2016-12-12

A Model of Classroom Environment and Social-Psychological Factors Influencing Computer-Based Compositional Creativity

Candice Ann Davenport
University of Miami, cdavenportmusic@gmail.com

Follow this and additional works at: https://scholarlyrepository.miami.edu/oa_dissertations

Recommended Citation
https://scholarlyrepository.miami.edu/oa_dissertations/1765

This Open access is brought to you for free and open access by the Electronic Theses and Dissertations at Scholarly Repository. It has been accepted for inclusion in Open Access Dissertations by an authorized administrator of Scholarly Repository. For more information, please contact repository.library@miami.edu.
UNIVERSITY OF MIAMI

A MODEL OF CLASSROOM ENVIRONMENT AND SOCIAL-PSYCHOLOGICAL FACTORS INFLUENCING COMPUTER-BASED COMPOSITIONAL CREATIVITY

By

Candice Ann Davenport

A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

December 2016
UNIVERSITY OF MIAMI

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

A MODEL OF CLASSROOM ENVIRONMENT AND SOCIAL-PSYCHOLOGICAL FACTORS INFLUENCING COMPUTER-BASED COMPOSITIONAL CREATIVITY

Candice Ann Davenport

Approved:

Stephen F. Zdzinski, Ph.D.
Professor of Music Education

Don D. Coffman, Ph.D.
Professor of Music Education

Carlos Abril, Ph.D.
Professor of Music Education

Corin Overland, Ph.D.
Assistant Professor of Professional Practice of Music Education

Marilyn J. Neff, Ed.D.
Associate Dean of Planning, Communications, and External Relations

Guillermo J. Prado, Ph.D.
Dean of the Graduate School
DAVENPORT, CANDICE ANN (Ph.D., Music Education)  
A Model of Classroom Environment and Social-Psychological Factors Influencing Computer-Based Compositional Creativity (December 2016)  

Abstract of a dissertation at the University of Miami.

Dissertation supervised by Professor Stephen F. Zdzinski.  
No. of pages in text. (145)

The purpose of this study was to examine the influence of affect, motivation, and classroom environment on creativity of computer-based music compositions. Participants were high school students ages 14 to 18 ($N = 146$) enrolled in non-traditional computer-based music courses from three schools across two states ($k = 3$). Surveys on motivation and mood provided the social-psychological data. A survey on classroom environment provided the contextual data. Participants created digital compositions using GarageBand on classroom computers to serve as the creative task. The compositions were rated for originality, craftsmanship, and aesthetic appeal using the Consensual Assessment Technique, which provided the creativity data. Data analysis included Pearson correlation analysis, exploratory factor analysis, maximum likelihood confirmatory factor analysis, and maximum likelihood structural equation modeling. Results of the CFA indicated strong loadings of all observed variables on the proposed latent factors, resulting in good model fit ($\chi^2 = 56.245$ (41), $p = .06$), (RMSEA = .08, $p = 0$), (TLI = .96), (CFI = .97), (SRMR = .06). Results of the SEM indicated a moderate effect of classroom environment on creativity ($\beta = .14$), and of classroom environment on Motivation ($\beta = .17$). Motivation had a small but meaningful effect on creativity ($\beta = .08$).
Dedication

This dissertation is dedicated to my grandmother, Ann. Thank you for always being the voice in my head, and a constant reminder that all little girls can do and be anything that they have the courage to imagine.
Acknowledgements

An undertaking of this size could not be possible without the help of so many wonderful people. I would like to extend my gratitude to my professors, colleagues, family, and friends that have provided such invaluable and selfless support and encouragement throughout this adventure.

Thank you to my husband, Frank, for believing in me enough to take this journey by my side. He (unknowingly) embraced the arduous road traveled, and remained steadfast despite my psychosis that is “the doctoral experience.” Thank you also to my dearest friend, Amelia, for the continuous support throughout my journey.

I also want to offer my gratitude to Sandy Sanchez and Susie Lalama for embracing me as the “new kid” and providing endless support and humorous friendship. Thank you also to Vimari, Kat, Donna, and Johanna for all of your kindness and encouragement throughout this experience!

I am so uniquely fortunate to have had such inspiring professors to help guide this stage in my career. I would like to thank Drs. Coffman, Abril, Overland, Neff, Zdzinski, Russell for your tireless and insightful efforts toward this life-changing experience. To Drs. Webster, Hickey, and Abril, thank you so very much for sparking the flame that has shaped my career through your own work, for encouraging me to take this journey, and for your constant guidance, support, and friendship throughout the years.

No words are sufficient to express my immense gratitude to Dr. Stephen Zdzinski. His genuine support, encouragement, and exhaustive efforts toward shaping me as a researcher and mentor has been truly been an honor. I will be forever grateful for his mentorship, thoughtfulness, and friendship.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF FIGURES</th>
<th>viii</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF TABLES</td>
<td>ix</td>
</tr>
</tbody>
</table>

## Chapter

1. **INTRODUCTION** ................................................................. 1
   - Defining and Measuring Creativity: A Consensual Definition ........ 2
   - Initial Model ................................................................. 5
   - Motivation ........................................................................... 7
   - Affect .................................................................................. 8
   - Classroom Environment .................................................... 10
   - Need for the Study ............................................................ 13
   - Purpose and Research Questions ......................................... 13
   - Operational Definitions .................................................... 15
   - Delimitations ...................................................................... 16

2. **LITERATURE REVIEW** .......................................................... 18
   - Componential Model of Creativity ........................................ 18
   - Model of Creative Thinking in Music ..................................... 20
   - Social-Psychological Model of Musical Ability ....................... 22
   - The P’s of Creativity .......................................................... 23
   - The Creative Person ............................................................ 24
     - Affect ............................................................................... 24
     - Motivation ......................................................................... 26
   - The Creative Place .............................................................. 27
     - Social Environment of Instruction in Music Education .......... 28
     - Classroom Environment ................................................... 29
     - Computers and Technology ............................................... 32
   - The Creative Product ........................................................... 34
     - “Traditional” Measures ..................................................... 35
     - Criticisms ......................................................................... 37
   - Amabile’s Consensual Assessment Technique ........................ 39
   - Summary and Discussion ...................................................... 59
   - Conclusion ........................................................................... 62

3. **METHOD** ........................................................................... 64
   - Participants ......................................................................... 64
   - Students ............................................................................... 64
   - Judges ................................................................................. 67
Procedures ................................................................. 68
Latent Predictors of Creativity ............................................. 71
  Affect ................................................................. 73
  Motivation ............................................................ 74
  Classroom Environment .............................................. 75
Indicator Variables ......................................................... 76
  Affect ................................................................. 76
  Motivation ............................................................ 77
  Classroom Environment .............................................. 78
  Creativity ............................................................. 80
Data Analysis .............................................................. 84

4 RESULTS AND DISCUSSION ............................................. 87
  Descriptive Analysis Results ......................................... 89
    Affect ............................................................... 89
    Motivation .......................................................... 89
    Classroom Environment .......................................... 90
    Creativity ........................................................... 91
  Correlational Analysis Results ....................................... 92
    Affect ............................................................... 92
    Motivation .......................................................... 92
    Classroom Environment .......................................... 93
    Creativity ........................................................... 95
  Measurement Model Factor Analyses ................................. 96
  Structural Equation Model ........................................... 100
  Discussion .................................................................. 102
    Relationships ......................................................... 103
  Factor Analyses and Models ........................................... 106

5 SUMMARY, CONCLUSIONS, AND IMPLICATIONS ...................... 109
  Summary .................................................................. 109
  Conclusions ............................................................ 114
  Recommendations for future research ............................... 116
  Limitations ............................................................. 119
  Implications for practice .............................................. 121

REFERENCES ................................................................ 124

APPENDIX A  Asmus’ Magnitude of Motivation in Music Items .......... 139
APPENDIX B  PANAS Positive and Negative Affect Schedule Items .......... 140
APPENDIX C  Classroom Environment Scale Short Form R Items .......... 141
APPENDIX D  Composition Rating Form for Judges .......................... 143
List of Figures

Figure 1. Proposed structural equation model of classroom environment and social-psychological predictors of musical composition creativity .............................................. 6

Figure 1.2. Theoretical latent path model of classroom environment and social-psychological predictors of musical composition creativity ................................................. 14

Figure 1.3. Initial measurement model ................................................................. 16

Figure 2.1. Amabile’s Componential Model of Creativity ........................................ 19

Figure 2.2. Webster’s Model of Creative Thinking in Music ....................................... 21

Figure 2.3. Schmidt’s Social-Psychological Model of Musical Ability .................... 23

Figure 2.4. Zdzsinki’s Model of the Social Environment of Instruction for Music .. 29

Figure 3.1. Initial structural equation model ........................................................... 72

Figure 3.2. Theoretical latent path model of classroom environment and social-psychological predictors of musical composition creativity .............................................. 73

Figure 3.3. Affect as latent factor in isolation ............................................................ 74

Figure 3.4. Motivation as latent factor in isolation ..................................................... 75

Figure 3.5. Classroom Environment as latent in isolation ......................................... 76

Figure 3.6. Affect indicators .................................................................................... 77

Figure 3.7. Motivation indicators ............................................................................. 78

Figure 3.8. Classroom Environment indicators ....................................................... 80

Figure 3.9. Creativity indicators .............................................................................. 83

Figure 3.10. Measurement model ............................................................................... 85

Figure 4.1. Respecified proposed model ................................................................... 98

Figure 4.2. CFA with standardized maximum likelihood parameter estimates........... 100

Figure 4.3. Structural model with standardized maximum likelihood path estimates... 101
List of Tables

Table 4.1. Affective Characteristics ................................................................. 89
Table 4.2. Motivational Characteristics ............................................................ 90
Table 4.3. Classroom Environment Characteristics ........................................... 91
Table 4.4. Creativity Characteristics .................................................................. 91
Table 4.5. Pearson Bivariate Correlations of Motivation Variables .................. 92
Table 4.6. Principal Components Factor Analysis of CES with Varimax Rotation ... 94
Table 4.7. Pearson Bivariate Correlations of Classroom Environment Factors .... 95
Table 4.8. Exploratory Factor Analysis with Varimax Rotation .......................... 97
CHAPTER ONE

INTRODUCTION

The field of music education prides itself on its potential for developing students’ creativity, laying claim that music making “comes as close as any cultural activity to what we usually call ‘creativity’” (Csikszentmihalyi & Custodero, 2002, p. xiv). Of all of the activities in music, composition often allows students to reach their most creative potential (Hickey, 1995). As education seeks to develop generative and divergent thinkers, capable of competing in a global society, music teachers and policy-makers have increasingly embraced compositional activities, evidenced by the inclusion of composition in music education guidelines such as the MENC (1994) National Standards for Arts Education and the NAfME (2014) Core Music Standards.

