer his past experience to build new experience. The six-year-old Phil had no formal training on musical instruments. He earnestly lined up the bells, played the bells in sequence and then drew pictures of bells lined up exactly like they were in the working zone. Later, Phil drew (the representation of his “music”) what he saw (the bells lined up).

Comparing Bob and Phil in their processes of creating a tune using the simulated Montessori bells, Phil was constructing a musical score or story book for reading that the music was always played in sequence from left to right and top-down without pausing between pitches. Every bell got to play once in the sequence and this sequence was the whole piece of music for him. This process seemed resemble the Pathmaker defined by Bamberger (1991, 1999); that The Pathmakers seek the sequence of events that the representation and organization of the objects have a function as following a specific path of actions and trigger a specific condition. Whereas Bob treated the bells like both keys in the instruments and the notes for music score. In the case of constructing the tune “The Lily,” he was a Mapmaker where the meanings of the objects are fixed according to the maker’s mental structures and independently from their sequence or function in a song due to his understanding of bells as having fixed pitches and being reusable. But the participants in my study showed that the processes of using Build MyTune—I could be
beyond the processes of a Pathmaker or a Mapmaker. When using simulated Montessori bells in the computers, children also considered visuals as an important element in their works. Even for Bob, who clearly mastered the function of the tool and defined his goal as creating music, would carefully arranged the color patterns of the bells as he understood that he could use either a red or a blue bell for the same pitch to be represented in the musical phrases and the line of space.

Figure 14. The bell setting for Bob’s work “The Lily.”

How and When Did “Something New” Happen?

I asked Bob about his tune “The Lily” (see Figure 15.): “Did you, have you heard of this melody before?” “No!” Bob replied, “[it] just came into my mind.” When giving a child an instrument and ask him or her to build a new tune that they have never heard before, how did I know whether it was just a result of random exploration, or intentional actions approaching towards some goals? Were the children aware of the novelty and appropriateness in their works? Several things in my design of the tools and tasks helped me observe whether they were making conscious decisions, and how they came up with the idea. 1) They were put into individual computer station to work on their own; 2) they were given opportunities to name the tunes and
save the settings; 3) they were given opportunities to share their ideas with someone else (draw a picture about their tunes and describe the works and processes); 4) there were tasks requiring convergent thinking (matching pitch in Build MyTune—I, constructing the beginning of “Twinkle Twinkle Little Star” using Build MyTune—II, learning to play the first phrase of “Hot Cross Buns” and making variations for it, etc.) and divergent thinking (making a tune of your own); and 5) they were asked to create new tunes using the same tools repeatedly.

**Intention of Creating New Works**

From the observation of classroom activities, I found they were able to replicate the short phrases I demonstrated and make variations of that phrase. When they used the computer programs to create tunes or settings, the novelty came from their unique views of tools and the ways working with the tools, and the appropriateness was judged based on their perception of tasks (either music or a piece of art work) and their goals in mind (what they wanted to do with the tools). The novelty in this context does not mean that they were creating a new genera of style of music. Some works were beyond the conventional music styles because the children did not have enough training to produce conventional music using the tools or their views of tools and personal preference led them to develop something different (e.g. visual, play, etc.). In terms of creating something new beyond their past experiences or previous works, I saw that it seemed natural for some kids like Bob, Connie, Tracy, and Jessica to create something different each time even using the same tools, but some of the kids would create similar works if they were using the same tools.

Bob’s second piece was called “The Hedgehog, (see Figure 16.)” it was different than “The Lily” in terms of the melodic and rhythmic patterns. Both pieces followed the classic
musical form, beginning with the tonic and end with cadence. Unlike “The Lily” where some bells were used twice as he was playing the keys/string in the instrument, for “The Hedgehog,” he placed the bells on the working zone as if they were notes functioning in a musical score and were played straight through the sequence.

![The Lily](image1)

Figure 15. The Lily (by Bob).

![The Hedgehog](image2)

Figure 16. The Hedgehog (by Bob).

Phil constructed the tunes quickly and named the tunes consistently. It was always his name followed by a number (e.g. Phil2, Phil3, etc.). Although each time the order of the bells was different, he always lined up the bells horizontally in the working zone and played through them as sequenced. I do not know whether Phil would keep doing the same thing using Build MyTune—I if I asked him to continue the tasks for several more weeks. I also do not know whether Phil would change the ways he constructed the tune if he picked up some ideas from the classroom activities or I needed to give him some other type of tasks using Build MyTune—I. When Bob said that the idea just “came” to him, it sounded like a mystery and it was indeed difficult to identify exactly when and how. But by examining their works and their processes,
there were cases when new ideas were developed through participants’ past experience or through playing a new tool. These cases will be discussed in below sections.

**Build Upon Past Experience**

Bob said the idea just “came” to him, then he explained further that originally he was going to construct a tune sort of like “Twinkle Twinkle Little Star.” “I created the top notes first, and then I went back to choose more notes”. Prior to using *Build MyTune—I* to construct a tune, we had a group activity which I demonstrated the beginning of “Hot Cross Buns” using metalophone, asked them if they recognized the song, and then requested them to replicate the beginning of “Hot Cross Buns.” After they practiced the phrases, I asked them to come up two more measures of their ideas. “Hot Cross Buns Variation 1” was what Bob’s version of “Hot Cross Buns” variation. Then, I asked them to play another variation and to assign group members some music patterns and to join as an ensemble. “Hot Cross Buns Variation 2” was what Bob came up with.

Figure 17. Hot Cross Buns (original tune).

Figure 18. Hot Cross Buns Variation 1.
I did not know whether this activity had direct influence on how Bob got an idea to create new melody based on the beginning of a known song (e.g. “Twinkle Twinkle Little Star” or “Hot Cross Buns”). I also did not know whether this classroom activity was the first time Bob created new songs based on something he knew. The following week, he told me that he sometimes improvised melodies on piano. I asked him to pick a known melody and to improvise variations on piano with my accompaniment of ostinato chords (repeated chord progression). He picked up a short but complex melody in six-eighth beat and then we played for several minutes. Because it was a continuing sequence of a theme (the known melody by him) and variations, he sometimes played something he did not like and did not know what to do. When he felt struggled, he would come back to the theme. Unlike the short melody created in the classroom activities or from Build MyTune— I, during this more lengthy piano improvisation experience he often came back to the theme.

Another participant showed that a new tune could be derived from an old tune. Connie was able to create short variation from the motive of “Hot Cross Buns” as well. After the exercise of creating variations, Connie completed the pitch matching activity, and then began to create a new tune. She listened to the two bells that played E previously paired for the pitch
matching activity, and then she added another bell (G). Now she can play E, E, G, using the three bells. This sounded like the beginning of lullaby. She kept adding other bells and then completed the tune. She gave a name, “Lullaby,” to this new tune.

Another important aspect of creating new things from known knowledge is that: From Bob’s activities of creating variations, using simulated Montessori bells to construct a new tune based on the beginning of a known song, and practicing the song he created in simulated Montessori bells using another instrument—violin, it showed Bob’s ability to transfer his past experience to different platforms (music patterns, instrument, etc.) as new experience. These platforms share a common property—a tangible object could produce a pitch, and these pitches were within the musical structure of his mental model so he could use the skill of inner listening to imagine or expect how they sounded like.

Learning from the Unfamiliar Situation

The first time Bob used Build MyTune—II, he was fascinated by the “mysterious” atmosphere he created using patterns of a wide range of pitches and various timbres. Although this interface was new to him and there was no prior instruction on how to create a tune or what the tune should sound like, Bob quickly developed a strategy of listening to the changes while he adjusted sliders (for different pitches) and selected different dropdown menus (for instrument choices, number of beats per cycle, tempo/speed and sequence patterns). He composed several different patterns. He was smiling, nodding his head and conducting music while he was exploring the patterns. When I asked him to play his music for me, he started with one sequence, seamlessly altered patterns in the middle of the song, switched back and forth among different patterns and sometimes even used the random feature (clicked on the random button for the
system to generate random patterns of sequenced pitches) to create unexpected effects. He seemed satisfied with what he heard. “How do you feel?” I asked him. “Good.” He answered with a smile on his face. “How does this music sound different than the other music you have made?” “More complex.” he said. When I asked him what title he wanted to call his music, he said this music is “unknown.” “The title is unknown?” I asked him. Bob laughed and said, “yes.”

There were a number of ways the participants created music using Build MyTune—II. When Bob played his music for me, unlike the other participants, he had sets of the tempo, beats per sequence, pitches selected, and then he seamlessly altered the dropdown menu to change to different instruments with the music progressing. The music he played sounded like a continuing variation that was within a set of modes and rhythms but with constant changes of instrumentation or sequence of playing (forward, backward or random sequence). Nevertheless, since this music was very different than any music he heard, he could not think of a term to describe it at the time he constructed the tune. The new tool helped Bob created something new; but on the other hand, Bob developed his unique way of structuring and playing music using Build MyTune—II.

**Unexpected Situations Lead to Reflection**

In general, the processes of children making music using Build MyTune—I and Build MyTune—II or other instruments were full of playfulness and imagination, yet they were frustrated when there were technical issues or they could not comprehend the constraints of the tools. Interestingly, the processes of design—beginning from not knowing what outcomes would
be to progressing/developing a sense of appropriateness—can be found in cases in which the participants practiced to overcome the technical difficulty.

Tracy’s first saved settings in Build MyTune—II seemed to be a result of exploration from lists of different instruments, beat cycles, tempo, playing sequence, etc. When Tracy developed her second work, she found a setting of steel pan with sliders (pitches) that went up and down. She liked this setting but was unable to save it. This technical difficulty forced her to practice many times to make a setting that sounded similar to what she created before. The first time she made the steel pan setting, she did not know what the final product would sound like. When she reconstructed the setting, she had a goal (since she still remembered how the steel pan setting sounded like) and was acting toward that goal. But while she reconstructed the sliders and instruments, she did not make exactly the same setting she had before. She could not recreate the setting because she did not really remember the exact pitches. Also, it was too difficult to move the sliders to the exact pitches even if she had known which pitches she wanted. Tracy only knew the relative height of each slider. So, during the reconstruction, Tracy created many versions of the steel pan settings that sounded similar but with slightly different pitch patterns. The reconstruction due to the technical difficulty forced her to evaluate her ideas and to understand how she got there. It also allowed me to see her design process from unknown to confirmed outcomes.

No Change to My Tune

The children explored, listened, arranged, evaluated and made decisions on the bell settings or the functionalities in the computer programs. Once they saved their settings, seldom did they want to make changes. “Do you want to change anything?” I asked Connie. “No,” she
replied. When I asked Erin if she liked the music, she nodded her head. “Do you want to make any changes?” Erin shook her head. “You really don’t want to change your piece?” I asked Phil repeatedly. He shook his head and replied confidently, “No!” Only once, Kate slowly and hesitantly told me that she might change something.

**Making Revision during Exploration and Development of Strategies and Goals**

The children in my study did not seem willing to change their works once they considered the works were completed, but refusing to change the music at what they considered the end of the process does not mean that these participants did not revise their music. From the screen recordings I found that all of the children made revisions when they were developing strategies or goals for their tunes. The examples were moving the bell(s) from the preparation area to the working zone in *MyTune I*; listening or thinking for a while and then moving the bell(s) back; changing the instrumentation, beat cycle/patterns, or pitch sliders in *MyTune II*, or fine tuning the bell(s) or slider(s) positions to make them more visually interesting (in the children’s minds). The following field notes are few of the examples of the children’s revision during development of strategies and goals.

**Alex using MyTune—I:**
- Dragged a red bell and then moved it back. He then replaced the third red bell with another one (in pitch C).

**Bob using MyTune—I:**
- Played from the second line in the working zone. E, D, C, then switched the D and F in the third line, which became F, D, F. He played F, D, F, one more time.
- He played from the second line in the working zone. E, D, C, then changed the third line back to F, D, F…

**Bob using MyTune—II:**
- Changed to piano, and then changed the sequence pattern. …finally stayed with random…
Connie using *MyTune—II*:
- Changed the tempo to very slow. Cycle-1 beat, instrument – organ, and still random sequence. Moved the slider to the top and then clicked On. Changed the slider while the music is playing (but her speed of changing slider was faster than the tempo).…Changed the tempo to medium and then changed again to slow. Selected 4 beat cycle. Then changed the sliders…Changed the instrument to chime, listened for a second then changed to bell.
- Changed the tempo to very fast. While the music is going, the mouse is wondering around on the screen, (seemed do not know what to do)…

Erin using *MyTune—I*:
- Played the two bells again, then moved red C back to the outside area.

Jessica using *MyTune—II*:
- Changed the first slider and then clicked On…
- Started to move the sliders down again (for constructing a new piece) Mouse wondering on the screen for a little bit. Changed the instrument to organ. Began to build a pattern of up-down-up-down, etc. for the sliders…

Phil using *MyTune—I*:
- After he added the fifth one, he played through them, then he began to explore other bells. Picked up a red c to be the last one, then think for a while, put this red c back to the outside area. Played the original five bells in the working zone back and forth…

Tracy using *MyTune—I*:
- Changed the sliders again. Clicked On to listen, then clicked Off. Back to changing sliders. Changed the instrument to steel pan (she seemed want to reconstruct her steel pan setting) Changed the tempo to slow, very slow, fast, very fast. Then back to medium.
- While the musical pattern was playing, she changed one slider, moved it up and down and listened how it sound differently…

**Point of Decision Making**

The point of finishing with self-satisfaction seemed to be the moment they clicked the “save” button (unless they were experimenting with the “save” button function). When they shared their works with me or the other participants, they had to play through the bells (in *Build*
MyTune—I) or playback the settings for a certain time (in Build MyTune—II) which was either a repeated patterns or randomized sequence of certain pitches, instrumentation, and tempo. The children reflected on their processes (how they made the tunes) and products (what did the outcomes mean to them) through reviewing the processes and products with me or other participants. Even after their reflection and being asked whether they wanted to make changes, they tended not to change their tunes. Instead they turned their interests to something else, either moved to the next piece, began to draw their visual representation, or played in the classroom. I found the phenomenon of “no change to my tune” was interesting. It was like they were drawing a picture and knew when it was done. Although most of them did not want to revise the tune after it was done, many of them did show enthusiasm to compose another tune, and in some cases, the new pieces sounded or looked like the variations (revised version of previous works).

Figure 20. Bob’s drawing of his piece called “Space.”
Making Sense of the Outcomes

**Meaning of the Tune**

I asked the participants to show me how their composition sounded and describe the meanings to me in pictures and words. This step gave me and the children an opportunity to reflect on their creativity processes and to develop or confirm the meaning of the tunes. My assumption that the meaning was developed after the tune was based on the notion that they did not know what they were about to create. In the case of Bob playing *Build MyTune*—II the first time, he was not clear about what this music represented but agreed to try to draw a picture of the music. For a while, he was searching for ideas to represent his music on the drawing. However, when he started to draw, he drew confidently and quickly and used a lot of colored pens. In the end, he wrote “Space” as the title of the picture and music. He described to me, “It's like… a lot of comets were flying, big comets…or small, sometimes, they explode.”