With the increased pervasiveness of technology’s use in the classroom, differing thoughts exist regarding which learning contexts provide optimal environments for students’ compositional experiences (Adileh, 2012). Particularly in music education, many argue that there will always be a need for traditional instructor-led programs, while others believe that technology-driven and student-led programs, such as blended or online models, may take the place of face-to-face learning in the future. However, Jorgensen (2011) asserts that it is the manner of social interactions inherent in the different teaching and learning environments involving technology that often drive these arguments of cost-versus-benefit. Regardless, the use of computer-based music technology for compositional activities is increasing (Dorfman, 2008; Dammers, 2012; Webster, 2012).
However, when investigating the learning environments of students’ creative experiences, another hurdle presents itself— the ambiguous nature of creativity in research.

**Defining and Measuring Creativity: A Consensual Definition**

Despite decades of research, an explicit and widely agreed-upon definition of creativity continues to be a topic of debate. While most researchers and theorists seem to agree that creativity involves the development of a novel product, idea, or problem solution that is of value to the individual and/or the larger social group, agreement upon definitional components beyond novelty and appropriateness (value) has been debatable (Hennessey & Amabile, 2010). Although perspectives and investigations of creativity have become more complex, our ability to precisely define creativity has remained fairly problematic.

In a more specific approach, the creativity of compositional products has typically been seen as a fleeting and largely situation-dependent state (Runco, 2004). Therefore, assessing compositional creativity is a difficult and controversial task. Well-known and widely used models for assessing creative products, such as those by Guilford (1950, 1970) and Torrance (1966, 1988), paved the way for research in this area by developing factors of divergent thinking upon which to rate creativity.

However, the use of such objective testing and the validity of this factorial approach to measuring creativity have been challenged from a sociocultural perspective (Csikszentmihalyi & Getzels, 1988, 1999; Elliott & Silverman, 2015; Stefanic, 2014; Webster, 2002). Hickey (2001) suggests that one of the greatest criticisms is that the theoretical constructs were validated through tests such as factor analyses, but never
against external measures of creative productivity. Brown (1989) argues that the creativity tests had only apparent construct validity and not criterion validity. Additionally, the paper-and-pencil tests do not capture the complexities of real-life creative tasks.

As an alternative, Amabile (1983, 1996) suggested that the most valid way to measure creativity is through the use of domain experts’ global and subjective assessment of creative products—a technique now known as the “consensual assessment.” Amabile (1982) first argued that it is impossible to define clear and objective criteria for a creative product. Furthermore, anyone using objective criteria to evaluate creativity interprets the criteria differently, and thus social appropriateness can never be avoided in creativity research. Sawyer (2006) stated, “If creativity can’t be defined without appropriateness, and appropriateness can only be defined by the people working in a domain, then the definition of creativity is fundamentally and unavoidably social” (p. 122).

Based on the contextual nature of creativity, Amabile (1982) developed the Consensual Assessment Technique (CAT), which uses the subjective judgment of expert raters in the appropriate field to evaluate creativity. The CAT has several key components to provide validity of the approach. First, more than one rater is required in order to prevent issues of individual bias and to assess inter-rater reliability. The inter-rater reliability of consensual assessment by experts is then suggested as the equivalent of construct validity. Additionally, the experts must be knowledgeable in the particular area being examined since the rating of creativity is subjective in nature (Baltzer, 1990). Amabile (1982) states, “If appropriate judges independently agree that a given product is highly creative, then it can and must be accepted as such” (p. 1002). By definition,
according to this theory, a product is then considered creative if the experts in the domain agree it is creative. “A product or response is creative to the extent that appropriate observers independently agree it is creative…. Thus, creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers (Amabile, 1983, p. 31).

Because of its simplicity and consistency of high inter-rater reliability, this methodology has continued to be widely used in creativity assessment literature (Baer, Kaufman, & Gentile, 2004; Kaufman, Baer, Cole, & Sexton, 2008). In fact, the CAT is being used in real-world classroom and workplace environments, including cross-cultural contexts (Amabile & Mueller 2007). Studies of musical creativity have also begun to emerge and have largely shown high reliabilities with the use of the CAT. The CAT has been used to investigate musical creativity in relation to social and environmental contexts (Bangs, 1992; Brinkman, 1994, 1999; Byrne, MacDonald, & Carlton, 2003), to musical behaviors (Priest, 1997, 2001a, 2001b), to discover indicators of creativity (Baltzer, 1990; Auh, 1997), to connect processes and products (Hickey, 1995; Daignault, 1996; Stefanic, 2014), for the development of assessment rating scales (Webster & Hickey, 1995), and to identify domain experts and judging conditions (Hickey, 2001; Priest, 2006). These studies have all shown reliable and appropriate use of the technique. Therefore, the use of the CAT avoids the problems with objective and abstract creativity tests (Hickey, 1995), and is optimal for addressing social, contextual, and individual influences on creativity.
Initial Model

Interest in creativity has produced a large body of research including studies focused on (but not limited to) aspects of the person (e.g., personality, intelligence) (Batey & Furnham, 2006), process (Collins, 2007), and context (Amabile, 1983, 1996) in relation to differences in creative thinking abilities (e.g., divergent thinking) (Collins, 2005; Guilford, 1968; Guilford, Merrifield, & Wilson, 1958; Torrance, 1966; Webster, 1987, 2002) or differences in relative creativity of actual created products (Baer, Kaufman, & Gentile, 2004; Hickey, 1995, 2001; Priest, 2006).

Rhodes (1961, 1987) suggests that this large body of research on cross-disciplinary foci of creativity be organized into four different potential research areas, known as “the four P’s”: (a) the creative person, (b) the cognitive processes involved in the creation of ideas, (c) the creative place or the environment in which creativity occurs or environmental influences, and (d) the resulting creative product. Batey and Furnham (2006) support this organization, noting increasing agreement on these interactions and movements to incorporate a multi-componential perspective into creativity research. From this perspective, complex interactions between the person and environment ultimately lead to a creative product (Amabile, 1983, 1986; Csikszentmihalyi, 1988; Mumford & Gustafson, 1988).

Since creativity involves a combination of personal factors interacting dynamically with the environment (Nica, 2013), levels of creativity can be explained by a specific combination of these factors. Structural equation modeling would provide an ideal method for understanding and clarifying these relationships. Through structural equation modeling, direct effects and indirect effects between each construct may be
revealed while holding other effects constant (Keith, 2006). Furthermore, utilizing the Consensual Assessment Technique will provide a socially and contextually sensitive approach to evaluating a relatively ambiguous area such as creativity (Byrne, MacDonald, & Carlton, 2003).

Using a multi-componential perspective, a model of the interplay between social-psychological personal characteristics and social-contextual influences of computer-mediated classroom environments on students’ digital music compositions is suggested (Figure 1). The model intends to examine the relationships between the latent constructs of affect, motivation, and classroom environment on the latent of creativity. The remainder of this chapter will explain and define the latent variables, express the need for the study, and identify research questions and delimitations.

*Figure 1.* Proposed structural equation model of classroom environment and social-psychological predictors of musical composition creativity.
Motivation

From a multi-componential stance, if we are to consider social contexts in which creativity of musical products is affected, it is of equal importance to consider the ways in which an individual’s personal characteristics negotiates within these situations (Amabile, 1996). Intrinsic motivation has been found to be largely conducive to creativity while extrinsic motivation is generally inhibitive (Amabile, 1996; Hennessey, 2004; Hennessey & Amabile, 1993, 2010; Shin & Zhou, 2003). In a meta-analysis, Jesus, Rus, Lens, and Imaginario (2013) revealed a significantly positive relationship between intrinsic motivation and creativity related to products. Bangs (1992) found that motivation also significantly influences the creativity of music compositional products. Furthermore, researchers have found that intrinsic motivation can be fleeting and susceptible to social-environmental influences, suggesting the need for examining this construct within the model (Deci, 1995; Hennessey & Amabile, 1993). Hurley (1993) supports the use of the motivation construct as being both a moderator and predictor, stating, “motivation is considered both a catalyst for learning and an outcome of learning” (p. 17). Because of the inclusion of music composition in the MENC (1994) and NAfME (2014) standards, the development of creative musical products can be considered as a learning outcome (Mitchell, 2014), and therefore students’ successes as indicated through assessment of these products can logically be considered as musical achievement.

The significance of motivation on music achievement has been shown in a variety of studies (Asmus, 1996; Austin & Vispoel, 1994; Hallam, 2002; Miksza, 2006, McPherson & McCormick, 2000; Schmidt, 2005). Based on attribution theory, Asmus
(1985, 1986, 1989) discovered the motivational factors students attribute to their music achievement. From this, Asmus developed the Asmus Measure of Motivation: Magnitude of Motivation Measure (AMM: MM; Asmus, 1989), which measures the factors of ability self-concept, personal commitment, music class compared to other activities, and the value of school music. This test has yielded a high reliability of $\alpha = .93$ (Asmus, 1989).

Self-concept has been cited as a key motivational factor in academic achievement (Marsh, 2007; Marsh et al., 2005). Personal commitment, or an intense passion for a group or task, has historically been found to play a significant role in the motivation of creative people. In studies of eminent scientists, composers, and artists, this personal commitment factor has been discerned (Amabile, 1996; Roe, 1952; Simonton, 1984). Lastly, Hall and MacKinnon (1969) found that certain values, such as interests, motives, and commitments, are strongly correlated to creativity by enhancing motivation. Jay and Perkins (1997) supported this relationship by asserting that creativity results when a person is trying to produce things that satisfy the values he/she embraces. These studies justify the factors of motivation included in the AMM: MM to be used in the study.