Alex was confused when I asked him to draw his music (initially using *Build MyTune*—I). “How do you draw music?” he asked. Indeed, even by giving time and opportunity to reflect ideas and develop meaning, the characteristics of one thing might still not able to transfer to another form. In fact, Alex did not want to draw a picture for his woodblock piece using *Build MyTune*—II (see previous example) because he could not find a visual representation for the music. It was not necessary to assume whether the music had or had no meaning to him.

**Personal Ways of Creating**

Were there different characteristics in the children’s creation using the same tools? The data show that the children were able to create music with different characteristics that associate
with the meaning of the piece. “Space” is in minor key (melodic patterns were using the pitches--A, E, D sharp, B, C and G sharp) and a very fast tempo. Bob alternated the instrumentation from organ, piano, timpani, woodblock, electronic piano sounds, etc. during playing. The piece sounded strong, busy, energetic and unpredictable with various elements or patterns going on continuously. The piece “In the Dark” (also using Build MyTune—II) is in a slower steady tempo in minor key (using less pitch choices-- A, D, C and B) with only bell tone. It shows a mysterious feeling. Bob drew a picture of person holding a flash light that glows in the dark for this piece.

When constructing works for Build MyTune—II, Jessica’s ways of describing the meaning of the piece has a pattern of giving a title that represents the instrument, sounds or feeling of the piece, and then drawing the up and down position of the sliders. During the session where Jessica used Build MyTune—II the first time, she created several patterns and named them. The “Aristo Cat Music” was when she selected piano sounds and adjusted the sliders to create patterns with different pitches. The “Chime Drum” was using the steel pan sound and the “Scary Pattern” was using the organ sound. She was motivated to create new tunes/settings and draw pictures of them. The interesting thing was that her drawing for all three pieces was the representation of what she saw on the screen. It seems that she tried to replicate the up and down of the slide positions and the settings were different for all three patterns.

It seemed like there was no single way children constructed meaning for their works. In Connie’s case, she was able to describe to me what the music sounded like to her. She named the piece “energetic dance” and drew a lot of colorful shapes/lines just like she danced with her hand movements when listening to what she made using Build MyTune—II, a continuous fast beat of notes in various pitches (not in conventional scale or mode such as a major or minor scale). I was
wondering if she already had an image in mind at the time she created the pattern, when described to me, or until she really draw a picture. Mindy, once discovered two of the bells she used sounded like the pitched tones (B and G) for saying “dinner;” she drew a picture of her mother serving a dish of food and calling “dinner.” Tracy told me that she felt the up and down of the sliders looked and caused the music to sound like going up and down the stairs. She drew a picture of a cartoon character climbing up to the top of the mountain and wrote “up and down the stairs.” Kate was fascinated with the pirate and treasure hunting during the Halloween season when the class was held. She named her piece “pirate ship” and came in a pirate costume one day.

Claiming Authorship

I saw children in Build MyTune class claim their authorship by naming the piece after themselves. Many of Alex’s and Phil’s works using the Build MyTune—I (simulated bells) had titles of their names, except Alex’s last drawing for Build MyTune—I was named “Police.” Although the works he created through Build MyTune—II sounded quite different than any of the work using Build MyTune—I, Alex still named this work after his name. In the example of Alex’s woodblock piece, he did not want to draw a picture of it but gave a name for the piece—“I want to name it Alex.” Another example of children associating their names with their works was Jessica. Jessica always signed her name on the drawing that described her music. After the title, she wrote: By Jessica. Somewhere in the picture, I always found “Jessica Studio” as if this is a CD cover for a music album.

Other than assigning names in the title of the tune or in the invented visual representation, ways of claiming authorship that were also defined included voluntarily sharing with others and
emphasizing themselves while sharing (e.g. “I” made a another one [music/work]), feeling good about being able to play the same piece using different instruments in the classroom or at home (Bob played what he created in Build MyTune—I using violin and piano and felt good about the piece was “still there” even he changed the instruments), trying to go back to the same feeling or settings created earlier (e.g., Alex was excited about playing a group composition in which he put effort created it), and/or correcting others when teaching others about their tunes, etc.

Sharing with Others

Sharing Motivates New Works

During the session using Build MyTune—I the first time, Tracy was building her musical robot regardless how everyone else was working on the computer program. Checking with Jessica to see if she had some progress, I came to her station: “can I hear your music?” Jessica said, “Sure.” I gave my comments: “Oh, interesting!” Jessica asked eagerly, “can I make another one?” “Sure, you can make another one,” I said. “What are you doing? Tracy?” Jessica turned her head and looked for Tracy. Tracy was still building her musical robot at this time. “I mean, I made a nice one, do you want to hear it? Tracy?” Tracy went to Jessica’s station and I heard either Jessica or Tracy was excited, yelling, “wooo…” Jessica said, “another aristo cat…” Tracy said “another musical robot!” After Jessica shared her music with Tracy, Tracy then went to her station to create her own. After she created something, Tracy share with Jessica and asked her, “do you like it?” Tracy then spoke to herself: “… [I am going to name it] ghost…” Jessica later asked Tracy’s opinion for her new piece: “Do you like it? Tracy? So how do you think of it?”
From the classroom interaction, I felt that the twin sisters must have been sharing many things and ideas together, and they seemed to use to build things together as well although they may have different styles, methods, and aesthetics. Sharing in the learning process was a stimulus of motivation and/or new ways of seeing and doing things. During the sharing, they describe their ideas and processes of constructing the music. Previously, Alex found there were orange dots (each represents a saved setting) in Rachel’s setting. He was curious what they were. Rachel shared with Alex and me how she created the tunes and saved them. She also taught Alex how to save the settings (created orange dots). This was one of the examples where children were inspired and taught by their peers. Sharing also gave them opportunity to build self-efficacy. Initially, Alex was shy during the class activities and did not show much expression when he created works using Build MyTune—I. It was after several weeks of the class, when Alex shared his work in Build MyTune—II with us: Alex smiled to Rachel and then looked at the computer, still smiling.

Sharing Promotes Reflection

Sharing did not work well for all cases. I heard Bob and Connie arguing. They two had different ideas of music (using Build MyTune—I) and did not agree with each other in terms of what sounded “good.” There were also occasions in which even though I assigned tasks of creating music as a group using classroom instruments, the results of the ensemble were in dissonance. Kate, Mindy, Tracy and Jessica either played sounds with their own tempo, played their own patterns regardless my counting of steady beat, or played by themselves without listening to what other people were playing. But interestingly, during the last two sessions, Kate, Mindy, Tracy, and Jessica began to listen to each other without my instruction. They came to the
classroom and started with playing instruments together. They chose their instruments (Conga drums and other percussion instruments) to play as a group. They sometimes exchanged instruments with each other. I found them adjusting the tempo of the rhythmic patterns during playing in order to fit in the ensemble. They were pleased to announce that they were creating a “musical play.”

Sharing with other is an action to explicitly express and describe the ideas, also an opportunity to reflect on their works and processes. In Build MyTune class, children shared their works with others as part of their “learning by doing” experience which means the reflective practice was built into their classroom and creativity experience by my research design and by the nature of children’s interaction. There is no way that I could have known if their processes or outcomes were different than the results in this study if there was no sharing/reflection during their creativity activities, since sharing/reflection were already part of the process.

Ways of Practicing Design

Stages of Children’s Creativity and Knowledge Sharing Processes

This question has been raised in the beginning of this chapter: How do children learn to design something that they do not know yet? As described in the above sections, children began their music making process with making sense of the tools (its visual presentation, functions or constraints). They listened during the exploration or evaluation. They built on their past experience or learned from unfamiliar situations to develop new ideas. The goals may or may not have been apparent to the observer. Yet, there is evidence that the studied children were able to developed strategies and routines to approach their goals once the goals were determined (e.g.
Alex developed his goal of constructing groups of red and blue bells to represent the Avatar; Tracy and Jessica are able to click through bells to find the matched pitches, etc.). Sometimes, the unexpected situation led them to create something new, or, they would be assigned tasks or be self-motivated to create. Mostly, the children modified their works during the exploration or development of strategies or works, but they did not want to change their tune once they considered the works were finished. Finally, they constructed the meaning of their works and shared their works with others, and were motivated to create new works.

These findings were described by themes earlier. These themes were developed based on the codes categorized by children’s music abilities (the ability to differentiate pitch, rhythmic patterns or timbers, understand and building structures, retain memory, etc.), music activities (individual or group activities dealing with music, such as group practice, individual improvisation, playing a known song, playing a new song, etc.), music making processes (actions and events toward creating works when using Build MyTune—I, Build MyTune—II and some classroom instruments), the children’s perception and views, the role of teacher, the role of technology, and the children’s background.

Moreover, the themes associated with the studied children’s creativity and knowledge sharing processes were merged into four stages: Stage I: making sense of tools, Stage II: developing strategies and approaching goals, Stage III: completing works, and Stage IV: sharing knowledge. Each stage was defined by a sequence of activities and the output of these activities. The reason for organizing these themes into stages was to conceptualize the children’s creativity and knowledge sharing patterns within this specific context using Build MyTune—I, Build MyTune—II and some classroom instruments. This organizational structure was helpful when discussing particular phenomenon such as the ways children’s reflect and revise/extend such as
revision, which occurred in Stage II: developing strategies & approaching goals. Table 1 presents an organizer for these stages. The left cell under the main category has the examples of activities and the right cell shows the output of these activities.

Table 1

Organizer of the Studied Children’s Stage and Activities Involved in their Creativity and Knowledge Processes

<table>
<thead>
<tr>
<th>Stage I: Making Sense of Tools</th>
<th>Output: View of tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities: Exploring sounds, visuals, functions and constraints of the tools and sometimes relating this new experience with past experiences</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage II: Developing Strategies and Approaching Goals</th>
<th>Output: Strategies, routines and goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities: Building on past experience; learning from unfamiliar situations; exploring tools; listening, seeing, encountering problems; solving problems; searching from memory; identifying goals; repeating/practicing; evaluating; making decisions; making revision</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage III: Completing Works</th>
<th>Output: Creativity outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities: Making decisions, evaluating/validating works, claiming authorship, making meanings</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage IV: Sharing Knowledge</th>
<th>Output: Visual representation or description of the works, motivation to new works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities: Making sense of the outcomes, sharing outcomes or processes with others, learning from others, repeating/demonstrating, developing motivation for new works</td>
<td></td>
</tr>
</tbody>
</table>

Creativity, Knowledge Sharing and Reflective Practice

The children’s creativity and knowledge sharing processes were further analyzed using the framework of reflective practice. The results show that components of reflective practice were found in the studied children’s creativity processes and the occurrence of these components varied by individuals and the situations encountered. For example, Bob, who had strong musical
background and was older than the others, was able to demonstrate seeing, listening, searching, exploring, modifying and making decisions seamlessly without stopping his actions, whereas Alex, who had no music training and was younger, had to stop the feedback sounds, made changes and then turned the sounds back up to evaluate the changes he made. Such cases illustrate that Bob’s practice had traits of reflection-in-action while Alex had a pattern of reflection-on-action. An example of the occurrence of surprise and on-the-spot experiment was that Alex found a new way of laying out the simulated bells (one on top of another) after he experienced unexpected technical difficulties. Another one is that Leo discovered that clicking the On button in Build MyTune—II enabled the feedback sounds; this result surprised him and changed his actions from random exploration to mindful experiments.

The patterns also show that when associating the processes of the children’s creativity and knowledge sharing with the components in the reflective practice model, the components of knowing-in-action, reflection-on-action, reflection-in-action and on-the-spot-experiment are interwoven with the activities in all four stages. In other words, each stage is comprised of one or more of the components from the reflective model. For example, knowing-in-action is a notion of revealing tacit knowing through actions (Schön, 1987), which is necessary during the every stage of the process. The studied children demonstrated quite often that they draw from their past experiences to perceive or act on the new situation. Bob and Connie created music starting from the melodies they were familiar with (“Twinkle Twinkle Little Star” and “Lullaby”), demonstrating that the children’s backgrounds and experiences added to their compositions. In the case of Alex, building many versions of the war of avatars using the red and blue bells might have come from his experience of playing computer games. The following table shows examples
of how the codes belong to the stages of creativity defined in this study and are framed under the reflective practice model.

Table 2

Themes Structured with Creativity Processes and Reflective Practice

<table>
<thead>
<tr>
<th>Themes</th>
<th>Knowing-in-action</th>
<th>Surprise/unexpected outcomes</th>
<th>On-the-spot experiment</th>
<th>Reflection-on-action</th>
<th>Reflection-in-action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage I: Making Sense of Tools</strong></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>exploring sounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exploring visuals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exploring functions and constrains of the tools</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>relating new experience with past experience</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Stage II: Developing Strategies &amp; Approaching Goals</strong></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>building upon past experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>learning from unfamiliar situation</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>exploring tools</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>listening</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>seeing</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>encountering problems</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>solving problems</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>searching from memory</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>identifying goals</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>repetition/practicing</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>evaluating</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>making decisions</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>making revision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stage III: Completing Works</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>making decisions,</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>evaluating/validating works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>claiming authorship</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>making meanings</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>making sense of the outcomes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sharing outcomes or processes with others</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>learning from others</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>repetition/demonstrating</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>developing motivation for new works</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When children began to make sense of the tools, the activities related to the components of surprise/unexpected outcomes and on-the-spot-experiment were noticeable. They gradually developed strategies and built up routine practice with occasions of experimenting. When they encountered an unfamiliar situation, had technical difficulties, could not make things the ways they liked, or came across problems that confused them, they sometimes paused and did not know what to do. These events, related to surprise/unexpected outcomes, still occurred at times
during the stage of development of strategies and approaching goals. When the surprise happened, a lot of exploration, decision-making and revisions were involved.

The notion of reflection-in-action and reflection-on-action was not so much which one would happen during which particular stage but rather it was about how the children reacted or handled the situation during uncertainty or unexpected outcomes. During the cycle of creativity (from making sense of the tools, to developing strategies and approaching goals, to completing works), some children’s practice involved more reflection-on-action, which they stopped before making another movement. Some of the children might have paused longer or even lost interest and quit, but other children gradually learned to handle the situation so well that reflection-in-action was possible. The evidence was apparent in Bob’s example of playing back the constructed melody line and moving bells back and forth between the working zone and preparation zone while searching for the pitch to fit his melody line. The fact that he intentionally went back and forth among exploring, searching, evaluating and validating the results shows that reflection-in-action happened during his processes.

The components—knowing-in-action, reflection-on-action, reflection-in-action and on-the-spot-experiment—work together as a cyclical model, but not all of the participants practiced the full model that included all components. Some participants never reached the stage of reflection-in-action during their practice. In the case of Leo using Build MyTune—I, he randomly explored the bell settings many times and typed random names for the title of his work. He did not display any reflection on his processes or decisions and seemed to stay in the zone of experiment and indeterminacy. Eventually, he lost interest and stopped practicing. In many other cases, the children moved through all four stages and had occurrences of all components of the reflective model.
The components of reflection-on-action and reflection-in-action existed during the stage of knowledge sharing in the cases of the children demonstrating a piece they made earlier with smooth actions or no hesitations. The process of the knowledge sharing was established by the design of this study, which involved the children reflecting on their processes and outcomes. Although reflection-on-action was a required step designed into the processes, some children did not remember how they constructed the music or could not articulate what the music or works meant to them (e.g., Alex looked confused when I asked him to draw his music). Also in the design was the task of asking the participants to use the same tools to create works several times to observe how and when the children reach the mastery level at which reflection-in-action takes place.

The following diagram depicts creativity and knowledge sharing stages observed from this study with the occurrence of reflective practice components. The diagram showing ways of learning design is a composite framework includes variations summarized from all participants.

Figure 21. Composite framework of creativity processes and reflective practice components.
Practicing with the Same Tools Repeatedly

In fact, the processes also varied sometimes for the same participant working on the same tool. Here, I am taking another approach to learn about their processes of design by examining individuals’ processes of music making utilizing the same tools repeatedly. It helps me understand whether the same or different components appear each time when an individual creates a piece of work using the same tool. I use Alex’s processes as an example.

On the first day of using Build MyTune—I, Alex produced seven pieces, meaning there were seven times he constructed and reconstructed the settings of the bells, named the settings and clicked the “save” button. The very first time, he spent almost three minutes before reaching the final decision. He spent a substantial amount of time exploring, listening, and moving bells back and forth from the preparation area and working zone. The bells were set line by line and alternated in colors (one blue bell followed by one red bell). Although he clicked through the bells to listen to the sound earlier, he did not listen to the bell tones before he dragged certain bells into the working zone. It seemed that Alex cared more about the visual effect than how the sounds influenced his arrangement.

The second time, Alex spent less time on exploration and quickly formed the goal of arranging a setting consist of only red bells in the working zone. After he dragged and arranged red bells in the working zone, he played these bells without particular order. This action of playing through bells randomly after he constructed the setting is quite interesting. I did not know whether this action is part of his exploration of the settings he made, but obviously order of the sounds did not matter because he did not rearrange the bells after he heard the sound. After the second piece, he seemed to have a clearer goal of his next piece. He spent no time on
exploration; instead, he quickly dragged all blue bells into the working zone, and then fine-tuned
the position of the blue bells in the working zone. He began another construction after his blue
bell piece—moving all the red bells to the working zone. The difference of this red bell piece with
his first red bell piece was that the last red bells were placed on top of another red bell. But he
moved the two bells away and then saved the setting. So, the final result of this piece is an all
red-bell arrangement just like the second piece.

Even though during his third piece (all blue bells), the attempt to place some bells on top
of others was only an experiment but not for the final result. He seemed to get an idea for his
next piece. He began to move bells, arranged bells in the preparation area, and sometimes placed
one on top of another. Now, it looked like there were only red bells on the screen (blue bells
were hiding under). Alex discovered a new way of building the settings! Because this idea
involved new ways of selecting and placing the bells, and sometimes encounter technical
difficulties, it took more time (3’16’’) than the previous construction. The following actions
showed that Alex stayed with this new idea. He moved all red bells away, and then moved all the
blue bells to the working zone. After he put each red bell on top of one blue bell, he saved the
settings. It seemed that Alex was clear about the function and meaning of preparation area and
working zone. He was also self-aware of his goals.

For his next two constructions, he stayed with this idea of making some bells on top of
other bells. He was trying some new ways of making these layers, although sometimes failed.
However, he had built up a routine of clicking/playing through the bells after he arranged the
settings. The action of playing was without particular orders and had no effect on the
arrangement of the bell settings. The table below displays the themes of activities during each of
Alex’s construction using Build MyTune—I the first day. The duplicated activities have been
removed from the table (each of the activities may be appear multiple times but only show one time on this list). The order of these activities is not represented as progressive processes in the table due to some activities reoccurred and interweaved with each other.

Table 3

Activities Involved in Alex’s Creativity Processes

<table>
<thead>
<tr>
<th>1st time</th>
<th>2nd time</th>
<th>3rd time</th>
<th>4th time</th>
<th>5th time</th>
<th>6th time</th>
<th>7th time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration/</td>
<td>Preparation area</td>
<td>Self-awareness of goal</td>
<td>Exploration/</td>
<td>Preparation area</td>
<td>Approach the idea</td>
<td>Approach the idea</td>
</tr>
<tr>
<td>experiment</td>
<td></td>
<td></td>
<td>experiment</td>
<td>area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process speed</td>
<td>Working zone</td>
<td>Naming the music/setting</td>
<td>Arranging space</td>
<td>Something new</td>
<td>Developing strategies</td>
<td>Listening</td>
</tr>
<tr>
<td>Preparation area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arranging visual patterns</td>
<td>Exploration/ experiment</td>
<td>Making decision</td>
<td>Developing strategies</td>
<td>Naming the music/setting</td>
<td>Making decision</td>
<td></td>
</tr>
<tr>
<td>Listening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Exploration/ experiment</td>
<td>Making decision</td>
</tr>
<tr>
<td>Working zone</td>
<td></td>
<td>Self-awareness of goal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical difficulty</td>
<td>Naming the music/setting</td>
<td>Working zone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approachin the idea</td>
<td>Making decision</td>
<td>Technical difficulty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change idea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making evaluation</td>
<td></td>
<td></td>
<td></td>
<td>Making the idea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making decision</td>
<td></td>
<td></td>
<td></td>
<td>Naming the music/setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncertain/undecided</td>
<td></td>
<td></td>
<td></td>
<td>Making decision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naming the music/setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time: 2’57”</td>
<td>Time: 0’47”</td>
<td>Time: 0’42”</td>
<td>Time: 0’42”</td>
<td>Time: 3’16”</td>
<td>Time: 0’43”</td>
<td>Time: 0’41”</td>
</tr>
</tbody>
</table>

There is no one way of creativity whether novices or experts (Wiggins, 2003). Even for same individual using the same tool, the processes can be different. In the beginning, Alex did
not know what the end product would be like or which approach he would take. Alex spent more
time on exploration and development of ideas in the initial construction and became more
confident and aware of what he wanted to do in the subsequent constructions. But he did not
always stay with the same ideas, he would try new ideas with new strategies which results
involving more activities and spending more time to finish the construction.

While such processes still fit in the categories under the main themes of children’s music
making processes using *Build MyTune—I* and *Build MyTune—II* in general, it is also useful to
discuss the children’s processes under Amabile’s (1996) creativity model, Schön’s (1987)
reflective practice, and other research findings such as Webster’s (2003) and Wiggins’s (1994,
2003) studies. The examples of process introduced in this chapter will be visited again in the
next chapter, in which the processes of creativity and knowledge sharing with the focus of
reflective practice, and the implications for instructional design will be discussed.
CHAPTER 5
DISCUSSION AND IMPLICATION

This study investigated children’s creativity and knowledge sharing processes and how components of reflective practice played a role in their processes. This study employed a qualitative approach. Eleven children attended music classes, playing classroom instruments and researcher-designed computer programs during this study. Information pertaining to the participants’ music creativity processes and products, peer interactions, visual representations of their music/works (i.e., drawing artifacts), and interview responses about their thoughts and processes were collected and analyzed. Three research questions were examined:

1) What are the children’s creativity and knowledge sharing processes?

2) How do the children practice reflective thinking and action during/after their creativity and knowledge sharing processes?

3) How does novelty generation occur during children’s music making processes?

In the previous chapter, children’s creativity and knowledge processes were presented. Findings from the observation of children’s creativity processes, the interview notes, and children’s creativity outcomes and artifacts confirmed every studied child experienced different processes of creativity and produced different outcomes. Also verified was that when practice repeatedly utilized the same tools, some children developed different strategies and created different works (such as Bob created different music using Build MyTune—I), but some applied similar methods and produced similar works (such as Phil, who always lined up the bells in Build
With the understanding of the limitations of this study, the results from this qualitative study might not be applicable for children with other demographic characteristics and cognitive levels and in other settings. While the studied children’s processes of creativity echoed the model of reflective practice in general, components such as media, cognitive development, domain knowledge skills, coaching, social interaction, external and internal stimuli (as intention or motivation) also played important roles contributing to the variations of the model. In this chapter, I am going to discuss the phenomenon of the studied children’s creativity and knowledge sharing processes with a focus on reflective practice organized by the research questions. Issues and implications for instructional design and/or school curriculum will be addressed in conjunction with each research question. Furthermore, highlights of how this study contributes to the domain of IT/learning and future research directions will be presented in separate sections.

Research Question 1
What are the studied children’s creativity and knowledge sharing processes?

Summary of Findings for Research Question 1

The children began their creativity processes with making sense of the tools (i.e., the musical instruments or computer programs provided for this study). They tried to evaluate what the tool looked like, how it sounded and what it could or could not do by exploring its feature and comparing it with their past experience. Such evaluation involved listening, visualizing, comparing and conceptualizing. Observing their processes of using Build MyTune—I (a computer program simulating two sets of Montessori bells) and Build MyTune—II (a computerized musical sequencer with various choices of sound patterns), I found that the goal of
what needed to be created was not apparent to the children initially; however, they gradually formed strategies and developed goals during trials.

When using Build MyTune—I, for the children who had stronger musical backgrounds (Bob and Connie), their goals were more musical and their processes involved intensive listening and adjusting. For the children who had less musical training, the goals of their works seemed to be more visually, rather than aurally, significant and the listening parts were not a priority in terms of making decisions for moving and placing the bells. But for all of the studied children, visual representation was something important; they all took time to adjust the order or placement of the bell icons for visual reasons.

Most of the studied children generated novelty in their works. A new work might be built based on the children’s past knowing of an existing melody or sounds or a way of gaming or storytelling or might be developed through discovering new ways of seeing and hearing. Sometimes the unexpected situation led them to create something new. Children finalized their works by saving the settings and sharing their works with the others. Some of the children were self-motivated to create new works or motivated after sharing with others.

The title of the tunes/works given by the children and their drawing of the works revealed how they claimed authorship of their works and what the works meant to them. When sharing their work with others, some children were able to reflect on their processes of creativity. Each child had different ways of creating works, and these works had different audio or visual characteristics and different meanings for the children. Even for same individual using the same tool, the processes and products could be different.
Discussion for Research Question 1

Stages of Children’s Creativity and Knowledge Sharing Processes

The above mentioned processes were coded as activities and ordered chronically during analysis. Four major themes were merged to characterize the studied children’s creativity and knowledge sharing processes. The first stage is called Making Sense of the Tools. In my study, children’s music making processes began with understanding the aspects of the tools (Build MyTune—I, Build MyTune—II and some classroom instruments) since these programs or instruments were new to them. They explored sounds, visuals, functions, and constraints of the tools and sometimes related these experiences with their past experiences. During the second stage – Developing Strategies and Approaching Goals, the children utilized the tools to explore and develop ideas, strategies and routines to reach their goals. The ideas or strategies might have built upon past experiences, been learned from unfamiliar situations, or discovered through surprise or intentional searching. Once the children identified their goals, they began to build up routine processes to approach the goals, but there were still a lot of revisions that involved evaluating, decision-making and adjustment during this stage.

The third stage is called Completing Works. The stage of Completing Works involved the final decision making, evaluating and validating of the works. In Build MyTune—I, this was about evaluating the bell settings in the working zone; and in Build MyTune—II, this was the clicking of the “save” button and playing the piece. This stage also involved claiming authorship and making meaning for the works they created, although sometimes the meaning was not clear until they were asked to reflect on their works and draw pictures for their pieces. The fourth stage is called Sharing Knowledge. During the knowledge sharing process, the children were
making sense of their outcomes, sharing outcomes or processes with others, and learning from
others through demonstrating their works, drawing pictures about their works and explaining
their processes or meaning of the works. Through these processes they also developed
motivation for new works.

These four stages were generated from my data in a specific context of playing the two
computer programs as well as some instruments in a classroom setting in which there were three
or four children at each session. Before examining each of the stages in my study in conjunction
with the stages described in Amabile’s (1996) creativity model, it is important to review how
Amabile defined the stages in her creativity model (Stage I—problem or task identification,
Stage II—preparation, Stage III—response generation and Stage IV—response validation).

The four stages presented by Amabile (1996) categorized the cycle of the creativity
processes at the micro level as well as the entirety of a composition. In other words, the stages of
problem or task identification, preparation, response generation and response validation could be
used to describe the whole process of a child using MyTune—I from scratch to completion of the
work or to illustrate the iterative steps when a child was going through developing strategies and
goals.

Amabile (1996) defined the preparation stage as building up or reactivating store of
relevant information or algorithms and the response generation stage as searching memory or the
immediate environment to generate response possibilities. These cognitive activities were found
in the first and second stages in my study where the children needed to retrieve their past
experience and to respond to surprises or changes. For example, during the stage of making
sense of the tool, the children searched their memory to find information they could use to
comprehend the situation, meanwhile the unfamiliarity caused them to take actions and respond
to the situations. The new experiences were then built up as new knowledge if the children were able to master the situation.

According to Amabile (1996), the third stage, response generation, is where the novelty is generated, but it is not until the fourth stage, response validation, that the individual tests the response possibility against the factual knowledge or other criteria, the creative outcomes can be considered applicable. This stage can be compared with the Completing Works stage in my study in which the children made decisions that they had completed their works and searched from their past knowing again to construct meaning for their works. I argue that the cycle of Amabile’s model still occurred and repeated in the Completing Works stage because the cognitive domain skills and creativity relevant skills were still required as the children needed to make sense of their own work (examined the works, compared with their past knowing, tried to name the works and gave meaning to the works).

Amabile (1996) pointed out that stages in her model might not be sequential. This notion is consistent with my study that not every child went through all four stages (as defined for my study) and even for each individual child, the processes of their construction could be different (see Table 3). The phenomenon of musical background affected the types of goals formed (musical or visual), and the level of listening found in my study can be explained by Amabile’s (1996) model in that the domain relevant skills are responsible for the stages of preparation and response validation. Amabile’s model indicated the importance of social factors and motivation for influencing creativity. This notion is confirmed in my study in that the motivation promoted through the knowledge sharing processes or by the sense of fulfillment (completing the works that they liked or forming a new goal for a new piece) led to the discovery of a problem for another cycle of creative tasks.
The children in my study might not have begun with the stage of problem identification (external stimuli or internal stimuli), which was confirmed by Amabile (1996) as Stage I. But Amabile (1996) also addressed that the components in the creativity process might not be sequential. Although the children were assigned, or self-motivated, to play the instruments or to create works, they might not have initially recognized or discovered problems since they did not know what to learn or to create. However, Amabile’s model did not mention how the media could have influenced the processes and products of the creativity, but exploration of the tools and the perception of the tools did play important roles in my study, which will be elaborate in the discussion of research questions 2 and 3. The cognitive activities mentioned in Amabile’s (1996) model: searching from memory, storing information, generating response possibilities, and validating response can be further examined with reflective practice in the discussion for research question 3.

Research Question 2
How do the studied children practice reflective thinking and action during/after their creativity and knowledge sharing processes?

Summary of Findings for Research Question 2

The studied children’s creativity and knowledge sharing processes were further analyzed using the framework of reflective practice. The results show that components of reflective practice were found in the children’s creativity processes and that the occurrence of these components varied by the individuals and the situations encountered. The examples mentioned in Chapter 4 show the children who had strong musical backgrounds and were older were able to demonstrate traits of reflection, evaluation and decisions seamlessly without stopping their
actions, whereas the children who had no music training and were younger sometimes could not react to the excessive incoming information and had to stop and then think and act. In addition, data reveal the occurrence of on-the-spot experiments as the results after encountering unexpected situations or discovery of features or problems.