**Affect**

Most research regarding affect and creativity has revealed that positive affect promotes higher levels of creativity, while negative affect generally has a negative influence. In addition, positive affect facilitates not only intrinsic motivation (Isen & Reeve, 2005), but also problem solving on complex and difficult tasks (Isen, 2000). However, some researchers argue that the relationship between positive mood and creativity is complicated (Kaufman, 2003), and studies have shown that positive affect may promote productivity but not quality of ideas (Vosburg, 1998) and divergent
thinking (Clapham, 2001). In fact, a study by George and Zhou (2002) found that under certain conditions, negative affect actually led to higher creativity than positive affect, further supporting the notion that social psychological factors and contexts are intertwined. For example, employees that are unsatisfied with the work environment were found to be more likely to produce novel ideas in order to change their situation. Conversely, employees who were satisfied with the work environment were less likely to be creative, as change would be undesirable.

Despite these discrepancies, affect has been shown to have significant influence on musical performance achievement, and creative musical outcomes. Ciabattari (2006) found that students preferred different affective states in the different performance contexts of individual practice, ensemble rehearsal, and ensemble performance. Papageorgi, Hallam, and Welch (2007) described the significance of excessive anxiety on the motivation of musicians. This relationship suggests the possibility of motivation as a mediator between affect and creative outcomes. This mediating relationship has also been shown in studies regarding creative products in organizational and social psychology (Isen & Reeve, 2005; Erez & Isen, 2002; Byron, Khazanchi, & Nazarian, 2010; Watson, 1994). However, Asmus (1996) argues that a converse relationship exists, suggesting that affect mediates motivation through attributional sequences.

The use of the Positive and Negative Affect Schedule (PANAS: Watson & Clark, 1999; Watson, Clark, & Tellegen, 1988) will be an appropriate tool for measuring the variables of positive and negative affect (Denison, 2015). These variables will serve as
indicators for the latent construct of affect. The scales have shown high reliabilities, ranging from .86 to .90 for PA and from .84 to .87 for NA (Watson, Clark, & Tellegen, 1988).

**Classroom Environment**

Elliott and Silverman (2015) argue that composition is never done alone, but through a socially constructivist manner, involving peers, teachers, etc. Therefore, both the learning environments and the music compositions themselves are contextually bound and intertwined. Furthermore, Webster (2002) recognized that any creative process resides within a specific context made up of sociocultural “enabling conditions,” including environment, task, and peer influence. As such, these conditions are depicted as having some causal effect on creative outcomes (Stefanic, 2014). The social environment can significantly influence creative performance (Hennessey & Amabile, 2010). Although research has begun to focus on both the process and products of creative tasks in classroom contexts (Barrett, 1998; Folkstead, 1998; Webster, 1994, 2002), investigating the environmental factors that affect creativity is lacking in music education (MacDonald & Miell, 2000).

Though limited, some research exists in regards to social environmental variables influencing the creativity of compositional products. Miell and MacDonald (2000) investigated the impact of certain social variables have upon 10-11 year old children’s musical creativity. Results of the study indicated the musical and verbal communication styles of the friendship pairs differed qualitatively from those of the non-friends. The friends spoke and played more music in total and also had different patterns of
interaction, indicating that they were building on each other’s ideas. These differences in communication were reflected in the product scores, in which compositions by friend-pairs generally revealed higher levels of creativity.

MacDonald, O’Donnell, and Davies (1999) investigated the importance of social variables such as collaboration and communication, social environment of the classroom, and motivation with 15 special needs adults in Gamelan workshops. Results indicated that the opportunity for collaboration and communication was perhaps the most important, with stark differences between the two groups.

Some prior studies have also qualitatively examined the processes of music compositions in different instructional mediums that utilized computer-music technologies. Jennings (2005) utilized a case study approach with a child who composed music using sequencing software in a face-to-face context in order to identify effective teaching strategies. Reynolds (2005) also conducted a qualitative study examining the compositional process of children in face-to-face context. Gall and Breeze (2005) investigated the processes of computer-based music composition in four primary schools, five secondary schools, and one tertiary college. The students worked in pairs using three different types of music sequencing software. The findings revealed relationships between the types of software used, student collaboration and teacher interaction, and the students’ perceptions of the software.

The previously described studies were conducted in traditional face-to-face environments. However, Seddon (2007) used a qualitative approach in which a secondary school in the U.K. was linked with a secondary school in Norway to enable computer-mediated group compositions without teacher mentoring in an online learning
environment. The study sought to examine the compositional process while also seeking participant perspective through interviews. Notably, the students reported that they preferred to work without a teacher present.

The findings from these studies are insightful, however they reveal glaring gaps in the field regarding the creativity of music composition in different computer-mediated classroom environments. Perhaps most noticeably, all of the aforementioned studies focus on the creative process rather than the product. Both of the studies regarding social variables suggest that factors such as peer affiliation and involvement play an important role in musical creativity, supporting the need for further research in this area. In addition, the qualitative findings suggest more investigation is needed in regard to teacher interaction, as well as general classroom environmental factors in relation to musical creative products.

For the current study, the latent variable of classroom environment will be indicated by the measured variables of student involvement, teacher involvement, affiliation, task orientation, competition, order and organization, rule clarity, teacher control, and innovation found within the Classroom Environment Scale (CES) Form S (Moos and Trickett, 1974). Several studies have found significant relationships between the various dimensions of the classroom environment and student achievement when using the CES (Lind, 1999; Moos, 1980; Hamann, Mills, Bell, Daugherty, & Koozer, 1990; Trickett & Moos, 1995). Additionally, because the model is focused on person-level social psychological variables and their interactions with the classroom environments as predictive of creativity, the CES scale provides an appropriate tool for examining students’ individual perceptions of these environments.
Need for the Study

While previous research has suggested each of the included model factors in individual studies with creative processes and outcomes, no study to date has examined the combined influence of these factors on creative outcomes as defined by the Consensual Assessment Technique. Furthermore, no studies currently exist that examine the contextual or person-level factors influencing compositional creativity of computer-mediated contexts specifically. Considering the increased prevalence of hybrid and computer-mediated learning contexts, as well as more emphasis on student-centered and differentiated learning, this is an important consideration in music education that warrants attention. Lastly, the absence of an understanding of the connection between classroom environment and social psychological factors as related to creative products reveals a gap in our understanding of creativity in music education. A potentially well-fitting SEM model could provide a practical and insightful way of describing these relationships for teachers and practitioners alike, while also providing a new theoretical perspective of musical creativity with consideration of contexts.

Purpose and Research Questions

Feldman, Csikszentmihalyi, and Gardner (1994) view creativity as a developmental strategy in which learners rely on personal resources and knowledge to interpret or create meaning. Creativity is seen as located within all learners, rather than an individual trait. Investigations into the role of learning context as well as social psychological factors may provide rich information as to how and why students may be creative, and lead to more insight as to how practitioners may provide more optimized
and differentiated opportunities for creativity tasks. The purpose of this study is to examine the influence of affect, motivation, and classroom environment on the creativity of secondary students’ computer-based music compositions.

Specifically, this study seeks to answer the following research questions:

1. What relationships exist within the latent factors of affect, motivation, classroom environment, and creativity?
2. How well do the observed variables represent the latent factors of affect, motivation, classroom environment, and creativity?
3. What is the predictive influence of the variables and latent factors of affect, motivation, and classroom environment on creativity?

As an initial point of entry for investigating a possible theoretical structure for creative products, a structural path model of the latent factors was created from this study’s research questions (Figure 1.2):

![Diagram](image-url)

*Figure 1.2. Theoretical latent path model of classroom environment and social-psychological predictors of musical composition creativity.*
**Operational Definitions**

Throughout this study, the term “creativity” will refer to the quality (or creativeness) of a creative product. In this sense, “creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers” (Amabile, 1983, p. 31). Additionally, for the sake of this study, the term “computer-mediated” refers to classroom and learning environments in which students utilize technology, specifically laptops and/or desktops, as “the major medium by which music concepts and skills are introduced, reinforced, assessed” (Dorfman, 2013, p. 13).

The latent construct of Affect will be indicated by the measured variables of positive and negative affect (Watson & Clark, 1999; Watson, Clark, and Tellegen, 1988). Motivation will include the measured variables of ability self-concept, personal commitment, value of school music, and music class compared to other activities (Asmus, 1989). The latent variable of Classroom Environment will include the measured variables of student involvement, teacher involvement, affiliation, task orientation, competition, order and organization, rule clarity, teacher control, and innovation (Moos & Trickett, 1974; Fraser, 1982; Fraser & Fisher, 1986). Lastly, Creativity will be defined as the quality of creativeness of the digital compositions, and be indicated by the measured dimensions of originality, craftsmanship, and aesthetic value (Amabile, 1982, 1983; Hennessey & Amabile, 1988; Brinkman, 1994). These definitions are visualized in the initial measurement model (Figure 1.3).
While external environmental influences such as home and family environment, and social interactions outside of the school have been suggested as having an impact on music teaching and learning (Zdzinski, 2011, 2005), and therefore perhaps influencing creativity, examination of these factors is beyond the scope of this study. Additionally, the inclusion of person-level factors as related to creativity, such as personality (Amabile, 1983, 1996; Swanner, 1985; McCrae & Costa, 1997; Batey & Furnham, 2006) and creative style, or preferences for addressing creative tasks (Brinkman, 1994; Kirton, 1976, 1978; Wakefield, 1992; Isaken & Puccio, 1988; Isaken, Puccio, & Treffinger, 1988).
1993) were originally considered due to having strong theoretical connections throughout creativity literature. However, because of practicality concerns, including fatigue on the participants and teacher-facilitators, as well as general time constraints and limited resources, these latent factors were dropped from the current study. Their inclusion into an expanded version of this model would prove informative in later research. Lastly, it should be acknowledged that much of the existing research regarding creativity is focused on the creative process. However, because this study specifically seeks to understand the interactions of the Person and Place to predict the musical Product, Process is therefore excluded from the study.