The patterns also show that when associating the processes of the children’s creativity and knowledge sharing with the components in the reflective practice model, the components of knowing-in-action, reflection-on-action, reflection-in-action and on-the-spot-experiment are interwoven with the activities in all four stages –Making Sense of Tools, Developing Strategies and Approaching Goals, Completing Works, and Sharing Knowledge (defined in the findings for research question 1). In other words, each stage is comprised of one or more of the components from the reflective model. The apparent example is that knowing-in-action is necessary during every stage of the creativity and knowledge sharing processes because the children frequently drew from their past experience to perceive or act on new situation. The components—knowing-in-action, reflection-on-action, reflection-in-action and on-the-spot-experiment—work together as a cyclical model. But not all the participants practiced the full model that included all components. Some participants never reached the stage of reflection-in-action during the practice. Some children moved through all four stages and had occurrences of all components of the reflective model.

Other interesting findings include that 1) the media attributes contributed to the reflective model by providing affordance for the studied children to reflect on, plan, and develop ideas and to retain memory of their construction/decisions; 2) although the children’s musical backgrounds affected their strategies and goals (being musical or non-musical), all of the children in my study paid attention to the visual effect of their works; and 3) the children tended not to revise their
works once they decided the works were completed. Examples of these phenomena were mentioned in Chapter 4 and will be further elaborated in the following sections.

Discussion for Research Question 2

Creativity is considered as ill-defined problem-solving (Maitland, 1976; Mumford & Gustafson, 2012; Schön, 1987), as the children in my class sometimes did not know what their goals were before they explored. One of the challenges for the instructional designer or school curriculum is to adopt a certain model for teaching/coaching creativity. Can reflective practice be the instructional design model for creative problem solving? Previous discussion of the children’s processes of creativity and knowledge sharing compared the findings from my study with Amabile’s (1996) model of creativity process. Amabile’s (1996) model pays attention to the motivation, social environment, and cognitive processes of searching for information from the memory or the environment to generate a response and to validate the response. This cognitive process can compare with the phenomenon found in Bamberger’s (1991) and my study that individual’s knowing plays an important part in every stage of the creativity process.

The component of reflection-in-action found in many cases of my study is also defined in Kennedy’s (2002) creativity model results from studying high school composers. The essential component—listening is defined as preparation, stimulation, inspiration and evaluation, which is not only passively receiving information but an active way of engaging without stopping. However, the fact that some children did not engage in listening before they moved the bells in Build MyTune—I or that the listening part was not as predominant as the visual effect in their processes does not mean the absence of reflection-in-action in their processes. For the non-musical inclined children, the occurrences of reflection-in-action might have been in their
processes of focusing visual effects or other non-musical aspects. While the findings from my study show that the children with stronger musical backgrounds and who were older had traits of reflection-in-action, it needs to be noted that association between the levels of cognitive ability and reflection-in-action is beyond the scope of this study. This could be an area for future study.

The following section will further addresses the findings of 1) Media Attributes and their Roles in Reflective Practice and 2) Children’s Reflective Thinking and Ways of Revision. When looking at the roles of media attributes of the tools (Build MyTune—I, Build MyTune—II, and other instruments), several factors were examined: the properties of the media attributes, what function they provided, the limitations, the ways children interacted with these media, and the types of outcome produced. Previous studies demonstrated the importance of media on the process and products of learning and practice (Bamberger, 1991, 2003; Bamberger & Schön, 1983; Schön, 1987); the findings from my study confirm this notion and raise interest to specific aspects of media characteristics. The children’s ways of reflection and revision were the one of the main interests of my research. Therefore, the interview question about whether they wanted to change their works and my observation of their creativity and knowledge sharing processes were used to examine how the components of action such as exploration, experimentation, routine practice, revision, and reflection worked in the studied children’s creativity and knowledge sharing processes. A comparison of existing studies and the findings from my study for this particular issue will be discussed.

Media Attributes and their Roles in Reflective Practice

The studied children interacted with the computer programs (Build MyTune—I and Build MyTune—II) and musical instruments during the Build MyTune classes. Each of these programs
or musical instruments has its features, which were inherited from specific media attributes or
designed by me. Although the media attributes might have influenced and varied the outcomes of
creativity and processes of reflective practice (Schön, 1987), when discussing the roles of media
in reflective practice by means of comparing the children’s ways to interact with the computer
programs and musical instruments in my classes and cases from other studies, it is still hard to
conclude whether the differences were due to specific aspects of the programs or instruments or
because of some other extraneous elements that took place. However, these lessons were
certainly worth discussing and posting for future research questions.

I found two features in the computer programs that support children’s reflective
processes: one is the design of the working zone and preparation zone in Build MyTune—I,
another one is the playback in loop function in Build MyTune—II. These two features play roles
in the reflective processes in different ways. The design of working zone and preparation zone
was initially to help me observe the children’s actions and decisions, but eventually, the object-
space relationships (with underlying tonal, visual and structural characteristics) provided
children unique ways to plan, construct and present their composition. In the previous chapter, I
described how the participants utilized the working zone in Build MyTune—I. When the children
begin to use the Build MyTune—I program, the bells (two sets of simulated bells in blue and red)
were placed in the preparation area in a random order. Each bell has its property: a pitched
sound, a bell shaped icon, a color and its position. Because of the bells’ identical shape, the
children needed to explore the sounds and work out ways to construct their settings. The children
moved the bells or arranged the positions of the bells in the working zone and clicked the “save
setting” button when they were satisfied with their construction.
So, the working zone of a saved setting captured the characteristics of the bells and their relationships. It can be perceived as an explicit form of thoughts that helped the children remember what were determined in a certain space-time; as examples Erin was drawing a smiley face and Tracy was drawing a square using these bells. It also served as a blueprint or music score for Bob’s compositions. But the function of the working zone in my study appeared to be more than a blueprint or score from which the children arranged the bells like musical notation. Compared to the traditional musical notation that notes are read from left-right and top-down with each symbol indicating the specific pitch and duration, the children sometimes played the bells in the working zone in a non-linear fashion. Screen recordings of their processes confirmed that they developed strategies and formed the principles of their construction to be like a mapmaker or a pathmaker as Bamberger had discovered in her study (1991).

Reflective practice is perceived as “a conversation” between the learners and the materials (Bamberger & Schön, 1983). According to Choulier, Picard and Weite (2007), materials are interpreted as problem–solution duality, methods and tools, management, or projects (within a social context) of a specific or designed situation. Bamberger (1991) has indicated that the position of bells and the related actions within searching area and working area to be the identity of the problem-solution the participants needed to deal with. The function of a working zone is important because it provides an affordance for the children to reflect in and on their actions. No matter the situation of arranging simulated bells in the computer programs in the above cases or like Tracy arranging musical instrument as a station called “Musical Robot,” the children seemed to have the need of a work space to manage the materials they wanted and to try ideas as they evolved. Such a finding has a significance implication to the field of
instructional design, especially when a design is for children to be creative and to design something they do not know yet.

The playback in loop function in *Build MyTune—II* enforced the children’s reflection-in-action in a different way. For the children who did not understand the concept of musical elements, or did not know what the outcomes would sound like even when they read the description of each menu/button, the constant playback of their selection allowed them to connect the sounds/patterns and the actions they made. Because the constant playback of the sounds/patterns was so obvious, the children almost needed to “act” immediately if they did not like something. If they did not take action, sometimes it meant that they were trying to comprehend the situations or they liked what they heard. For some children, like Alex, this constant feedback might have been too fast and too overwhelming, so that sometimes he had to stop the sounds and then change the selections (meaning that he had to reflect on the outcomes of his actions).

The importance of providing feedback is nothing new in instructional design theories (Mory, 2004). Yet, traditional theories talked about giving feedback toward convergent thinking/decision where answers of true or false would apply, or as reinforcement during programmed instruction (Mory, 2004). In terms of designing feedback for creative outcomes where enduring ambiguity is an important and a necessary aspect of the process, a definite and straightforward answer might not be helpful. Guidance from a master would be useful in the learning of design and creativity as suggested by Schön (1987). Schön provides examples of how the coach is responsible for providing critical thinking experiences and leading the activities in the cases of architecture design studio and piano master classes. In both cases, the coach
demonstrated, questioned and provided guidance to students to help them form meanings from their experiences.

Although coaching is one of the principles of reflective practice, I stayed away from telling the children what to do to construct their work or what types of work were appropriate as much as possible when they used the computer programs. It was my intention to observe how the children worked with the computer programs and how they interacted with other participants. The children did not receive feedback from a coach, rather they were shown “what they did (the playback sounds)” and “how they did it (the playback of the screen recordings).” They were given opportunities to reflect in or on the situations. The function of the playback loop did not just benefit the children without musical backgrounds, even for Bob and Connie, who were the most musically trained participants, enjoyed the effect of this feature. They were nodding or dancing while listening and adjusting the settings using Build MyTune—II to create their music. The children were self-coached to make decisions based on what they heard and saw from the interaction with these computer programs.

When the children were placed in a self-coaching situation with feedback features so that they could play the looped sounds as they changed the settings or could switch on and off the sounds and only listen to the sounds as they needed, the opportunities of providing demonstration and critical thinking relied heavily on the instructional environment and strategies. From observation of the children’s creativity processes using both Build MyTune—I and Build MyTune—II, it seemed that the children had no trouble making decisions and expressing their preferences. The sounds or patterns they liked related to their past experience, yet there were occasions in which the children found the new sounds or patterns entertaining even though they were not able to comprehend or appreciate them right away. The opportunity and timing of
introducing new sounds and patterns becomes important for the instructional environment. Opportunities for critical thinking were offered through the knowledge sharing processes during which the children reflected on their works and received feedback from peers. Although the questions asked during the interview (after they shared the works with the instructor) and group interaction were intended to lead to critical thinking and discussion, the results did not actually change the children’s perspectives. I suspect that the repertoire of new elements and the critical thinking opportunities needed to go together or one after another immediately in order for the children to make connections (new and past experiences) cognitively.

There were also limitations in the computer programs. The design of the classroom activities and computer programs was based on the reflective practice theory and my teaching experience. Although there were self- and user-testing of the computer programs prior to the research study, the ways the children interacted with the computer programs were beyond my expectation of design. For example, the simulated Montessori bells in Build MyTune—I were presented as 2-D images on the computer screen and I could not assume the children perceived these icons as the simulated bells. In fact, children perceived these icons as images of various objects (e.g. umbrella, fire and water, etc.). Although the children developed strategies of map making or path making like Bamberger’s (1991) study, it was not clear whether there would have been an impact on the amount of time taken for construction or the types of works they would have created if the children have been given real Montessori bells for this study.

There is one interesting observation: most of the studied children considered visual effect a very important aspect in their works. They laid out the instruments or music program settings on their computer screens in ways to represent visuals meaningful to them. This pattern was noticeable for children of all different levels of musical backgrounds (Alex, Tracy and Erin
tended to arrange the bell icons to represent some images, Connie once created bell settings representing how a funny guy moved, and even Bob would spend time to carefully arrange the bells so they would alternate between red and blue). It could be argued that this behavior did not only appear when the children used the computer programs; some of them tended to arrange classroom instruments in ways meaningful to them visually as well.

I did not expect that the children would have had such focus on the visual representation of the bell settings they constructed. I also did not expect that they would experience a variety of technical difficulty when using Build MyTune—II. However, the features in Build MyTune II that allow the children to select instrument, pitch, tempo, playing sequence to make melodic and rhythmic patterns along with the looped feedback function seemed assist children with less musical training focus more on the sounds rather than visual. For Phil, Alex, Tracy, Jessica, Rachael and Kate, it was evident that their processes involved more intensive listening comparing with their processes using Build MyTune I.

From the postmodern point of view, it is the development of the computer technology that enables the non-linear ways of exploring and learning about music (Garnett, 2001; Yeaman et.al., 1996). In fact, the children in my classes had grown up with tools having these postmodern traits (non-linear information navigation, image/visual literacy, learning via discovery, trying new thing without instruction, etc.) and well embraced the tools or features with such characteristics (computer games, creating art work via apps in tablets, etc.) (Brown, 2001). Plenty of evidence showed that the children were self-coached, motivated to explore while receiving feedback from their own action, and generated something new from unexpected outcomes. It also suggests that teachers and designers should offer different types of tools and opportunities for reflection through creative activities in the classrooms.
Children’s Reflective Thinking and Ways of Revision

In my study, the children did not want to revise their work after they decided they were finished. This interesting phenomenon did not seem to be an isolated case. In Webster’s (2003) study of group composition by sixth graders, children modified their works during the music creativity processes, but they would not change their minds once they determined the works were finished. The types of revision that happened during the sharing and creativity processes were considered an integrated process of composition in Webster’s (2003) study. Similar to Webster’s study, the children in my study indeed made revisions while developing strategies and compositions, but would not change the finished works and wanted to move on to their next works.

When discussing children’s ways of revision, we need to consider the types of revision that happened in my classroom. I am going to discuss four types of revision as categorized below: 1) revision during the composition (exploration, change of ideas, etc.), 2) revision after the composition, 3) variations (new pieces based on previous ideas), and 4) extensions from the segments (combination of ideas to intentionally make a longer piece).

The second type of revision rarely happened in my study, neither requesting by the instructor or their peers, nor self-motivated actions after their reflections. However, the processes of the children using Build MyTune—I or Build MyTune—II programs illustrate the first, third and fourth types of revision. As an example of the first type of revision, they explored and changed their ideas quite often during the stage of making sense of the tools and developing strategies, but once they clicked the “save” button, the works were considered finished by them. They were either ready to share the pieces with someone else or move to a new piece. Moving on
to the next piece could be considered as the third type of revision, as the development of a new idea depending on the materials or goals they were working on. Cases from my participants seemed to show clear intention whether they were working on new ideas or replicating previous ideas. Reviewing Tracy’s process of repeatedly trying to reconstruct the steel pan setting that she lost, she had a definite goal and tried to regain the feeling and sounds she once owned. Phil’s new pieces looked very similar to his previous pieces; whereas Alex’s work each time focused on an idea based on previous works (settings of all blue bells, or all red bells, etc.) that I would considered as variations.

The revisions expected in a music educator’s eye usually mean different orders of pitch, rhythm pattern, instrument choice, etc., which all my participants had manipulated during their creativity processes but refused to change when we discussed their projects during their reflection afterward. Only two participants displayed the ability of making extensions— the fourth type of revision that combines ideas from segments they worked on previously. When constructing music using *Build MyTune—II*, most of the children considered one segment/setting to be one piece. For example, a melodic pattern decided by the children selecting instrument, pitches, tempo, and sequence could be played repeatedly because of the looping function, a program design. Only Bob and Connie, who were the oldest among the children and were most experienced with musical training and with the ability to remember and explain their works, created longer pieces structured from the segments combined from several patterns they had previously composed.

It is not clear whether children’s reflective thinking promoted their willingness to revise or extend their works in my study. It is also not clear whether the factors of cognitive development and domain skills could be relevant to their ability or motivation to combine ideas
or make extensions, although the cases of Bob and Connie might suggest that. Both Webster (2003) and Wiggins (1999, 2005) suggested teachers should provide feedback and opportunities for revision during children’s creativity processes. Yet, teachers and designers should be careful not to take control over the authorship of creativity; instead, they should develop more sophisticated ways of fostering reflective thinking and bringing new experience to help students focus on the quality of their work (not just thinking to get the works done or change the ideas because someone else asked them to do so). Further investigation of how cognitive skills, domain knowledge, social interaction and coaching roles can enhance the process of revision and extension during children’s creativity processes may be needed.