The study will be delimited to high school students who are enrolled in non-traditional computer-mediated music courses, and who have had at least one semester of coursework utilizing GarageBand. The creative task will involve creating digital music compositions, and as such will attempt to eliminate issues of technical prowess and creative music-making platform familiarity.

Finally, although the original rationale of the study involves the specific classroom environment of computer-mediated classrooms, the use of the theoretical model in a variety of classroom contexts involving creative products may provide further insight into these relationships.
CHAPTER TWO
LITERATURE REVIEW

The recent movements to incorporate a growing variety of personal and environmental factors into creativity assessment have pushed for expanding perspectives. A multicomponential perspective situates creativity in the individual as the result of a complex interaction between the person and the environment, ultimately resulting in a creative product (Csikszentmihalyi, 1988; Mumford & Gustafson, 1988). While multicomponential accounts allow for greater breadth and depth in creativity research (Batey & Furnham, 2006), they can be difficult to navigate and truly understand. Therefore, it might be helpful to understand the major theories and models that led to the conceptual thoughts behind the design and rationale of this study.

Componential Model of Creativity

Amabile (1983) noted that despite the apparent importance of social and environmental influences on creativity, at the time, there was virtually no research on these factors within the social psychology of creativity. In fact, she found that out of nearly 7,000 citations included in Rothenberg and Greenberg’s (1976) bibliography of studies of creativity from 1566-1974, only 138 were concerned with social or environmental influences. Further, in many of those citations, the “social variable” was referred to as “social class” (p. 358). She suggests that this problem is due to the dominance of trait approaches to identify personality differences in creative people throughout social psychological research. However, Amabile (1983) asserts that the trait approach is incomplete. She argues that creativity is best conceptualized not as trait or ability, but rather as a behavior resulting from interactions of personal characteristics,
cognitive abilities, and social environments. This behavior results in creative products. However, the interactions “can only be completely explained by a model that encompasses all three sets of factors” (p. 358). From this, Amabile (1983, 1996, 2012) developed the “Componential Model of Creativity” (figure 2.1).

Figure 2.1. Amabile’s (1983, 1996, 2012) Componential Model of Creativity. Broken lines indicated the influence of particular factors on others. Wavy lines indicate the steps in the process. Only direct and primary influences are depicted (Amabile, 1996, p. 113).

While other theories of creativity exist, the componential model is distinct in many ways (Amabile, 2012). First, it is relatively comprehensive in scope, involving skills and motivation within the individual and social environment. Second, it specifies the theoretical impact of the components at each stage of the creative process. Third, it
emphasizes the social environment and its impact on the individual within a creative process. Although the componental theory has expanded to include the process of organizational innovation, this easily translates to educational settings.

**Model of Creative Thinking in Music**

The subject of creativity has been an interest in many fields of research, including areas such as psychology, education, business, various sciences, the arts, and many others. Since Guilford’s (1950) address to the American Psychological Association noting the apparent neglect of creativity as a research topic, it has been explored from an ever-expanding variety of perspectives.

Creativity is a domain that crosses so many disciplinary boundaries, and therefore has an extremely broad literature base; a widely applicable theory of creativity does not exist. Various researchers have focused on the influence of factors such as psychological, social, cognitive skills, domain knowledge, context and environment, and creativity skills (and others) on creativity. To account for the many possible variables influencing creativity, Woodman and Schoenfeldt (1989) proposed an “interactionist theory,” which argues that multiple factors should be considered simultaneously. Some of the more widely known theoretical models of creativity fall within this theory. For example, Guilford’s (1967) “Intellectual Problem Solving Model” accounts for memory, problem solving, and evaluation of creativity. Amabile (1983, 1990) describes the interactions between domain-relevant skills, creativity skills, and motivation in creativity.

Webster’s (1987, 1990) “Model of Creative Thinking in Music”, one of the most influential models involving musical creativity, is a holistic attempt to account for a wide range of influences on creative musical thinking. The model begins with a “product
intention,” such as a composition or performance, and ends with a creative product as the outcome. In addition to convergent and divergent thinking (Guilford, 1967) and the processes of preparation, incubation, illumination, and verification (Wallas, 1926), Webster suggests the consideration of certain “enabling skills” and “enabling conditions” as well. These skills include musical aptitude and creative aptitude, while the conditions are motivation, subconscious imagery, the environment, and personality. Additionally, craftsmanship and aesthetic sensitivity are abilities considered as part of the convergent thinking process in the development of a final product. As evidenced by the interaction of different components within the enabling skills and conditions, Webster’s model (Figure 2.2) suggests a multi-componential framework for evaluating creativity.

![Diagram of Webster's Model of Creative Thinking in Music](image)

*Figure 2.2. Webster’s (1987, 1990) Model of Creative Thinking in Music.*
Social-Psychological Model of Musical Ability

Schmidt (2011) asserts that throughout history, research regarding musical ability has been inextricably linked to the broader field of psychology. Literature suggests parallels between the two domains as evident in research in both areas on factors such as personality and intelligence. However, Schmidt contends that the division between research in musical ability and social psychology has been inhibitive and that a reunification is called for. While there has generally been support for the incorporation of personality factors within musical ability research, the inclusion and consideration of motivation, cognitive style, and affective variables have been lacking. Additionally, he notes that the existing research seems disconnected, despite obvious connections, and therefore an integration of social-psychological constructs within theories of musical abilities is needed. Based on this necessity, and extensive reviews of literature, Schmidt developed the “Social-Psychological Model of Musical Ability” (2011), displayed in figure 2.3.

The proposed model assumes that in musical situations such as making discriminations, performing, or solving problems, the lines between musical ability and social-psychological constructs become blurred (p. 9). In the model, the processes identified with musical ability are at organized in boxes across the top, while processes identified with social psychology are organized in boxes across the bottom. Connecting lines between the research area boxes identify the possible theoretical interactions.

Schmidt (2011) articulates that this is a working model, and full exploration of the ideas has yet to be accomplished, the attempt to move toward a more unified framework for research in the social psychology of music and musical ability has been influential.
The theoretical interactions from the three previously explained models easily translate and have provided a source for organization of thought and rationale throughout this process.

![Diagram showing the relationships between different processes and musical ability.]

Figure 2.3. Schmidt’s (2011) Social-Psychological Model of Musical Ability

“**The P’s of Creativity**”

In a useful attempt to organize the unwieldy base of literature resulting from the various perspectives, several writers (Rhodes, 1961; Kratus, 1988; Balkin, 1990; Brinkman, 1994; Runco, 2004, 2007; Stefanic, 2014) classified the study of creativity into the umbrella topics of person, process, and product. A fourth “P” (“press” or “place”) refers to the creative environment (Isaksen, Puccio, and Treffinger, 1993). While this study will only focus on person, place, and product, this outline utilizing “the four P’s” will be used to organize the review of relevant literature for the remainder of this chapter.
The Creative Person

“Person” research focuses on the inherent, innate, and internal characteristics or traits of an individual (e.g., personality, motivation, intelligence, mood, cognitive style, etc.). The general goal of these investigations is to define the qualities within a person that can enhance or detract from creativity. The implications of music education research regarding the individual person and creativity can provide insight into which characteristics are compatible with certain creative musical experiences and contexts. As the person approaches a creative musical experience with complex individual characteristics, an understanding of these interactions is especially important.

Affect. Most research regarding affect and creativity has revealed that positive affect promotes higher levels of creativity, while negative affect generally has a negative influence. In addition, positive affect has been shown to significantly influence intrinsic motivation (Isen & Reeve, 2005; Isen, 2000). However, some researchers argue that the relationship between positive mood and creativity is complicated (Kaufman, 2003), and studies have shown that positive affect may promote productivity but not quality of ideas (Vosburg, 1998) and divergent thinking (Clapham, 2001). This is supported by Amabile (1996) who found that “the effects of mood on creativity remain unclear” (p. 239).

The meta-analytic study of affect’s relation to creativity within organizational settings by George and Zhou (2002) found that under certain conditions, negative affect actually led to higher creativity than positive affect. The logic behind this assumption is that creative performance often requires hard work, initiative, effort, and persistence. However, positive affect, which signals that an individual is possibly happy and/or content, was found to sometimes inhibit the initiative needed to find new ways of doing
things (Hirt et al., 1996). Conversely, when the work context emphasizes and rewards creative performance, negative affect may influence individuals to develop new ideas in an attempt to change their situation (Martin & Stoner, 1996). The results of the meta-analysis suggest that the relationship between negative and positive affect on creative output depends upon the context, and whether or not that context encourages and rewards creativity. These findings further supporting the notion that social psychological factors and contexts are intertwined.

Despite these discrepancies, affect has been shown to have significant influence on music performance, and thus creative musical outcomes. Ciabattari’s (2006) study found that students preferred different affective states in the different performance contexts of individual practice, ensemble rehearsal, and ensemble performance. A certain level of negative affect (such as anxiety) can enhance performance experiences and outcomes, but high levels of negative affect can be detrimental. This was found to be congruent with much of the research involving performance anxiety and performance outcomes. Papageorgi, Hallam, and Welch (2007) described the significance of excessive anxiety on the motivation of musicians, which presents an “inverted ‘U’” of the beneficial to detrimental continuum of anxiety. This relationship suggests the possibility of motivation as a mediator between affect and creative outcomes. This mediating relationship has also been shown in meta-analytic studies regarding creative products in organizational and social psychology (Isen & Reeve, 2006; Erez & Isen, 2002; Byron, Khazanchi, & Nazarian, 2010; Watson, 1994). However, Asmus (1996) argues that a converse relationship exists, suggesting that affect mediates motivation through
attributional sequences. Weiner (1986) asserts that affect influences and is influenced by motivation. These arguments suggest that special attention should be paid during analysis of the current study.

**Motivation.** Intrinsic motivation has been found to be largely conducive to creativity while extrinsic motivation is generally inhibitive (Amabile, 1996; Hennessey, 2003; Hennessey & Amabile, 1993, 2010). Shin and Zhou (2003) studied the relationship between intrinsic motivation and the creativity of responses to transformational leadership questions at different companies in Korea. The study found that intrinsic motivation was highly significant and positively influenced creativity. Jesus, Rus, Lens, and Imaginario (2013), in a meta-analysis, revealed a significantly positive relationship between intrinsic motivation and creativity related to products. In his 1992 study, Bangs found that motivation also significantly influences the creativity of music compositional products. Furthermore, researchers have found that intrinsic motivation can be fleeting and susceptible to social-environmental influences, suggesting the need for examining this construct within the model (Deci, 1995; Hennessey & Amabile, 1993). Hurley (1993) supports the use of the motivation construct as being both a moderator and predictor, stating, “motivation is considered both a catalyst for learning and an outcome of learning” (p. 17).

The significance of motivation on music achievement has been shown in a variety of studies (Asmus, 1996; Austin & Vispoel, 1994; Hallam, 2002; Miksza, 2006; Schmidt, 2005). Based on Attribution theory, Asmus (1986, 1989) discovered the motivational factors students attribute to their music achievement. From this, he developed the Asmus Measure of Motivation: Magnitude of Motivation Measure (AMM: MM; Asmus, 1989),
which measures the factors of Ability Self-Concept, Personal Commitment, Music Class Compared to Other Activities, and the Value of School Music.

Self-Concept has been cited as a key motivational factor in academic achievement (Marsh, 2007; Marsh et al., 2005). For example, McPherson and McCormick (2000) studied the influence of motivational factors on musical performance outcomes of 349 instrumental students. Using a self-report questionnaire of self-regulatory and motivation items, the study found that self-concept was particularly significant in predicting performance achievement. Personal commitment, or an intense passion to a group or task, has historically been found to play a significant role in the motivation of creative people. In extensive studies of eminent scientists, composers, and artists, this personal commitment factor has been discovered (Amabile, 1996; Roe, 1952; Simonton, 1984). Lastly, Hall and MacKinnon (1969) conducted multiple step-wise correlation analyses on seven personality inventories against the creativity of 62 architects. They found that certain values, such as interests, motives, and commitments are strongly correlated with creativity by enhancing motivation. Jay and Perkins (1997) supported this relationship by asserting that creativity results when a person is trying to produce things that satisfy the values he/she embraces. These studies justify the factors of motivation included in the AMM: MM to be used in the current study.

The Creative Place

The creative product, person, and process are well-known factors that impact creativity, but the context of learning may also have an influence through environmental factors (Woodman and Schoenfeldt, 1989). In describing psychological research on creativity, Woodman and Schoenfeldt (1989) state that there has been a heavy
"concentration on creative persons, but generally little appreciation for ‘creative situations’ or circumstances that might be conducive to creative behavior" (p. 79). Social, cultural, and organizational situations along with physical environments of classrooms can play a major role in the creativity of musical products.

**Model of the Social Environment of Instruction in Music Education.** Similar realizations of literature gaps involving learning environment have occurred in the research domain of music education. During their 1993 examination of influential studies in music education research, Schmidt and Zdzinski also found that the “Environment of Instruction” was one of the most neglected areas in the literature. The environment of instruction refers to non-instructional influences that may impact instructional outcomes. While potential external environmental influences include family and home environment, school environment, and the social environment outside of school, Zdzinski (2005) argues that social factors within the learning environment are worth addressing also. These factors are what Zdzinski (2011) examined and from thus developed the “Model of the Social Environment of Instruction for Music Education (Figure 2.4). In the model he considers the influences of home and family, peers, media, and social influences within the school and community. The model displays the theoretical connections between these influences and also considers individual differences (gender, age, ethnicity, socioeconomic status, community type, and mobility) that may interact with the social factors.

The present study seeks to understand social psychological and environmental influences on creative musical products, and this model exemplifies the theoretical relationships possible within music learning contexts.
Figure 2.4. Zdzinski’s (2011) Model of the Social Environment of Instruction for Music

Classroom Environment. The classroom environment has recently been considered as a predictor of students’ academic achievement and school satisfaction within general education (Pickett & Fraser, 2010; Moos, 1980; Trickett & Moos, 1995). Evertson, Emmer, and Worsham (2006) found that a positive classroom environment will encourage students to be more excited about their learning experiences. Fraser and Tobin (1991) found that classroom environment can strongly influence affect, behaviors, and learning outcomes, and that if teachers positively impact classroom environments; they will therefore positively impact students’ academic achievement (Evans et al., 2009).
Studies examining pre-service teachers’ impact on the classroom environment has shown that in some cases, high authority issues have led to low academic achievement (LaRocque, 2008). This has also been found at the university level. University field supervisors and mentor teachers have reported that pre-service teachers that have been unsuccessful in their field experiences have been unable to create a classroom environment conducive to academic, emotional, and social learning (Moore, 2003). Additionally, studies have found that the climate in educational environments is largely dictated by the relationships between teachers and students, and among students themselves (Allodi, 2010; Zedan, 2010).

Researchers have also linked student participation in music ensembles to many of the dimensions within the Classroom Environment Scale, such as affiliation, teacher involvement, teacher control, and student involvement. Value of the music class, teacher involvement, and affiliation were found to be positive influences on participation in music at the secondary school level (Frakes, 1984). Additionally, students who reported a lack of these variables tended to drop out of ensembles (Koutz, 1987). Hamann et al. (1990) also found that contest ratings were highest in environments which students reported high teacher involvement, order and organization, student involvement, and affiliation. Lastly, Lind (1999) sought to investigate whether classroom environment was related to the enrollment of Hispanic students in choral music programs. An additional purpose was to determine if White students, Hispanic students, and Non-White Non-Hispanic students assessed classroom environment differently by ethnicity. Using the
CES, the researcher found ethnicity did not seem to have an effect on choir program enrollment. The study also did not find significant differences in assessment of classroom environment by gender.

These findings in both general education and traditional music ensemble classrooms easily transfer to non-traditional music education settings. The studies also support the validity of the use of the Classroom Environment Scale (Trickett & Moos, 1973; Moos and Trickett, 1975), and its subscales of student involvement, teacher involvement, affiliation, task orientation, competition, order and organization, rule clarity, teacher control, and innovation as indicators for the classroom environment latent proposed in the study.

MacDonald and Miell (2000) investigated the impact certain social variables within the learning environment had upon children’s musical creativity. In the study, the participants attended experimental workshops in order to complete a compositional task. The children were asked to compose a piece of music entirely of their own, using different classroom instruments, in a style of their choosing, to reflect the theme of “the rain forest.” The students were then to practice their ideas and perform them for the others in the workshops. Half of the children were allowed to work with a friend while the other half worked with a child they knew from another class, but who was not a friend. Using a qualitative approach, the researchers videotaped and recorded the sessions in order to analyze the collaborative creative processes. A teacher from another school evaluated the compositional products using a rating scale developed by Hargreaves, Galton and Robinson (1996). Results of the study indicated the musical and verbal communication styles of the friendship pairs differed qualitatively from those of the non-
friends. The friends spoke and played more music in total and also had different patterns of interaction, indicating that they were building on each other’s ideas. These differences in communication were also reflected in the product scores, in which compositions by friend-pairs generally revealed higher ratings. The researchers argued that since so much of creative music making with students takes place in a social context, more research attention should be paid to the effects of contexts on the creative process and outcomes.

MacDonald, O’Donnell, and Davies (1999) investigated the importance of social variables such as collaboration and communication, social environment of the classroom, and motivation with 15 special needs adults in Gamelan workshops. Participants not involved in the Gamelan workshop were involved in other non-group activities such as cooking workshops. Qualitative analyses such as videotaping, interviewing, and recording, as well as content-based pre- and post-tests were used to analyze the impact of these variables. Results indicated that the opportunities for collaboration and communication were perhaps the most important, with stark differences between the two groups. Participants in the workshop were found to be highly motivated and demonstrated improvements in social and communication skills, while non-group participants did not show any improvements.

Computers and Technology. The addition of computers and technology as an important consideration of social interactions in learning environments has been largely supported (Zdzinski, 2011). Some prior studies have qualitatively examined the processes of music compositions in different instructional mediums that utilized computer-music technologies. Jennings (2005) utilized a case study approach with a child who composed music using sequencing software in a face-to-face context in order to identify effective
teaching strategies. The study involved video recordings of the child as well as data from the music technology provided rich data during the compositional process. However, teacher intervention in the learning process was found to be at the teacher’s discretion rather than at the request of the student, indicating an instructor-led approach. This issue was suggested as problematic in regards to developing teaching strategies that are conducive to learning outcomes.

Reynolds (2005) also conducted a qualitative study examining the compositional process of children in face-to-face context. The goal of this study was to reveal the way in which the children navigated the computer context during a compositional process. Using video and audio recordings, as well as pupil interviews, the process revealed the actions and decisions of seven children’s compositional processes. However, because the composition process data were intermittently rather than continuously saved, the study failed to provide complete compositional processes. Despite this issue, implications for further research regarding the dynamic of computer contexts in music were discussed in the study.

Gall and Breeze (2005) investigated the processes of computer-based music composition in four primary schools, five secondary schools, and one tertiary college. The students worked in pairs using three different types of music sequencing software. Qualitative data was collected through the use of video recordings of both the classroom and computer screen, and were supplemented with interviews. The findings revealed relationships between the types of software used, student collaboration, and teacher interaction, and the students’ perceptions of the software.
The previously described studies were conducted in traditional face-to-face environments. However, Seddon (2007) investigated the feasibility of a collaborative computer-based music composition created in an e-learning environment. During the study, a secondary school in the U.K. was linked with a secondary school in Norway to enable computer-mediated group compositions without teacher mentoring in an online learning environment. The study sought to examine the compositional process while also seeking participant perspective through interviews. Notably, the students reported that they preferred to work without a teacher present, which suggests that online environments may present very different results on the CES. This also suggests that the computer element of the learning context may play a mediating role within future studies of classroom environment.