The phenomenon that children tend not to make revisions or extensions after they considered their works were finished probably did not present as a problem to them at all. So, why is making revisions or extensions important during children’s creativity and knowledge sharing processes? Wiggins (1994) addresses the need for placing creativity in the social-constructivist view of learning. If we examine the processes of creativity and knowledge sharing being a learning experience toward socialization, it is worth bringing perspectives outside of a child’s own to enrich his/her experiences. Evidence from Wiggins’ (1994) study shows that children were willing and able to adjust their ideas via discussing with peers during group composition. Creativity is also a process of socialization that leads to understanding of various musical styles established by other composers and accepted in their cultures.

Webster (2003) argues why revisions and extensions should be promoted in teaching/learning music composition. He describes that revision is part of the music making process by definition. It is the core of what music or art is about. Art cannot be alive without the continuous processes of developing musical/art thoughts through interacting with the materials. I
can resonate with such a notion from my own experience practicing and performing music. My goal of playing music has always been pursuing the feeling and the quality of craftsmanship in which I found constant refining is a must and a piece will never be played exactly the same every time.

The second rationale Webster (2003) raised is that revisions and extensions have been found in some parts of children’s or adults’ creativity processes by nature. In Hickey’s (2003) adaptation of Amabile’s creativity model, revision is a step toward successful composition that an individual would go back once some initial ideas/outcomes were developed, or happens when the individual is motivated to compose again. The creativity process can be fulfilled or can fail without further revision. This model seems to cover all four scenarios of revisions and extensions defined earlier. The children in my study demonstrated revising their ideas during the stages of “making sense of the tools” and “developing strategies and approaching goals.” This finding coincides with the revisions belonging to the stages of two (preparation) and three (response generation) in Hickey’s Amabile model.

The third rationale Webster (2003) identified for the importance of revision and extension during creativity was its value to education. Webster advocates that teaching/learning composition is a way to learn about music--its elements, structures and styles. I can agree with this rationale from an educator’s point of view. This rationale is also supported by Wiggins (1994). The children in Wiggins’ study were able to compose according to the musical forms taught in class (e.g. ABA form) in which one piece of music will need at least two motifs (ideas) and need a variation derived from one of the ideas. In this situation, revision and extension were built-in as a natural process of creativity and as learning activities.
Beyond socialization or learning existing musical styles, promoting revision and extension also has a purpose of helping learners to experience and handle new situations. Such experience can enhance individuals’ capacity of tolerance of ambiguity which, supported from the literatures, Dacey and Lennon (1998) considered as the most critical personality trait of a creative person. Promoting revision or extension can foster creativity and reflective practice: a successful pedagogy of promoting revision and extension may be the essence of how reflective practice results in novelty. If a teacher can introduce some new ideas other than the children’s own, it is actually helping children develop variations of their existing knowing and action. Furthermore, teachers should encourage children to negotiate relationships among the old and new materials/ideas that result as an extension of the original ideas.

Research Question 3

How does novelty generation occur during the studied children’s music making processes?

Summary of Findings for Research Question 3

The children in my classes went through the creativity and knowledge sharing processes. They created new works (pieces or fragments of music, sounds, settings that had some meaning to the children, pictures that represented their music) or discovered new ways of playing an instrument or computer programs. In some cases, the children created different works each time and assigned different titles and meanings to the works (e.g. Bob, Connie, Tracy, and Jessica); in other cases, the children created similar works and had the same pattern for naming their works (e.g. Phil, and Alex). According to Bamberger (1991, 1999, 2003), novelty can be seen as not only creating new works but also new ways of seeing, hearing, or playing music (Pathmaking and Mapmaking). These types of novelty were also found in the children’s creativity and
knowledge processes during this study. The examples of Phil playing the simulated Montessori bells sequentially based on the order arranged and Bob treating the bells like both keys in the instruments and the notes for music scores and playing the bells according to his mental structures of the bells which were independent from their sequence or function in a song illustrated how different ways of hearing and seeing affected the actions. For the children who had more musical background, it seemed they could recognize and give meaning to the multiple properties of the objects (pitch, duration, musical structure, color, shape, position) in the tools and demonstrated new ways of arranging bells and constructing songs more frequently.

We understand the phenomenon of novelty generation from the analysis of interactions among individuals, materials/environment, processes, activities and outcomes. As previously discussed, some of the critical components (process related) that contribute to creativity include 1) media attributes (e.g. working zone) provide affordance for individuals to make reflective conversations with the materials and 2) the nature of artistic works require tolerance of ambiguity and promote revision/extension as part of the processes. Beyond the above mentioned components, there are many other factors such as background knowledge/achievement, ability of figural creativity, age, gender, grade level, stimuli, use of time, etc. that contribute to the creativity processes and determine the levels of creative behaviors and outcomes (Kennedy, 2002; Kiehn, 2003; Torrance, 1961, 1970; Webster, 1979).

From this study, aspects of how novelty was generated are summarized as patterns of building new experiences based on the children’s’ past experience, novelty as the outcomes of changes in the environment or unexpected situation, the children’s unique perspectives led to unique outcomes, and their intention/motivation led to creation. Examples of generating novelty based on their past experience include creating a new song based on a known song, creating
variations from a theme, developing new ideas based on their past experiences, etc. Examples of novelty as outcome of changes in the environment or experiencing unexpected situations include the cases when the children encountered new tools, heard new sounds, saw new things, or experienced technical difficulties. The cases of children’s unique perspectives leading to unique outcomes are illustrated by the children’s unique way of hearing, seeing and playing as well as giving specific meanings to the works they created. Finally, in most of the cases, the children were motivated to create new works once they were inspired by others or satisfied with their creativity experiences. Their intention of creating original works (not imitating others or repeating their old works) varied by individuals (e.g. musical background, cognitive level, tools, moods, etc.).

These patterns were found in the participants’ experience regardless of their levels of musical background and cognitive development and the types of creativity in their works. The phenomenon can be explained by the ways of interaction among individuals’ internal knowing (mental model, past experience), external environment (stimuli, changes, perspectives from others) and the process (practice, engagement, meaning making), which can be paralleled with the essential components in the reflective practice (knowing-in-action, surprise/unexpected outcomes, and action and reflection) (Schön, 1987). The following paragraphs discuss these themes with relevant theories and studies and conclude with the discussion about the connection between knowledge sharing and creativity.
Discussion for Research Question 3

Novelty Built Upon Past Experience

From the observation of classroom activities, I found the children were able to replicate the short phrases I demonstrated and make variations of that phrase using xylophones. It means they could store the information about sounds and actions, and generate responses by the goals (repeating the same information or making changes). They were also able to find paired bells with matched pitches using Build MyTune—I meaning they had a basic level of domain knowledge in terms of differentiating pitches. Although some of the children could play short songs using xylophone, keyboard or recorder, only Bob and Connie (older children with musical backgrounds) demonstrated using simulated Montessori bells to construct a new song based on known melodies. For the children without a strong musical background, their works related to their past life experiences (i.e., the sounds reminded them of some events in their life, or they tried to arrange the works so they were visually meaningful to them).

The situations of novelty built upon past experience involved the cognitive activities mentioned in Amabile’s (1996) model—searching from memory, storing information, generating response possibilities, and validating response. When Bob created a new song based on a known song, his intention was to create something like “Twinkle Twinkle Little Star” but not totally like it. He discovered different ways to arrange and to play through the sequence of the limited number of bells (two sets of an octave of a major scale) in Build MyTune—I. In order to validate the actions/responses generated with his intention (something sounding like “Twinkle Twinkle Little Star” or not), he needed to search from his memory about the pitches, rhythms, melodic patterns and structure of the song to decide which bells to use or which action to take. In this
case, the intention of creating “something new” drove his practice as cycles of exploration and validation.

In the case of creating variations for “Twinkle Twinkle Little Star” and “Hot Cross Buns,” Bob still followed the musical structure of the original songs (the variation of “Hot Cross Buns” in minor key or change of the rhythmic patterns) that he needed to make these new elements (different pitches or rhythms) fit the existing structures. Other examples of creating new works based on past experience include Alex’s variations based on the story of “fire and water” avatars; and, Connie’s piece, which sounded like a lullaby in the beginning but had different melodic patterns later on, etc.

Amabile (1996) mentioned how the domain-relevant skills work during the creativity processes. For people who have a high level of domain-relevant skills, they spend little time on the reactivation of the already stored information relevant to tasks during the preparation and make better judgments on the appropriateness and usefulness of the ideas/responses. The question is whether the adequate judgment of appropriateness is based on the conventional criteria within the cultural style or the personal unique perspectives. In Bob’s case, the songs he created were assessed by the domain knowledge within his musical culture (the musical styles he learned) and personal style (he was satisfied with his work and constructed meaning for the song). Whereas Alex’s work fitted his idea of developing the stories using these bells (personal style) but did not relate to the conventional musical style (no tonal structure and the playing of the bells had no relation to the auditory property of the bells).

The scenario of the children creating new works based on their past experience can also be explained by Schön’s (1983, 1987) notion of “knowing-in-action” being an essential component during the reflective practice. However, without the intention to change or
opportunities to explore unfamiliar areas, the children could still stay in the loop of their past knowing. This notion brings up other two other components in Amabile’s (1996) creativity model—the creativity-relevant skills and task motivation, which will be discussed in the following sections.

**Changes as Stimuli to Inspire Novelty**

Novelty can be the outcome of reflective practice for several reasons. One source could be that the stimuli or unexpected situations result in variations of actions/practice and then lead to novelty as the outcome. If one always stays in the zone of knowing-in-action in which there is no change in the routine practice, there will be no new outcomes generated from such routine practices. But the world around us constantly changes, especially in this advancing technological society; these changes as stimuli can easily cause new or unexpected situations to push one out of the original routine practices. Therefore, new outcomes are generated not only as responses to these surprises, but these new situations can inspire creativity (Schön, 1983, 1987). Evidence from my study showed that new stimuli (media, choices of sounds, rhythms, patterns, etc.) resulted in new types of music and new ways of interacting with the programs. Bob, Connie, Tracy, Jessica, Mindy, Alex, Rachael and Kate were all excited about *Build MyTune—II*, its capacity of choices and the strange sounds it could produce. Bob expressed that he had never heard the music he made when he first composed using *Build MyTune—II* and initially thought the piece should be called “unknown.” As mentioned earlier, even technical difficulty can sometimes lead to new ways of seeing things. Alex accidentally discovered that he could lay all the simulated bells one on top of another and constructed a setting looked like one bell on the screen.
When change as stimuli results in unexpected situation that could be beyond the repertoire of the children’s past experiences, they paused their actions or performed on-the-spot experiments. Such a condition requires the abilities of suspending judgment while exploring a wide range of pathways or available features in the environment, which is the essential characteristic of creativity-relevant skills described by Amabile (1996). When we understand that novelty may be inspired by changes, teachers can introduce new elements (e.g. sounds, instruments, musical style, composition strategy, etc.) into the curriculum and encourage students to embrace changes. Teachers can also support students to work through the challenges when they encounter technical difficulties or experience unfamiliar situations.

**Novelty Developed through Unique Perspectives**

Stauffer’s (2003) study confirmed that young composers do have unique voices representing their identities. Although each of them created different works each time, the participants in Stauffer’s study seemed to be well versed in their views of music and exhibited how their life experiences could influence their choices of instruments, musical styles and events or movements of sounds. Barrett (2000) studied a five-year-old child’s invented notation for her invented songs. In this case, the notation seemed to be the “reflection” of her inner world—a picture of a horse rather than a “window” of the musical events (e.g. metric of rhythm, contour of melody, etc.).

I came to know the children in my classes had unique perspectives and created unique works through observing their activities playing classroom instruments and computer programs, recording and analyzing their creativity processes and outcomes, asking them to name their pieces and having them draw their music and talk about the drawing. The notion that the
children’s unique perspectives led to the creation of unique works relates to the notion that the children’s new works were based on or shaped by their past experience as described by Stauffer’s (2003) and Bamberger (1991). Cases showed that the children’s past experiences contributed to their choices of instruments, patterns, or ways of movements. For example, Erin named her piece using Build MyTune—I “Church Bell.” In the paper, she drew a church with two bells in the top tower and explained to me how the music reminded her of an experience in church with her friend. Bob’s piece—“The Lily,” using Build MyTune—I to construct something like “Twinkle Twinkle Little Star” (in the beginning) but not totally like it (changed the melody as it progress) adopted the beginning melodic pattern of the song and developed new patterns is a case of creating a new song from a known song.

But the issue of whether the studied children demonstrated unique voices or styles that represent their identities is beyond bringing in the past experience during creativity. The unique perspectives were not only inherited from their existing mental models, they were developed through intentional exploration and decision making and every new experience will contribute to their future decision making. The children in my classes did not only make choices based on the instruments they studies or they knew. Many of them did not produce works similar to the music they listened to, especially when they encountered new tools or new elements. One of the reasons could be that the children without sufficient domain-relevant skills could not produce music in conventional styles. In fact, they might or might not have intended to create something like the music they listened or knew about.

I asked the children what their favorite music was in the survey prior to the class sessions and tried to have them talk about the music they listened to and the music they created during the sessions. By doing so, I gained understanding of the children’s perspectives of what music is
about and compared what they created to the music they defined. Although the end goal of this class was not about asking the children to create something similar to their listening experiences, in one of the session, I gave a task of asking them to use Build MyTune—I to play “Twinkle Twinkle Little Star” (which was one of the tasks in Bamberger’s (1972, 1991) studies). Except Bob, no other children in the classes were able to use Build MyTune—I or Build MyTune—II to produce something similar to what they usually listened to or some folk tunes learned in school. Tracy did purposely play “Mary has a Little Lamb” using matelophone and compared the tones in the matelophone with the simulated bell sounds in the computer.

How do the characteristics (the instrument choice, the pitch choice, the music structure, etc.) in one child’s works (collectively) using Build MyTune—I or Build MyTune—II distinctly different from the works done by the other children? The more obvious traits are that Bob was able to produce folk song like music using Build MyTune—I and improvise a long piece with complex patterns in Build MyTune—II versus some other children who tended to create pictorial works using Build MyTune—I and short fragments using Build MyTune—II. But these traits could due to the level of cognitive skills and domain-relevant skills and not explained by the identities. To understand whether the studied children can produce original works based on their unique perspectives, further analysis is needed from the ways they constructed and played the works, and the characteristics and meaning of the works.

During the stage of defining goals and developing strategies, the children showed different ways of constructing their works. They rarely looked at others’ works before or while they were developing their own works; also they were certain about not revising their works after sharing with each other. The ways they constructed and played the music were through their own exploration and practice using the computer programs. The example of how Bob’s and Phil’s
different processes of constructing and playing music fit with the ideas of Pathmaking and Mapmaking supports that new ways of seeing, hearing and playing the music were developed through their unique ways of thinking about what the piece meant to them. Bamberger’s (1991) notion of “knowing” was developed, in that one could hear or see the same thing with new insight over time, or an expert and a novice could have different hearing and seeing for the same music or work, can be explained by how Bob and Phil constructed and played the bells in different ways.