These studies reveal gaps in the field regarding the creativeness of music composition in different computer-mediated classroom environments, and also in the evaluation of the classroom environment in relation to computer-mediated environments. Both of the studies regarding social variables suggest that social factors such as collaboration and communication play an important role in musical creativity, supporting the need for further research in this area.

The Creative Product

It is logical to assume that if a person engages in a creative endeavor, a creative product will result. However, the assessment of a creative product is problematic due to the disagreement on not only the definition of creativity, but also on what factors and/or qualities should be considered when assessing creative products (Brinkman, 1994). This section therefore describes the commonly used psychometric measures used to evaluate
creative products, the existing criticisms of their use, and an alternative that is more suitable for the current study.

**“Traditional” Measures.** Much of the interest in musical creativity in the latter half of the twentieth century is often credited to J. P. Guilford’s (1950) presidential address to the American Psychological Association, in which he urged psychologists to aim for more systematic research efforts on the topic of creative thinking. Guilford’s own research in creativity has immensely influenced conceptual foundations in musical creativity.

Guilford (1967) developed his “Structure of Intellect” model in which he hypothesized 120 primary mental abilities that reflect a person’s performance on intelligence tests. From these abilities, he defined creative thinking as the operation of 24 divergent production abilities, from which four primary concepts have been extensively used in measures of creative thinking: fluency (number of ideas produced), flexibility (the ability to shift between thoughts or ideas), originality (novelty of ideas), and elaboration (details of each idea). The use of these four concepts has permeated a great deal of the literature, tests, and models of both general and musical creativity centered on divergent thinking (Hickey, 1995). One of Guilford’s most influential contemporaries was E. Paul Torrance, who developed the *Torrance Tests of Creative Thinking* (1966, 1974). This test continues to be a popular standardized measure of creative thinking that utilizes Guilford’s (1967) four concepts. In music, Vaughan (1971), Webster (1977, 1994), and Gorder (1980) developed psychometric measures to investigate the creativity of musical products. These measures used improvised musical responses to stimuli that
were then scored for fluency, flexibility, originality, and elaboration. Many of these tests are still widely used today.

_The Vaughan Test of Musical Creativity_ (1971) was developed as a measure of musical creativity based on foundations in the psychology of creativity. The instrument utilized components of the _Torrance Tests of Creative Thinking_ (Torrance, 1966) and the Bentley (1966) _Measures of Musical Abilities_ as criterion measures. The test contained five rhythmic and melodic completion tasks, which were then rated for fluency, rhythmic security, ideation, and synthesis.

Gorder’s _Measure of Musical Divergent Production_ (1980) was modeled after the _Torrance Tests of Creative Thinking_ (1966) as well in order to assess musical fluency, flexibility, elaboration, originality, and musical quality through improvisational activities. Four subtests required participants to respond to a musical stimulus in which they could sing, whistle, or use a familiar instrument with which to improvise. Content validity was obtained through interviews with professional musicians while construct validity was obtained through factor analysis with the _Seashore Measures of Musical Talents_ (Seashore, 1915), the _Drake Musical Aptitude Tests_ (1957), the _Music Achievement Tests II_ (Colwell, 1968-1969), and the _Torrance Tests of Creative Thinking_ (1966).

The purposes of Webster’s (1977) _Measure of Creative Thinking in Music_ (MCTM) were to (a) establish a valid and reliable measure for the assessment of creative thinking in music, and (b) to investigate the relationships between creative thinking ability and measures of musical ability, general creative ability, and general intelligence. The tests intended to assess the creativity musical products of composition, improvisation/performance, and analysis. Scores from Colwell’s _Music Achievement_
Tests (1968-1969), the Torrance Tests of Creative Thinking (Torrance, 1974), the Music Aptitude Profile (Gordon, 1965), and selected standardized academic achievement tests were used in the development of Webster’s tests. Additionally, relationships between the measure and personal variables such as grade level, age, gender, performance medium, and years of piano study were also investigated. Tasks involved participants “filling in the blanks” or responding to stimuli through improvising, performing, composing, or analyzing. Lastly, each task was scored for fluency, flexibility, originality, and elaboration.

Webster’s (1994) Measure of Creative Thinking in Music (MCTM-II), one of the most widely utilized tests in musical creativity, uses game-like activities to illicit musical responses. The MCTM-II asks participants to use a sponge ball on a piano, temple blocks, and a microphone to create musical responses, which are then recorded and scored for musical extensiveness, musical flexibility, musical originality, and musical syntax. The measure was originally established in 1983 and has since undergone various validity and reliability, correlational, and factor analytical studies (Baltzer, 1990, 1989; Webster, 1987, 1990b; Swanner, 1985; Schmidt & Sinor, 1986;), ultimately transforming it into the measurement we currently have today. Not only is the MCTM-II the most rigorously tested tool for assessing creative potential in music to date, it also provides the most generative activities for participant responds (Hickey, 1995).

Criticisms. Well-known and widely used models for assessing creative products, such as those by Guilford (1950, 1970) and Torrance (1966, 1988), paved the way for research in this area by developing factors of divergent thinking upon which to rate creativity. Their works have had a powerful influence on the variables often used to
evaluate creative people and products. Yet the use of divergent thinking tests to evaluate creative outcomes has been criticized (Csikszentmihalyi, 1988, 1999; Elliott & Silverman, 2014; Stefanic, 2014; Webster, 2002). Hickey (2001) suggests that one of the greatest criticisms is that the theoretical constructs were validated through tests such as factor analyses, but never against external measures of creative productivity.

Brown (1989) argues that the creativity tests had only apparent construct validity and not criterion validity. Additionally, the paper-and-pencil tests do not capture the complexities of real-life creative tasks (p. 8). While Guilford, Torrance, and others have described creative abilities through tests of divergent thinking, Amabile (1982, 1983) argued that assessing the creative quality of products would better reflect creative ability. She claimed that, “despite these two rather well-established approaches to the assessment of creativity, it can be argued that the criterion problem still presents a major obstacle to successful and rigorous empirical work” (1982, p. 998). In addition, she suggested that the subjective assessment of creative products by experts in the domain in which the product was created offers a more valid approach to measuring creative output.

Furthermore, Hickey and Webster (1995) found that interjudge reliability of creativity scores based on implicit and global definitions was more reliable than rating scales with explicitly defined criteria.

Amabile’s (1982, 1983) manner of assessment can be considered as a conceptual reversal of the techniques used in “traditional” creativity tests. The traditional measures score tasks and subtasks to produce a global assessment on one’s creativity, an assessment, Amabile argues, “that is ultimately based on the subjective judgment of the psychometricians who devised the subtasks or the raters who score them” (1983, p. 59).
The “traditional” approaches effectively make the author of a measurement the dictator of what defines creativity, regardless of social and/or contextual appropriateness. Amabile’s (1982) approach begins with the global, explicitly subjective assessment of a creative product, evaluated by socially and contextually appropriate judges. Because of the considerable flexibility in response, participants can actually create real-world products. Amabile claims that, “not only does the task itself mimic real-world performance, but the assessment technique mimics real-world evaluations of creative work” (1983, p. 59).

Amabile’s Consensual Assessment Technique. In 1982, Amabile developed the Consensual Assessment Technique (CAT), which uses the subjective judgment of expert raters in the appropriate field to evaluate creativity. The CAT has several key components to provide validity of the approach. First, more than one rater is required to prevent issues of individual bias and to also assess inter-rater reliability. The inter-rater reliability of consensual assessment by experts is then suggested as the equivalent of construct validity. Additionally, the “experts” must be knowledgeable in the particular area being examined since the rating of creativity is subjective in nature (Baltzer, 1990). “If appropriate judges independently agree that a given product is highly creative, then it can and must be accepted as such” (Amabile, 1982, p. 1002). Accordingly, a product is then considered creative if the experts in the domain agree it is creative.

Therefore, the use of the CAT avoids the problems with objective and abstract creativity tests (Hickey, 1995), and is therefore optimal for addressing the social, contextual, and individual influences on creativity in which this study is focused. This section provides a synthesis and critique of literature utilizing Amabile’s Consensual
Assessment Technique to evaluate creative products in music and their implications for the current study as well as future research and application in music education.

As far as can be determined, the first study in music research to employ a measurement of the creativeness of a musical product based on the Consensual Assessment Technique was conducted by Baltzer (1990). This factor analysis study sought to examine several measures of musical creativity, including Webster’s (1983) Measure of Creative Thinking in Music- Version II (MCTM-II), Wang’s (1985) Measures of Creativity in Sound and Music (MCSM), and Baltzer’s (1990) own Song Completion Measure (SCM), and the relationship between musical aptitude, musical achievement, academic achievement, grade, age, and gender. As part of the SCM, Ninety (N =90) first, second, and third grade public school students were asked to create five songs, through singing, which the researcher could complete. Participants were then asked to complete 5 songs that the researcher developed. All songs were recorded and rated for both rhythmic and melodic appropriateness/originality by two expert judges, using a scale from 0 to 4. Guidelines for the subjective criteria used global definitions that were interpreted by the judges. Scores for all compositions were totaled to create a composite creativity score.

Results indicated that inter-judge reliability was high for the overall composite creativity scores ($r =.86$, $p <.01$), supporting the use of the CAT. However, while inter-judge consistency was high for the objectively scored activities, such as those in the MCTM-II and MCSM measurements, Baltzer concluded that the degree of inter-judge reliability for subjectively evaluated tasks depended on the range of possible scores, wording of instructions for raters, and/or the nature of the abilities being assessed.
Furthermore, factor analysis of the variables did not justify their identification as indicators of musical creativity, but rather than they described the specific abilities needed to complete the compositional tasks.

Auh (1997) also sought to determine the best predictors of compositional creativity among the selected variables of formal music experiences, informal music experiences, musical self-esteem, musical aptitude, musical achievement, academic grades, IQ, and gender. The study involved sixty-seven ($N=67$) fifth and sixth grade students at a public elementary school. The participants were given 10 minutes to create a song of three minutes or less on an Orff alto xylophone. Once the song was completed, the students were asked to repeat it as exactly as they had played it the first time. The participants completed the task individually in a quiet room where their activities were videotaped and audio recorded. Data for the other selected variables were collected through various questionnaires, inventories, and school-provided records.