As previously described in Chapter 4, Connie constructed a piece—“Funny Guy” in *Build MyTune*—that the sequence of playing the bells represents the movement of the funny guy. She later drew a picture of a funny guy with the lines presenting the sequence for playing. The ways of playing representing the meaning of the song are unique and the characteristics of Connie’s music only make sense when we examine her meaning making processes. The children created a series of music pieces or works and constructed meaning for their works in which these sounds or works, the titles and the pictures represent their knowing during the state of development. Although the children might have created different works each time, there were patterns of how these pieces were constructed and played and how they described the meaning of the pieces. These cases show that the studied children’s personal perspectives can be developed through the processes of constructing works and making meaning for their works. Whether the meanings of the works were developed during or after they created the works is unknown, but it certainly required reflection during or after their creativity processes.

Dewey (1938a) talked about the need for a theory of experience, contending experience is the goal of learning. Because “every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after” (p. 35, Dewey,
The experience of creativity and knowledge sharing is a way toward becoming a reflective practitioner, and it helps us understand that uniqueness in the works is considered novelty when the personal perspectives (from their past experience or knowing-in-action) play a role in the reflective practice. In both Bamberger’s (1991) and my study, the children demonstrated finding new ways of seeing and constructing their works during and through practice. Also, as discussed earlier, the generation of novelty is also about generating something meaningful. The notion that new perspectives can be developed and lead to original works provides implication that instructional design should pay more attention to creative experience as a learning goal, which resonates with the notion of experiential learning (Morgan, 2008).

**Motivation and Intention**

Other than generating novelty naturally by encountering changes in the environment or representing personal perspectives, do children produce novelty by intention? Learning from the participants in my research study, motivation showed up as an interesting topic to discuss regarding the reflective practice model. Although motivation is not the primary focus in the reflective practice model, there have been discussions about whether the novelty is the result of a situated practice that happens naturally or is initiated via intentional effort guided by reflection-in-action and reflection-on-action (Cook & Brown, 1999; Rowland, 2004). In Amabile’s (1996) research in which stages of problem identification and response generation are linked with motivation. The children in my study might not have begun with a need for expression or their motivation might not have been associated with external rewards, Most of the children were self-motivated to create new works once they liked their creation and the experience of creative activities. Jessica was self-motivated to create many segments (choice of timber, rhythms,
sequence patterns, etc.) one after another using *Build MyTune—II*. She demonstrated strong interest in and ownership of her works (each of the drawings of her pieces was signed “Jessica’s Studio”).

The intention of creating subsequent works was strong for most of the participants, but the intention of creating something “different” each time varied by individual: In Alex’s construction of war of avatars, each work represented a different story; in Bob’s works utilizing *Build MyTune—I*, each piece consisted of different melodies, rhythms, visual patterns and the ways of playing although the choice of pitches were limited; in Jessica’s works using *Build MyTune—II*, each one had different settings and sounds. Whereas in the case of Phil creating many pieces using *Build MyTune—I*, it was hard to tell if there were new ideas from his processes (he followed similar strategies) or the outcomes (he always lined up the bells in left-right and top-down order and drew pictures representing settings of the blue and red bells). There were also cases like Rachel who was not interested in creating new pieces (in *Build MyTune—I*) once she fulfilled the assigned task (created something from *Build MyTune—I* and drew a picture of the piece), or Leo who simply withdrew from the process possibly due to his short attention span. In Amabile’s (1996) model, the component of task motivation is important to drive the direction of action and validation toward producing same sounds/patterns against ones’ memory or exploring different pathways or generating different responses during the stage of generating novelty as response.

Studies have discussed how intrinsic or extrinsic motivation drives the creativity processes (Amabile, 1985, 1996; Amabile, Hennessey & Grossman, 1986; Cropley, 2006). Cropley (2006) reviewed the social aspects of creativity and explained that creativity is defined, recognized and demanded by society; it is also a driver for social change. In Amabile’s (1996)
model of creativity, creative works come from the interaction among the components of 1) domain relevant skills, 2) creativity relevant processes and 3) task motivation with a series of stages of creativity processes. Amabile also added a component of social environment being an important factor to influence motivation. This model describes how novelty is generated depending on the factor of motivation and creativity relevant processes that promote the response generation from previously collected and prepared information. It emphasizes motivation (external or intrinsic) during socialization as being the determinant of how creative processes begin.

The example of interaction between Jessica and Tracy supports the notion of social influence being an important factor of motivation during the creativity processes mentioned in Amabile’s (1996) theory. When Jessica created pieces one after another using Build MyTune—II, she was very excited and showed her work to Tracy, who previously seemed not interested in the Build MyTune—II program. Tracy went back to her station and began to compose after she heard Jessica’s pieces. Later, Tracy was proud of her works and eagerly showed Jessica what she had created. Although there have been arguments about whether social assessment or external reward promotes or disrupt creativity (Amabile, 1996; Hennessey & Amabile, 1998), the notion of social aspects in the creativity processes during my study can be a significant implication for classroom teaching and instructional design: to foster peer interaction and sharing during group or individual creativity processes may motivate students to create more works.

Connection of Knowledge Sharing and Creativity

The discussion of Cook and Brown (1999) and Rowland (2004) not only explains how creativity happened during the practice, they provide the theories pointing out the connection
between knowledge sharing and creativity. It is the interplay between old knowing and new experience. Cook and Brown (1999) describe how practice bridges the different epistemology (state) of knowing – tacit, explicit, individual and group. Cook and Brown (1999) were specific about the different definitions of knowledge and knowing as knowledge is something that can be possessed but knowing involves action in the present. An example of riding bicycle was used as an analogy of interplay among these different forms of knowing. One who knows how to ride a bicycle has the tacit knowledge of riding a bicycle but the actual knowing of riding a bicycle involves the utilization of this tacit knowledge with the action. The written description (explicit knowledge) of how to ride a bicycle may help another person learn how to ride a bicycle, but this knowledge can only become meaningful when another individual begins to practice and experience what has been told. So, metaphors of specific contexts will be exchanged during the communication. Any type of practice between the individual and the surrounding world will have to involve all four forms of knowledge and knowing. These processes and relationships can explain some scenarios in my study.

Parallel with the bicycle riding example, the four forms of knowledge or knowing -- tacit, explicit, individual and group—can refer to the participants’ musical experiences (listening, playing, composing, sharing, etc.), the representation of their music (music notation, verbal description or drawing of their works using Build MyTune—I or Build MyTune—II, etc.), their individual understanding or activities about music and the world’s (could be a small community of practice or the general society) views about music or ways of practicing music. The limitation of my study is that there is not enough time and it was not intended to build a community of practice during the Build MyTune music classes. Although, during the last two sessions, I found that Tracy, Jessica, Mindy and Kate were self-motivated to play drums and other percussions as
a group without my instruction. They were role playing about a master was conducting the ensemble. They began to listen to each other and adjust the tempo of their rhythmic patterns.

Probably, a longitudinal study would be a better way to address the connection between the creativity and knowledge sharing processes. It is difficult for my study to support the causal relationship between the creativity and knowledge sharing other than that knowledge sharing contributed to the motivation part of the creativity process (e.g. Tracy was inspired to create new pieces after Jessica shared her works with Tracy). When I paired two children together to share their works and talk about what they felt about another one’s work, this often resulted in disagreement and not being willing to change their original works (e.g. Connie and Bob went into an argument when critiquing each other’s works). Yet, there was evidence of the whole cyclical process (I will call this “practicing”) as a meaning making experience that both creativity and knowledge sharing are crucial components during the process.

As Rowland (2004) stated, novelty is the result of intention guided by reflective practice. Although random exploration or trivial daily activities were part of, but not the sole component of, the studied children’s creativity processes because their goals might not have been determined in the beginning of the processes. However, without the intention of “making something,” the composer cannot “own” these products in a personal way; the novelty may not have been recognized by them or come from the children’s unique perspectives. Returning to the discussion of whether the interaction between the individuals and the groups promotes or kills creativity, it does not mean that insisting individuals’ unique points of view or compromising the group’s opinions will ensure the final products are creative and useful. However, creative works cannot be defined separately from the context because any individual must have interacted with one or more external systems in its creation (Amabile, 1996; Sternberg, 2001). Such a notion is
supported by West and Hannafin’s (2011) study in which their participants described their process of collaborative idea generation among the group members as being the most critical component of the communities of innovation. The lessons learned from my study confirm that knowledge sharing provides an opportunity for individuals to construct meaning and recognize novelty as well as for the group to add social perspectives as an input that inspires new works. Such a process involves interplay among all four forms of knowledge and knowing. And perhaps as implied by the research (Cook & Brown, 1999) that more studies on the management of organizational innovation and the types of community and community of practice that supports creativity need to be done (Amabile, 1998; Brown & Duguid, 1991; Hargadon & Bechky, 2006).

Implications for IT/Learning

A fundamental issue needs to be addressed prior to provide implications to IT/Learning for creativity: What does Instructional Design mean if creativity is the learning goal? As previously discussed, the process of creativity is a type of ill-defined problem-solving. Designing instruction or providing an environment for creativity implies facing ill-defined problem solving scenarios, meaning both learners and instructors would need to handle ambiguity. The problems might not be discovered or apparent at the latter stages and the judgment for decisions might not be based on a simple right or wrong answer, but instead be based on an insightful understanding of the complex situation (Rowland, 2004; Schön, 1983, 1987). The goal of instructional design is to recognize that learning is beyond knowledge transmission; it is to generate novelty (Grabowski, 2004; Yeaman et al., 1996). Through a postmodern lens, the instructional design for creativity embraces diversity and plurality in learning strategies and outcomes and supports that media does affect learning and creating (Davies, 1991, Yeaman et al., 1996). This exploratory
study based on the postmodern framework can be useful as it offers scenarios or raises issues that add to, develop, or improve learning environments for creativity. The following implications for IT/Learning in creativity will be discussed:

**Designing Media/Tools for Reflective Practice**

The experience of designing computerized interactive tools based on Bamberger’s studies is helpful for the future design and utilization of media/tools fostering reflective practice. Since instructional design for creativity means facing ill-defined problems, it is important that the instructional strategies and learning environments allow and encourage learners to explore. The feature of simulated Montessori bells (two sets of identical icons representing an octave of major scale) and randomized position by default required the children to take action. Although the decisions might not have been musical (output varied by the children’s musical training background), the feature of enforcing exploration encouraged the learners to discover sounds and allowed the instructors to understand what the decisions were based on. Further design of scaffolding (e.g. matching pitch) will be needed to allow learners to develop cognitive understanding as the basis of creativity (e.g. differentiation of sounds—domain relevant skills).

To promote reflection-in-action, the instructional designer can consider utilizing a working area for learners as the extension of their meta-cognitive spaces. In Build MyTune—I, the working area was the working zone in which the children moved simulated bells in and out of the space and organized information. In Build MyTune—II, the working area was the interface that held lists of selections from which children could make decisions and evaluate the results. Confirmed from Bamberger’s (1991, 1999, 2003) and my findings, a working area allowing
learners to plan, make changes and retain finalized structures as their creative outcomes can help learners work through their tacit knowing and explore new ideas.

The notion that media is the message taught us how media effects learning and creating: ways of knowing and the ways of creating, also the product of creativity (McLuhan, 1964; Yeaman et al., 1996). This idea is supported by the findings from this study in that the children were inspired, or constrained, by the choices offered and the features of the tools and, consequently, to create different types of music. Not only musical elements such as tonal choices, timbers or rhythmic patterns will result, the type of music created, the capacity of saving settings, and recording or allowing different ways of construction also affect the creativity outcome. Learning from Kratus’ (2001) study, the number of pitch options will affect the time spent on exploration and the duration of the works as well as the replicated patterns used in the composition. Also learned from my study is the younger children who had less musical training had to stop the looped feedback in Build MyTune—II to think and evaluate the choices made (reflection-on-action), whereas the older children who had stronger musical training could execute on-the-spot changes and reflection-in-action. Therefore, the designers should understand the options offered and how they can affect learners’ cognitive loads and consider how to strategize scaffolding by providing appropriate options and pacing during different stages of learning/creating for different types of users (based on their cognitive development, domain relevant skills, etc.)

Guidance and Affordance to Foster Revision or Extension

One lesson learned from my study was that children modified their decisions when they were in the stages of exploring the tools, developing strategies and approaching goals, but they
were not willing to make changes once they finalized their works. Instead they moved to a new piece if they were motivated. This phenomenon existed for the children in my study regardless of their ages and/or musical background. It was also interesting to learn that the new pieces might have been a similar piece (a variation of the previous work) or a totally different one (based on new developed ideas).

In the discussion sections, the need for fostering children’s revision/extension of their works was explained, but several implications for designing instructional approaches and tools will be further addressed here. First, it is important to recognize the new pieces (as the variations) could be the revision of the old pieces. So providing opportunities for them to retain, review, and reflect on their works to help them understand the threads of ideas and ensure their authorship of works is important. The instructional designer also needs to know the children might have developed ideas for the new work before they finished the previous one, so the timing of providing such reflection is important as well. Utilization of the same tool to produce variations based on an idea can be considered as repeated practice, which is necessary in internalizing actions as knowing and handling new situations resulting from discovering new ways of seeing and hearing (Bamberger, 1991).

Findings from the current study show that the source of novelty can be from encountering change in the environment and the process or from discovering new ways of seeing and hearing. With the understanding of how novelty is generated, the learning environment should be designed to incorporate new elements as stimuli to foster learners’ motivation to make revision and to expand their repertoire. The role of a coach might be helpful in this scenario. According to Schön (1987), the coach can demonstrate works or provide critiques. While learners can benefit from observing the demonstration, learners can also benefit from trying to imitate the coach’s
work as building new experience and engaging in practice. Coaches should avoid having the learners only imitate what the coach has demonstrated, encouraging a step further to assist critical thinking is necessary.

If music making can be compared to hypothesis testing, then the hypothesis (or end goal) would be to produce something that is personally, culturally and aesthetically pleasing, while the hypothesis testing phase involves the process of practice. Since knowing is not a static thing (Bamberger, 1991, 1999, 2003, 2011), constant revisiting and revising of the same material becomes a must during practice. In fact, the strategies of utilizing technology, fostering meta-cognition, enabling peer interaction and providing coaching can be incorporated into each stage of creativity. For example, the activities of learners’ exploration and self-expression utilizing technology can be followed by receiving feedback from the coach or peers. This feedback may lead to critical thinking, which requires reflection and more experimentation, and then the changes in the learners’ mental structure will lead to generation of novelty as outcomes.

**Opportunities to Connect Past and New Experiences and Encourage Meaning Making**

Human’s learning behavior is profound, especially the phenomenon of how new knowledge is created. Here, again, we can reference back to the two types of learning models in which one views learning as knowledge transmission and the other views learning as knowledge construction (Yeaman et.al., 1996). The importance of connecting learners’ past experience and new experience not only lies in the knowledge transmission aspect of learning but also on the side of knowledge construction.