To evaluate the creativeness of the compositional products, the CAT was employed. The compositions were rated by three judges on the five dimensions of craftsmanship, musical syntax, musical originality, musical sensitivity, and repetition of song. Based on support found in related literature, the researcher decided that these dimensions adequately represented the creativeness of a product, and thus the total score from all dimensions represented the creativity score for data analysis. The dimensions were rated on a 7-point scale in which the judges were prompted to rate “the degree to which” the compositions met the researcher-defined descriptions of the five dimensions.
Inter-judge reliability for the CAT was .75 and was found to be comparable to those in previous studies. Results indicated high correlations between craftsmanship and syntax \((r = .77)\), and between musical originality and sensitivity \((r = .80)\), and inter-correlations for the total dimensions ranged from .56 to .89. Significant correlations were found between informal music experiences and gender \((r = .29, p < .05)\) and between self-esteem and formal music experiences \((r = .49, p < .001)\). A high correlation was found between the tonal subsection of musical aptitude and the pitch subsection of musical achievement \((r = .41, p < .001)\). Academic grade was found to be significantly correlated to IQ scores \((r = .53, p < .001)\) and gender \((r = .37, p < .001)\). The total dimensions of creativity were significantly correlated to informal music experiences \((r = .33, p < .01)\), musical aptitude- tonal \((r = .30, p < .05)\), and academic grade \((r = .29, p < .05)\).

One major implication of this study is that the creativity of musical compositions may be influenced by sociocultural factors, suggesting further research in this area. Despite the moderately high reliability of the Consensual Assessment Technique, the study omitted any information regarding the qualifications or expertise of the raters, leaving readers to question validity. In addition, no information was provided regarding the manner in which the raters listened to the compositions, leading to further scrutiny surrounding the proper implementation of the CAT. Thus we are reminded of the importance of explicit and purposeful employment of the key procedures necessary for the successful use of the CAT.

Although the use of the Consensual Assessment Technique proved useful and reliable in Baltzer’s (1990) study, Bangs (1992) argued that the original social psychological basis of its use had been neglected. He asserted that it is crucial to
understand the social and environmental situations that can greatly impact musical creativity, and that creativity is “more than scores of fluency, flexibility, and originality” (p.86). The study therefore sought to adapt Amabile’s (1983) model of a social psychology of creativity to musical creativity. Secondary purposes of Bangs’s (1992) study were to design an assessment tool and to study task motivation and its effects on a creative product.

Thirty-seven third grade students participated in ten days of domain and creativity relevant music instruction such as basic musical concepts and technical skills for playing musical instruments. After the training, each participant created a recorded musical composition using any bell or percussion instruments they chose, with no time constraints. Next, the participants were randomly placed into the Intrinsic Motivational treatment, Extrinsic Motivational treatment, or the control group. Those in the treatment groups participated in sessions that related either intrinsic or extrinsic motivational ideas to music while the control group focused on the participants’ favorite things. After the sessions, the students again created a free composition that was recorded.

Using the researcher-designed Dimensions of Judgment assessment tool, which utilized the Consensual Assessment Technique, three expert judges evaluated the compositions using a 19-item 5-point Likert scale for quality of creativity and overall musical aspects. Reliability estimates for the first round of compositions were .76, and .82 for the second round, indicating that the assessments were reliable. One-way ANOVA analysis revealed a significant difference between mean scores among the three groups. The Intrinsic Motivational group scored significantly higher than the Extrinsic Motivational group ($p < .0001$) and the Control group ($p < .05$). Intrinsic motivation was
found to benefit musical creativity, while extrinsic motivation actually inhibited musical creativity, supporting the importance of task motivation in creative product evaluation. In addition, the use of the Consensual Assessment Technique, utilized through the Dimensions of Judgment assessment tool, proved to be adequately reliable.

In another consideration of social and environmental contexts, Brinkman (1994) sought to examine the effect of problem finding situations and personal creativity style on the creative product. Seventy-four (N=74) high school band students took the Kirton Adaption-Innovation Inventory (KAI), which categorizes creativity style as either adaptor or innovator. The 16 strongest scorers in each category were chosen to complete composition tasks using a synthesizer. Two tasks were given to all 32 participants chosen- an open problem, which was to compose a melody, and a closed problem, which was to compose a melody that uses mostly white keys on the keyboard, is in ¾ time, is energetic, and is approximately 12-20 measures long. The students had 15 minutes to complete each task, given in random order. Each melody was then recorded and the students completed the Student Information Form, which asked them to rate their own compositions and to identify their task preference from the two provided.

Three expert judges then rated all 64 melodies on a 7-point scale using a modified version of the Consensual Assessment Technique. The compositions were rated on the dimensions of originality, craftsmanship, and aesthetic value. Scores from all three dimensions were combined to produce a “creativity” score. Inter-judge reliabilities were: Originality, .84; Craftsmanship, .77; and Aesthetic Value, .76, for a combined .807, suggesting that the use of consensual assessment was a reliable route.
Brinkman’s (1999) study served as a follow-up to the previous study, and re-examined the data in order to investigate the effect of type of problem and creativity style on the musical compositions of high school musicians, with particular respect to creativity. The use of the *Consensual Assessment Technique* in this study appeared to be a viable way of measuring creativity, as was yielded in the high reliabilities and were consistent with previous research.

Some have also used the CAT to consider the influence of optimal conditions on the creativity of compositions. Byrne, MacDonald, and Carlton (2003) investigated the relationships between the concept of flow, or optimal experience, and the creativity of student compositions assessed through the use of the CAT. Forty-five ($N=45$) undergraduate students enrolled in an Applied Music I course at a university in Scotland participated in the study. The students were provided with three musical stimuli and asked to compose a piece of music based on their stimuli. Students worked in groups of two or three and met at least three times over a two-week period in order to complete and record the compositions.

Thirty-one of the students rated all 16 compositions using the *Consensual Assessment Technique*, based on a 7-point rating scale, and instructed to use their own definition of creativity to rate the degree to which each composition was creative. All student compositions were also rated using the CAT by two groups of specialists ($N=24$), comprised of music lecturer staff and postgraduate students. For comparison data, the specialists also assessed each composition on a standard set of criteria used by the music department. Mean scores generated by student responses to the Experience Sampling Form (ESF) identified mean levels of flow for each individual for all group meetings.
The results of the study produced important findings regarding the use of the Consensual Assessment Technique. First, reliability scores on the measurement scales produced acceptable coefficients of .89 for the creativity measures, .92 on the ESF measures, and .90 on the staff criteria measures. Second, a significant correlation was found between the staff criteria score and the music lecturer staff ratings for creativity ($r = .76, p < .01$), suggesting that the Consensual Assessment Technique is related to the criteria used at the university. Lastly, a significant correlation was found between scores on the ESF and the postgraduate student ratings for creativity ($r = .39, p < .01$). The findings support the use of the CAT as a robust and reliable method for assessing creative works and the researchers discuss the technique’s potential as an alternative to the more problematic criteria-based approaches. In addition, implications for the use of the flow model with the consensual technique in teaching and learning are addressed.

The purpose of the Priest (1997) study was to evaluate the effects of an instructional approach for beginning instrumentalists designed to foster their creative and critical thinking skills while functioning as listeners, performers, and composers. Fifty-five ($N = 55$) fifth grade students in public school band classes were randomly divided into an experimental group and two control groups. The control groups consisted of a clarinet-saxophone class and a trumpet-trombone class. The experimental group participated in a 10-week treatment consisting of instruction on music analysis, reading notation, playing-by-ear, composition and improvisation projects, and strategies for examining the effectiveness of various technical skills. In addition, all participants completed a posttest on playing a prepared piece, sight-reading, playing-by-ear, and improvising.
From the experimental group, five compositional products were analyzed using the *Consensual Assessment Technique*. Using a 5-point scale with .25-level increments, nine independent judges rated the compositions on the following items: Creativity, Elaboration or Extensiveness, Technical Goodness, Tone Quality, Tonal Center, Performance, Melodic Interest, Personal Preference, and Rhythmic Interest. Reliability was analyzed using Cronbach’s alpha, and coefficients ranged from -.26 on Technical Goodness to .95 on Creativity. High correlations were found between Creativity and the other dimensions. Results from the study indicated that when creating compositional tasks, in order to foster children’s abilities to produce creative products, appropriate balance between choice and constraint must be employed. The study supports the use of the CAT as evidenced by the high reliability of the more subjective domains. However, because of the high correlations between performance-oriented domains, such as tone quality, performance, etc. and creativity when used to evaluate improvisations, further research was warranted to investigate whether performance assessment affected creativity assessment.

Priest (2001a) further investigated his previous findings by attempting to determine how students who have been identified as belonging to high and low creativity groups, based on their composition and performance skills, function as listeners when assessing musical creativity and craftsmanship. Forty-four undergraduate students enrolled in a basic musicianship course for elementary education majors completed three composition-performance assignments using soprano recorders. The first assignment was to compose a piece between 20 seconds and 1 minute in length while demonstrating the ability to articulate, use proper breath control, and use at least three different pitches on
the recorder. The second assignment was to compose a melody using the rhythm of a poem and use at least five pitches on the recorder. The last assignment was to compose a melody in E minor in triple or compound-duple meter using at least five pitches on the recorder.

Prior to completing each composition assignment, all students participated in the researcher-designed Creativity and Craftsmanship Assessment (CCA), based on Amabile’s (1996) Consensual Assessment Technique. Three versions of the CCA were administered along with each composition assignment in order to familiarize the students with the CCA while providing models and examples of possible outcomes to aid in their completion of the assignments. During each CCA, the participants listened to five exemplary compositions completed by students previously enrolled in the course and were asked to rate the level of creativity and the level of craftsmanship for each composition. Participants were instruction to rate the selections on a continuous scale relative to one another rather than an absolute standard. In addition, instructions for the creativity item were described as “using your own definition of creativity, indicate the degree to which the composition is creative” (p. 67). The craftsmanship item was defined as “the degree to which the composition is technically good and well organized” (p. 67). Lastly, participants were asked to describe why they selected certain compositions as the most creative or demonstrating the highest level of craftsmanship.