As previously stated, instructional design for creativity means both learners and instructors need to handle and to tolerate ambiguity, which can be due to missing information,
unclear rules, or lack of existing framework. Since the ability to tolerate ambiguity is a personality factor (Dacey & Lennon, 1998), how an instructional design system can enhance this factor probably belongs to the future study area. However, Schön’s notion that experts have a wide repertoire so they are acting upon the variations rather than total surprise when they encounter something new can be a useful implication. As explained, Bob, the most musically inclined child in my study, was able to quickly recognize the features in Build MyTune—I (the bells could be used to play the same melody he could play on a piano or violin) and then create a song that he could later practice on a violin and piano. A totally new tool or situation (e.g. Build MyTune—II) might take Bob some time to explore and to comprehend, but once he practiced it and included this experience into his repertoire, he embraced this new experience and made it part of his repertoire of knowing-in-action. Such a process of building new experience while connecting to past experience will build up learners’ ability to face new situations. In other words, this ability is achievable through practice.

Connecting past experiences and new experiences and constructing meaning are also key to forming unique perspectives as sources of novelty. The strategies, described in Hickey’s (2015) study, that the coaches of free improvisation asked their participants to reflect on and discuss their experiences as a group can be helpful for constructing personal meaning and perspectives. Hickey’s study focused on these instructors’ processes and perspectives rather than their participants’. Although it was evidence of the improvement of the participants’ future music making ability or a contribution to their creative personality traits, the questions of how the music made the participants feel and how the music could be done differently were perceived by the experienced instructors as important to making the improvisation work.
Implications for instructional designers to scaffold meaning making processes include guiding the learners to reflect on their thoughts or processes, engaging learners to create metaphors or analogies, asking learners to draw representations of the works, encouraging learners to develop stories, etc. (Bamberger, 1991, 2011; Barrett, 1999, 2000; Grabowski, 2004; Hickey, 2015; Rowland, 2004). Bamberg’s (2011) study of how children discovered two scenarios (walking, clapping or drumming in different rhythmic patterns and rolling two different sizes of gears) had common underlying principles, and how they developed deeper understanding of the relationship of action and time was an effective case of children constructing meaning through scaffolding (learning through reflecting on past experiences and developing language to express their tacit knowing).

Summaries of IT/Learning Implication

How do the lessons learned from this study help design instruction, media/tools, and strategies to foster creativity, scaffold critical thinking, and offer opportunities for meaning making? Following table summarizes ideas suggested earlier in terms of what we can do (specific design in media/tool features or instructional strategies) to provide the educational values to foster creativity.
Table 4
Summary of Media Features and their Function in Creativity

<table>
<thead>
<tr>
<th>Media Features</th>
<th>Merits in Education for Creativity-Reflective Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Zone</td>
<td>A space that serves as affordance for reflective conversation with the material. It can support the cognitive process of exploration as well as searching and memory retention during the creativity processes</td>
</tr>
<tr>
<td>Saving the settings</td>
<td>Enforce point of decision making and serve as extension of memory to support reflection and future decision making. The saved settings can be used to build the extension of previous music ideas and to compose longer pieces.</td>
</tr>
<tr>
<td>Montessori bells (same color, shape, size, etc.)</td>
<td>Enforce exploration and decision making based on the sound.</td>
</tr>
<tr>
<td>Simulation of Montessori bells in computer</td>
<td>Enforce exploration and decision making based on the sound. Allow learners to work on musical activity individually in their own workstation.</td>
</tr>
<tr>
<td>Randomize the positions of bells</td>
<td>Enforce exploration.</td>
</tr>
<tr>
<td>Play-back Looped sound</td>
<td>Provide immediate feedback responding to a learner’s/user’s action.</td>
</tr>
<tr>
<td>Sequencer for selecting different pitches, instruments, tempo, rhythmic patterns from a graphical interface</td>
<td>Include various components in the learning environment for learners to choose. Learners can experiment with different combinations of their selections. It also helps learners with lower domain knowledge create more advanced musical patterns and learn from their choices.</td>
</tr>
<tr>
<td>Button to switch sound On and Off</td>
<td>For learners with different cognitive capacity to self-control the pace of practice (e.g. reflection-in/on-action)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
<th>Merits in Education for Creativity-Reflective Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up activities (playing musical games, interacting with instructors and other children, musical instrument improvisation, etc.)</td>
<td>Allow learners to explore and be familiar with the learning environment. Encourage learners to engage in the creativity processes without pressure of producing conventional outcomes. Help learners build musical experiences individually and within a group.</td>
</tr>
<tr>
<td>Pitch matching activity (using Montessori bells)</td>
<td>Practice the domain relevant skills. Enable new ways of seeing/hearing through reviewing the fundamental elements.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparing the computer simulation with the real instruments</td>
<td>Make connections to transfer the music experiences</td>
</tr>
<tr>
<td>Constructing a known song</td>
<td>Practice domain relevant skills, make explicit learners’ knowing-in-action</td>
</tr>
<tr>
<td>Imitating sounds or music patterns</td>
<td>Learn and practice domain relevant skills. Expose to new musical experiences as stimuli for building repertoire and generating novelty</td>
</tr>
<tr>
<td>Create variations</td>
<td>Learn and practice connecting past experience with new experience. Enforce searching for information from memory or the environment to be used as the response for creative outcomes.</td>
</tr>
<tr>
<td>Introduce new elements or new tools</td>
<td>Learn to handle new situations or technical challenges. Enforce on-the-spot experimentation.</td>
</tr>
<tr>
<td>Compose a new song</td>
<td>Practice facing ill-defined problem. Learn to handle ambiguity.</td>
</tr>
<tr>
<td>Asking about the perception of the tools and sounds</td>
<td>Make explicit learners’ knowing-in-action. Prepare for meaning-making for their creativity processes as a holistic experience</td>
</tr>
<tr>
<td>Name the work (music, setting, drawing, etc.)</td>
<td>Claiming ownership of their work. Provide opportunities for learners to construct meaning of their works</td>
</tr>
<tr>
<td>Construct graphic representation</td>
<td>Provide opportunities for learners to construct meaning for their works. Promote learners to build unique and personal perspectives.</td>
</tr>
<tr>
<td>Reflect on the processes of creativity</td>
<td>Make learners aware of goals or issues in their strategies. Prepare repertoire for future reflective practice.</td>
</tr>
<tr>
<td>Coaching-demonstration</td>
<td>Introduce new elements to learners. Learners are cultivated through experts’ problem solving models and perspectives.</td>
</tr>
<tr>
<td>Coaching-providing feedback</td>
<td>Provide opportunities for critical thinking</td>
</tr>
<tr>
<td>Peer Interaction - Group composition</td>
<td>Provide opportunities for building community of practice. Practice negotiation and revision.</td>
</tr>
<tr>
<td>Peer Interaction - Sharing music with others</td>
<td>Provide opportunities for building community of practice. Promote motivation and intention.</td>
</tr>
<tr>
<td>Peer Interaction-Providing feedback</td>
<td>Provide opportunities for building community of practice. Provide opportunities for critical thinking.</td>
</tr>
<tr>
<td>Practice same tools or same theme repeatedly</td>
<td>Engage in reflective practice and generate novelty intentionally or through negotiation with the changes in the environment. Build up experience through experiments and apply past knowing as the basis to judge the outcomes from the experiments.</td>
</tr>
</tbody>
</table>
Future Research

The lessons and limitations from this study also informed that the field of education technology still has a way to go to learn from the creativity processes and domain of art. Also it needs more input from both researchers and practitioners. I believe the study of components of reflective practice could help us understand what happens during the development of instructional design and how learning happens in the practical world. Summarized from the previous discussion, several directions are highlighted as recommendations for future research:

- More longitudinal studies to observe and analyze the connection between knowledge sharing and knowledge creation.
- Studies on individual creativity and group creativity will help us gain insight on how organizational creativity works and the types of communities and strategies (e.g., communities of innovation, sharing knowledge or creative ideas in social media environments, creativity activities for school curriculum, etc.) that support creativity.
- The effect of visuals to learners’ aural experiences during children’s music making processes. There are two aspects of the visual effect considering its relation to the children’s aural experiences. One way is the individuals’ invented graphical notation for their music composition similar to what Barrett studied (1999, 2000). This examines how children construct meaning from their music composition. Another way is to examine how visual representations affect children’s construction of their music compositions while they are creating: whether the visual aspect adds to the creation of music or takes away their opportunity of working on abstract thinking.

Looking at both aspects in studying the creativity experience as a whole, we ought to
understand the relationships among the construct of the objects, the action/strategies, the aural and visual perception of events, and the meaning of their works. These aspects could have an impact on designing and creating instructional materials or learning environments for children.

- More attention should be paid to studying media design elements. For example, how does fidelity compare with simulation; or, tangible objects with abstract thinking. And, what are the functions and constraints of instruments (e.g. analog piano produces quality tones vs. a digital synthesizer that offers sound/pattern options).

- More research is needed on how to incorporate motivation and creativity in instructional design.

- As mentioned in the methodology, Barrett’s (2000/2001) question (Appendix H) about how the music makes the children feel was not included in my interview questions (Appendix G) because this study focused on the processes rather than product. However, our feelings about music is why we make music—to express our feelings. Future studies could expand on the need for expressing feeling as the motivation/intention of creativity.

- More research is needed on postmodern frameworks of instructional design. For example, research can focus on creativity processes for digital learners; bringing in aesthetics/critical approach to theory and practice.; the co-existence of scientific and artistic approaches in terms of scholarships and instructional strategies.
Schön (1987) described how he came up with his theory by joining and observing a study of architectural education. In his first book—*The Reflective Practitioner*, he explained what he had discovered about competencies in professional knowledge, especially “reflection-in-action” that happened during situations of uncertainty, uniqueness and conflict. After these long processes of transcribing, coding, threading the themes and reviewing Schön’s reflective practice theory, I finally gained a deeper understanding of this theory. I had a feeling of “opening” and bringing back the memories of those children’s processes and my own teaching experiences as early as the first lesson I taught. These experiences were a kind of “learning by doing,” where I was learning the theory by developing the research framework, designing the computer programs, watching my participants’ processes and reflecting on my own processes.

I have more respect for the various models of creativity and believe that creativity in school curricula and within organizational team work is necessary and achievable. By understanding that 1) creativity and knowledge sharing processes involve connecting past experience with the current context, 2) media that provide playback, mapping, and saving function can serve as an affordance for reflective practice, and 3) novelty can be generated through intention guided by reflection, I advocate that instructional models should value meaning making as an important learning experience as well the learning outcome. Also understood is that creativity happens within classrooms and workplaces, as well as in social environments and beyond. It is the continuation of events and experiences that contribute to our ability to work through the ambiguity and generate something new and unique.
Teachers probably can understand the chaos and the uncertainty whether taking too much control or giving too much freedom when asking a group of kids to compose music in the classrooms. That being said, designing and implementing activities for a creativity curriculum is not only a matter of designing and following the pedagogical procedures, instead it is a matter of what the teachers’ philosophy of creativity is and how to carry out reflective practice to understand and handle the ambiguity. Designing or utilizing computer programs like *Build MyTune—I* and *Build MyTune—II* can offer children platforms to work and learn. More importantly, the curriculum needs to incorporate the individuals’ creative processes with many other types of learning activities (e.g. music appreciation, improvisation, learning music forms by composing, expressing ideas in various art forms, etc.). Using Bob as an example, how his experiences and daily practice of these various activities built up his ability to create music and meaning, can inspire us.

**Thinking Like a Composer**

On the third week of the class, I asked participants to bring their favorite music (a CD, a music score, or they could play the music on instruments). Bob brought his favorite music— it was Bach’s “Prelude from Suite No.1” for cello. This music is a solo piece with no accompaniment, which means there is no piano or orchestra accompanying the solo melody. I was impressed by Bob’s choice because this was a difficult piece even for an adult to learn to appreciate (Not like a song that can be understood through the lyrics or an upbeat rock & roll music that moves people kinesthetically. This music is very simple yet elegant if one knows how to appreciate the form, the chord, the expression of the sounds and timing, etc.) I asked Bob to tell me what was on his mind (like an image or a feeling) when he heard the music.
Bob: (Thinking for a while) I don’t know, it’s not really, I don’t really think of anything. But it is like, a story, maybe? In the beginning, it’s kind of calm, and gradually builds up….and then disappears…

Me: Do you remember what you were thinking when you first heard this?

Bob: (Showing a little excitement) I felt I really wanted to play this song.

Me: You heard it from a CD or from somebody playing the music?

Bob: I think I heard it from a television show….It’s in the background…

Me: Have you ever seen anybody playing this?

Bob: Yes, my orchestra teacher.

Me; Have you ever wondered how Bach created this music?

Bob: I don’t really think. (Me: If you guess?) I think he may be taking a cello, and then exploring….the four strings like that…(showing how to play in cello). Maybe playing some music like that…

Me: Have you ever used violin, cello or piano to try the process that you just described?

Bob: Oh, yeah. (Me: How did you try?) I heard it in the ear, not on the music [score], …some melodies and I just played it.

Me: So you were playing something that you heard, …How do you usually practice piano or violin?

Bob: I would choose something I feel not comfortable. I play it many times until it becomes automatic. And then I use that part, start from the beginning, play the whole song…If it is not right, I play through the process again. Sometimes, I play some songs I heard from the school or someone…

In this conversation, Bob shared with me what he thought about and experienced during the process of creating music. What he “guessed” about how Bach created music (just taking a cello…exploring…playing the four strings like that…) was actually from his own experience; what he described about the process of practicing piano or violin (choosing something he felt not conformable, meaning something presented as problems or challenges, playing it many times and making corrections) was the reflective practice; and what he experienced the process that he was motivated by external stimuli (other people’s music) or internal stimuli (he heard music in his ear) was essentially the thinking and behavior of a composer (Sloboda, 1985; Webster, 1990).

Bob has an “inner hearing” (Gordon, 2013) ability, like many professional musicians that they can look at a music score and can hear the sounds without playing the instruments. I
imagined that there is a working zone inside Bob’s head that the sounds he heard and played went into the area and somehow subconsciously reorganized and created new melodies that appeared in his ear. Although it has been suggested by Kratus (1989) that children aged 9 or 11 can have the similar compositional processes like adults, Bob was very special among all my participants.

This unique example helped me understand how reflective practice and meaning making relate to creativity process in ways much beyond what happened in the classroom. When I saw that he was able to make meaning of his creativity works, reflect-in/on-action, bear the unfamiliarity or ambiguity, and develop strategies to achieve goals, these qualities have been in his daily practice of instrument, rehearsal at orchestra or choir, improvisation on his own and appreciation of various musical styles. Bob could think like a composer!

**Holistic View of Learning**

This ability of thinking like a composer (or thinking like a scientist, a teacher, a writer, an artist, etc.) is what my view of a successful curriculum should be—one that includes holistic life experiences as the learning goal! Bob’s example shows us how it can be achieved. As a final point, creativity does not happen if one does not begin to practice. Such type of practice allows end goals defined at a much later stage and allows unexpected outcomes and processes. The practice should not be just random exploration or occurrences without intervention or decisions. Without the sense of owning and the state of “knowing” or “engaging,” there will not be dynamic interaction between the tacit and explicit knowledge; therefore, nothing is “created.” I did not intend to generalize all children’s creativity processes as the findings of this study were from a small sample size of children of specific demographics with specific musical background
in the specific research setting. Instead I perceive that the issues and limitations of this study to serve as the opportunities of more research in various settings. It is my hope this exploratory study of children’s creativity and knowledge sharing processes and how components of reflective practice play roles in their processes can contribute to not only the field of educational technology also the field of corporate organizational learning and inspire future studies.
REFERENCES


APPENDIX A
RECRUITING MATERIAL
Dear parents/guardians and students:

My name is Chia-Pao Hsu. I am a doctoral student in the Department of Educational Technology Research and Assessment at Northern Illinois University. I would like to invite you and your child to participate in a music course called Build MyTune. This course is designed for children from 7 to 11 years old and is intended for my research project using reflective practice during music creativity and knowledge sharing processes.

I have a degree in music education and have teaching experience in elementary schools, XXXX School and XXXX College. My interest is to develop an instructional environment and materials that support reflective thinking and foster creativity. This research project will be a one-hour music class on weekly basis for eight sessions starting from summer 2008. Students will be working with computer programs, musical instruments, other students and me (as an investigator and a teacher) in a music classroom setting. The classroom activities include interacting with computer simulations, playing think-out-loud games, improvising musical sound, recording music compositions, drawing self-invented notations and sharing with others.

The participants in this research project will be completed voluntarily. Any information you give will be confidential. This is not an Community School Class; therefore, no fee will be charged for the lessons. It is only by asking your time and participation to the classroom activities, survey questionnaires and interviews that this research project can be feasible. I will really appreciate you allowing me to learn about children’s reflective thinking, creativity and knowledge sharing processes through your help. Enclosed is an envelope with pre-paid postage. Please sign and send back the initial contact information if you are interested in this project. I will need to consider the availability of classroom, schedule for participants and then have you sign the informed consent and fill out a survey questionnaire soon.

Please feel free to call me or e-mail me if you have any questions regarding the project, activities or special concerns. I will be more than happy to explain to you the details at this stage of my research design.

Thank you so much for your time.

Sincerely,

Chia-Pao Hsu __________________________________________ Date: ______________
chsu@niu.edu
(If you are interested in this project, send back this part using the enclosed envelope)

☐ Yes, I am interested in this research project. I agree to give my child’s information for scheduling and grouping purposes.

☐ I am not sure if I want my child to participate in this project, but I want to know more details.

Parent’s/guardian’s name: ________________________(printed)

Signature: __________________________ Date: ____________

☐ Yes, I am interested in this research project. I agree to give my information for scheduling and grouping purposes.

☐ I am not sure if I want to participate in this project, but I want to know more details.

Student’s name: ____________________________(printed)

Signature: __________________________ Date: ____________

Parents/guardians, please indicate the day/time that works best for your child to schedule the music classes. (Check the day and then circle the time)

☐ Monday (morning, afternoon, early evening)
☐ Tuesday (morning, afternoon, early evening)
☐ Wednesday (morning, afternoon, early evening)
☐ Thursday (morning, afternoon, early evening)
☐ Friday (morning, afternoon, early evening)
☐ Saturday (morning, afternoon)

Additional questions or concerns

__________________________________________

Please leave the most convenient way for me to contact you.

Phone number: _____________________________ e-mail address: _____________________________
APPENDIX B

PARENT/GUARDIAN PERMISSION FORM
Dear Parents/Guardians:

My name is Chia-Pao Hsu. I am a doctoral student in the Department of Educational Technology Research and Assessment at Northern Illinois University. I would like to invite your child to participate in the music course *Build MyTune* and my research project using reflective practice on music creativity and knowledge sharing processes.

This music course does not belong to any school program, so the schedule will be upon the investigator, participants and the availability of the classroom. This research project will be a weekly one-hour music class for eight sessions. Students will be working with computer programs, musical instruments, other students and me (as an investigator and a teacher) in a music classroom setting. The classroom activities include interacting with computer programs, playing games and sounds, recording music compositions, drawing self-invented notations and sharing with others.

For the necessity of research agenda, please allow me to collect participants’ demographic information, observe participants’ classroom activities, gather participants’ creativity products, and conduct follow-up interviews. Survey results, artifacts, notes from observation, notes from interviews, and recording of music, video and screen activities will be used and coded for data analysis. Parents/guardians and students will be given a survey prior to the study and be interviewed during the program. Please allow me to use the samples and results of analysis in my dissertation and share with my dissertation committee, other appropriate members of Northern Illinois University and future research conferences.

The participants’ identities will be protected by using pseudonyms, and the recording of video and screen activities will be confidential and kept in a secured computer environment and only accessed through investigator’s password. Participants have full copyright of their artifacts,
such as individuals’ music composition and products. The collective artifacts belong to all participants who created them.

I deeply appreciate your child’s time and intellectual contribution to this study. There is no perceived risk in this research project. You and your child’s participation will be completely voluntary and can be terminated at any time by your own decision. If you have any questions, please feel free to contact me by phone (XXX-XXX-XXXX) or email (chsu@niu.edu). You can also contact my committee chair, Dr. Wei-Chen Hung, by phone (XXX-XXX-XXXX) or e-mail (whung@niu.edu), or the Office of Research Compliance at Northern Illinois University (XXX-XXX-XXXX) for any ethical issues regarding this research project. Additional resources are listed in the Office of Research Compliance’s website (http://www.orc.niu.edu/orc/).

You will receive a copy of this consent form to keep. Attached is a tentative schedule of the class sessions. You are making a decision whether or not to allow your child to participate, to be video recorded, for your child’s screen activities to be recorded, and for your child’s artifacts to be copied and shared for research purposes. Your signatures indicate that you have read the information above and agree to allow your child to participate voluntarily.

Thank you,

Chia-Pao Hsu ________________________  Date: _________________
chsu@niu.edu

******************************************************************************

My signature below indicates that I allow my child to participate in the music course Build MyTune and Chia-Pao Hsu’s research project using reflective practice during music creativity and knowledge sharing processes, including the survey questionnaire and interview.

Parent’s or guardian’s name (printed): _______________________

Signature: _______________________ Date:_________
My signature below indicates that I allow my child to be video recorded in this research project.
Parent’s or guardian’s name (printed): _______________________
Signature: ____________________ Date: ______________

My signature below indicates that I allow my child’s screen activities to be recorded in this research project.
Parent’s or guardian’s name (printed): _______________________
Signature: ____________________ Date: ______________

My signature below indicates that I allow my child’s artifacts to be copied and shared for research purposes.
Parent’s or guardian’s name (printed): _______________________
Signature: ____________________ Date: ______________
APPENDIX C

ASSENT FORM FOR MINORS
Dear Students:

My name is Chia-Pao Hsu. I am a student in the Department of Educational Technology Research and Assessment at Northern Illinois University. I would like to invite you to participate in the music course *Build MyTune*, which is my research project on music creativity and knowledge sharing processes.

This music course is not any part of your school program. The research project will be a weekly one-hour music class for eight sessions. You will be working with computer programs, musical instruments, other students and me in a music classroom setting. The classroom activities include interacting with computer programs, playing games and sounds, recording music, drawing notations and sharing with others.

To meet my research goals, please allow me to collect your basic information, observe your classroom activities, video record your classroom activities, record your screen activities, gather your creativity products, and ask you some questions. Please allow me to use your information and product in my dissertation and share with my teachers, other appropriate members of Northern Illinois University and future researches.

I will use a different name for you when I write the research paper. The recording of video and screen activities will be kept in a secured computer environment. Your music composition and drawing will belong to you. If the music is created by the group, it belongs to whomever in the group created the music.

I deeply appreciate that you give your time and effort to this study. There is no risk in this research project. Your participation will be completely voluntary and can be ended at any time you want. If you have any questions, please feel free to contact me by phone (XXX-XXX-
XXXX) or e-mail (chsu@niu.edu). You can also contact my dissertation chair Dr. Wei-Chen Hung by phone (XXX-XXX-XXXX) or e-mail (whung@niu.edu).

You will receive a copy of this form to keep. You are making a decision whether or not to participate, to be video recorded, for your screen activities to be recorded, and for your projects to be copied and shared for research purposes. Your signatures tell me that you have read the information and agree to participate.

Thank you,

Chia-Pao Hsu ________________________ Date: ______________

chsu@niu.edu

My signature below shows that I agree to participate in the music course *Build MyTune* and Chia-Pao Hsu’s research project on music creativity and knowledge sharing processes, including the survey and interview.

Student’s name (printed): ________________________

Signature: ________________________ Date: ______________

My signature below shows that I agree to be video recorded in this research project.

Student’s name (printed): ________________________

Signature: ________________________ Date: ______________

My signature below shows that I agree my screen activities to be recorded in this research project.

Student’s name (printed): ________________________

Signature: ________________________ Date: ______________

My signature below shows that I allow my projects in this research project to be copied and shared for research purposes.

Student’s name (printed): ________________________

Signature: ________________________ Date: ______________
APPENDIX D

SCHEDULE FOR MUSIC COURSE: _BUILD MYTUNE_
Tentative Schedule for Music Course: *Build MyTune*

(Subject to change according to unforeseen circumstances)

Week one: Introduction, warm-up activity (musical instrument improvisation), working with Interactive Simulation Program I (to construct an original tune and share with others)

Week two: Warm-up activity (practice think-out-loud game), working with Interactive Simulation Program I (to construct an original tune and share with others)

Week three: Warm-up activity (bring your favorite songs and share with others), working with Interactive Simulation Program I (to construct an original tune using self-selected timbers and share with others)

Week four: Warm-up activity (musical instrument improvisation), working with Interactive Simulation Program II (to create a new tune and then share with others)

Week five: Warm-up activity (musical instrument improvisation), working with Interactive Simulation Program II (to construct an original tune using self-selected timbers and share with others)

Week six: Warm-up activity (working with recorded music), working with Interactive Simulation Program II (compose and record melodic or rhythm patterns and share with others)

Week seven: Warm-up activity (musical instrument improvisation), working with Interactive Simulation Program II (construct tune using recorded patterns and share with others)

Week eight: Warm-up activities, review all composed music, sharing with parents and getting general feedback.
APPENDIX E

INSTRUMENT: SURVEY QUESTIONNAIRE
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I am a girl.</td>
<td>☐ I am a girl.</td>
</tr>
<tr>
<td></td>
<td>☐ I am a boy.</td>
</tr>
<tr>
<td>2. I am _______ years old</td>
<td></td>
</tr>
<tr>
<td>3. I live in DeKalb/Sycamore area</td>
<td>☐ I live in DeKalb/Sycamore area</td>
</tr>
<tr>
<td></td>
<td>☐ I live in outside of DeKalb/Sycamore area (indicate area:_____________)</td>
</tr>
<tr>
<td>4. I can play one or more than one musical instruments.</td>
<td>☐ Yes</td>
</tr>
<tr>
<td></td>
<td>☐ No (skip to question 6)</td>
</tr>
<tr>
<td>5. I have played __________for __________year(s).</td>
<td>I usually spend __________hours per week to practice this instrument.</td>
</tr>
<tr>
<td></td>
<td>I have also played ______ for __________year(s).</td>
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<td></td>
<td>I usually spend __________hours per week to practice this instrument.</td>
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<td>6. I participate (Check any of the following) at school.</td>
<td>☐ band</td>
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<td></td>
<td>☐ orchestra</td>
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<tr>
<td></td>
<td>☐ choir</td>
</tr>
<tr>
<td></td>
<td>☐ none</td>
</tr>
<tr>
<td>7. I often listen to (choose all that applied)</td>
<td>☐ classical music</td>
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<tr>
<td></td>
<td>☐ pop music</td>
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<tr>
<td></td>
<td>☐ jazz music</td>
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<td></td>
<td>☐ R &amp; B</td>
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<tr>
<td></td>
<td>☐ heavy metal</td>
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<tr>
<td></td>
<td>☐ country music</td>
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<tr>
<td></td>
<td>☐ others ____________________________</td>
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<tr>
<td>8. I like these leisure activities(choose all that applied):</td>
<td>☐ reading</td>
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<tr>
<td></td>
<td>☐ playing sports</td>
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<tr>
<td></td>
<td>☐ watching TV</td>
</tr>
<tr>
<td></td>
<td>☐ playing video/computer games</td>
</tr>
<tr>
<td></td>
<td>☐ making artwork</td>
</tr>
<tr>
<td></td>
<td>☐ listening/playing music</td>
</tr>
<tr>
<td></td>
<td>☐ others ____________________________</td>
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<tr>
<td>9. I usually spend about____ hours using computer per week.</td>
<td>☐ 0</td>
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<tr>
<td></td>
<td>☐ ½ - 2</td>
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<td></td>
<td>☐ 2 - 4</td>
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<td></td>
<td>☐ 4 - 6</td>
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<td></td>
<td>☐ 6 - 8</td>
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<td></td>
<td>☐ more than 8 (please indicate number of hours)</td>
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<td></td>
<td>________________</td>
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<td>10. I use a computer for (choose all that applied)</td>
<td>☐ home works</td>
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<td></td>
<td>☐ internet</td>
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<td></td>
<td>☐ games</td>
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<td>☐ music</td>
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<td>☐ movies</td>
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<td></td>
<td>☐ drawing/design</td>
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<td></td>
<td>☐ others ____________________________</td>
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<tr>
<td>11. My favorite books/authors is _____________</td>
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<tr>
<td>12. My favorite cartoon character is ______________</td>
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<tr>
<td>13. My favorite TV program or movie is ____________</td>
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<tr>
<td>14. My favorite songs are</td>
<td></td>
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<tr>
<td>(1). __________________________________________</td>
<td></td>
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<tr>
<td>(2). __________________________________________</td>
<td></td>
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<tr>
<td>(3). __________________________________________</td>
<td></td>
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</tbody>
</table>
APPENDIX F

BUILD MYTUNE—I AND BUILD MYTUNE—I INTERFACE DESIGN
Example of login page
Design of *Build MyTune*—I interface and functionality

![Diagram of Build MyTune—I interface](image1)

Design of *Build MyTune*—II draft interface and functionality

![Diagram of Build MyTune—II interface](image2)
Interview Questions:

- Describe what you hear and see.
- What were you thinking when you made this (point at the moment)?
- How did you create the song?
- How do you feel about your processes of creating the music?
- Would you change anything about the processes?
- Have you ever heard this music before? Where? What is the song?
- Does the music remind you of anything?
- What in the music does that?
- Would you change anything in this music?
- What would you change? Why?
- Is there anything else you would like to tell me?
APPENDIX H

BARRETTE’S ORIGINAL QUESTIONS
**Interview Phase One (play child’s composition)**

- What were you thinking when you listened to this music?
- (Replay) Describe what you heard
- How did you go about making this music?
- (Replay) How does the music make you feel?
- What in the music makes you feel that way?
- (Replay) Does the music remind you of anything?
- What in the music does that?
- (Replay) Would you change anything in this music?
- What would you change? Why?
- Is there anything else you would like to tell me?

**Phase Two (play adult’s composition)**

- What were you thinking when you listened to this music?
- (Replay) Describe what you heard
- How did you go about making this music?
- (Replay) How does the music make you feel?
- What in the music makes you feel that way?
- (Replay) Does the music remind you of anything?
- What in the music does that?
- (Replay) Would you change anything in this music?
- What would you change? Why?
- Is there anything else you would like to tell me?