After students completed and recorded each of their compositions, they also performed music literature from their method books. In the same manner in which they completed the CCA practice assessments, they also assessed their own compositions and performances for creativity and craftsmanship. Three independent elementary music
teacher judges completed the *Consensual Musical Creativity Assessment* (Priest, 1997), also based on Amabile’s *Consensual Assessment Technique*. Similar to the CCA, the music teachers rated the 44 compositions according to their creativity levels using a continuous scale, and relative to one another rather than an absolute standard.

Results of the Priest (2001a) revealed mild agreement between judges (.67) using Cronbach’s alpha, which was low in comparison to previous research in which consensual assessment was used to rate compositions. Students were then placed into high-, middle-, and low-creativity groups by scores. Pearson product-moment correlation yielded a .57 correlation coefficient between Judges 1 and 2, a .27 correlation coefficient between Judges 1 and 3, and a .38 correlation coefficient between Judges 2 and 3 with a mean interjudge correlation of .41. These results indicated that it was difficult for the independent judges to consistently assess creativity in composition while simultaneously assessing creativity in performance suggesting further research with the assessment of creativity and performance simultaneously. In addition, students’ qualitative responses to creativity ratings were coded by factors and analyzed. Chi-square analysis indicated that students whose creativity scores were high and middle tended to use more factors than their lower scoring classmates when describing creativity and craftsmanship, but no robust findings were found in this regard.

In order to investigate these behaviors, Priest (2001b) then sought to examine students’ assessments of musical creativity in relation to their ability to function creatively as composers. The author argued that although musical creative thinking does not seem to readily transfer from one environment to another, as in Priest’s (2001a) previous study, a variety of musical creative thinking behaviors might be mutually
supportive within a single environment. Fifty-four ($N = 54$) undergraduate students enrolled in a music fundamentals course for elementary education majors served as participants for this study. Procedures were mostly repeated from the previous study in that all participants completed the same three composition and performance tasks, and practiced using the CCA three times as well prior to completing the assignments and assessing their own products for creativity and craftsmanship.

In order to control for different levels of student performance tasks, as was presented as an issue in the previous study, one competent musician played all 54 of the melodies onto a master tape. From this tape, eight cassette tapes were generated with the 54 compositions randomly ordered on each. Eight independent judges who taught music courses to elementary education students used the CMCA (Priest, 2001a), based on the Consensual Assessment Technique, to rate the compositions relative to one another on four dimensions: (a) creativity, (b) melodic interest, (c) rhythmic interest, and (d) personal preference. All items were implicitly defined and employed a continuous scale to increase the reliability of the measure. In addition, because of the number of compositions being assessed, a relatively large number of judges were utilized to control for judge fatigue or inconsistency.

Student responses on the CCA were coded and analyzed quantitatively. From this, 23 factors contributing to creativity were produced, with musicianship or performance qualities being cited more than any other factors ($n = 130, 80.2\%$) and complexity being least cited ($n = 4, 2.5\%$). The judges’ ratings on all four dimensions were combined to produce composite creativity scores. Interjudge reliability using Cronbach’s alpha indicated produced a alpha indexes of .81 for creativity, .84 for personal preference,
.85 for rhythmic interest, .79 for melodic interest, and .85 for composite creativity score, suggesting moderately high reliability for the CMCA. Using the means of the judges’ composite creativity scores, the students were equally divided into high, middle, and low compositional creativity groups. A chi-square analysis of the student responses on the CCAs indicated significant differences between the groups. Students in the high-creativity group were more likely to use temporal factors as contributing to creativity and craftsmanship \( x^2 (df = 2, N = 162) = 13.07, p < .01 \). Students in the low-creativity group were more likely to use metaphors or similes when describing what contributed to creativity and craftsmanship \( x^2 (df = 1, N = 108) = 3.92, p < .05 \). These results suggest that highly creative students were more aware of temporal factors, while those in the middle and low groups were more concerned with performance attributes rather than structural qualities. Interestingly, those with more formal music training tended to fall in the middle and low creativity groups. Lastly, the findings support previous research, which suggests that performance achievement is not significantly linked to compositional creativity. Further research indicated by both of these studies is the need to investigate whether listening to exemplary models of the task outcome has an effect on self-assessment of creativity when using the Consensual Assessment Technique.

Hickey (1995) sought to examine the relationship between children’s musical thought processes and the quality of their resulting musical compositions. In addition, a secondary purpose of the study was to compare children’s creative musical thinking processes and products to their scores on a creative music aptitude measure, musical performance experience, and music teacher ratings of creativity. Twenty-one fourth and fifth grade participants spent 3 days exploring musical composition ideas using
synthesizers and Music Mania, a researcher-designed computer program. The participants’ activities completed within the program were recorded and served as musical thinking process data and were analyzed using combinations of qualitative and quantitative methods. In addition, Webster’s (1994) *Measure of Creative Thinking in Music-II* (MCTM-II) was used as an aptitude rating of creative musical thinking. The final project for the study consisted of student compositions completed using the MIDI synthesizers and the music program. The compositional products were then rated by three music teachers for qualities of creativity, craftsmanship, and aesthetic appeal.

The rating form was developed and adopted from Amabile’s *Dimensions of Judgment for Artist-Judges* and Bangs’s (1992) *Dimension of Judgment*, and asked the teachers to rate each dimension on a scale of 1 (“poor”) to 7 (“excellent”). Because the judges mostly agreed on the higher and lower ratings, but were in disagreement on those falling in the middle, those compositions that fell into the higher and lower thirds were used for the analysis in the study.

Results from the qualitative and quantitative process data analysis indicated that students in the high creativity and high craftsmanship groups had tendencies toward more flexible and fluent behaviors, like to change parameters, used a wider range of notes, used more measures, spent more time working on the compositions, and began earlier. In addition, they developed and experimented more, and thus their compositions emerged later in the process. Quantitative analysis results found low or negative relationships between the process variables, MCTM-II scores, and the creativity rating scores. No statistically significant relationships were found between the process variables, compositional creativity ratings, and level of musical performance experience. Also, no
significant relationship was found between MCTM-II and creativity rating scores. The negative relationships found between the process variables and creativity ratings might be due to disagreement between the exploratory sounds and sounds that teachers find desirable. The surprising lack of relationship between MCTM-II scores and process variables might be attributable to the shorter time spent working through the MCTM-II compared to the much longer time spent in the computer program processing stage (Hickey, 1995). Additionally, the differences in the way children created musical sounds was vastly different between the two tasks. However, a significantly positive relationship was found between the craftsmanship ratings. Lastly, while the Consensual Assessment Technique proved to be reliable for rating creativity, the author asserted that further research was needed toward the development of rating the “quality” of creative musical products.

The Daignault (1996) study was similar to Hickey’s (1995) study in that it sought to examine children’s computer-mediated creative processes in relation to the craftsmanship and creative qualities of their result musical compositions. However, the improvisational approach provided a different investigative perspective to the research. Twenty-five 10 and 11-year-olds participated in two research sessions that were devoted to familiarization to the technology and the compositional task, which consisted of three phases. The first phase asked the participants to record three to eight improvisations on a sequencer program. The second phase asked the participants to listen to all the recorded improvisations and then to select their preferred one. The final phase consisted of the participants adding development to the selected improvisation using piano roll notation. All processes during the third phase were audio-visually recorded for later analysis. Five
judges, using a variation of the *Consensual Assessment Technique*, rated the creativity and craftsmanship of the compositions. Means for each domain were calculated, and compositions that fell into either the highest or lowest thirds were used for analysis.

Interjudge correlation coefficients in the Daignault (1996) study indicated that the CAT can be utilized to assess children’s musical compositions with adequate levels of reliability. Qualitative analyses indicated that both the low creativity and the low craftsmanship groups tended to generate process-oriented improvisations while the high creativity and craftsmanship groups generated product-orientated music. Participants in the high creativity and craftsmanship groups also tended to use notation substantially in comparison to their low counterparts. Lastly, the high craftsmanship group tended to manipulate notation rather than improvising, as the high creativity group did.

Findings indicated that the judges agreed more on higher and lower ratings, but less on the middle area, which is consistent with Hickey’s (1995) findings. Inter-judge correlations between the two dimensions were not as distinct as expected, suggesting that the judges may have had difficulty discriminating between creativity and craftsmanship, or that they were too closely related. This lack of discrepancy could possibly account for lack of agreement with the middle scoring ranging (Horan et al., 2011), but more investigation is needed in this regard.

Webster and Hickey (1995) sought to better understand inter-judge reliability and concurrent validity when compared with the constructs of creativity, craftsmanship, and overall aesthetic value in the use of rating scales for creativity evaluation. They constructed two separate rating forms based on implicit and explicit items designed in the previous research (Webster, 1989; Hassler & Feil, 1986; Moore, 1990; Kratus, 1991,
1994; Bangs, 1992; Smith, 1993). One form included only implicit items, while the other included only explicitly defined items. Both rating forms intended to evaluate the constructs of craftsmanship, creativity, and aesthetic value.

Ten 5th and 6th grade children’s compositions were selected from a pool of 24 compositions created from previous studies done by Hickey (1993). The compositions were created using synthesizers with no parameters given other than a 30-minute time limit. Four music educators were asked to rate each composition twice- once with the implicit rating scale and, after a one-hour break, again with the explicit rating scale. A third form was then used which asked the raters to choose the best and worst two compositions in the categories of creativity, craftsmanship, and aesthetic value.

Inter-judge reliability was found to be relatively high for both forms and for both explicit and implicit items. The open-ended implicit scale was significantly more reliable than the more explicitly defined item scale. It was then suggested that judges are able to have clear judgments of musical creativeness without formal musical analyses using explicit rating scales. Overall findings of the study suggest that approaches to rating scales that use the Consensual Assessment Technique are a good choice for music teachers and researchers interested in children’s compositions.

Amabile (1983, 1996) argued that the most valid way to measure creativity is by using experts’ global and subjective assessment of creative products. Based on this assertion, Hickey (2001) sought to investigate which groups of people were considered experts in regards to rating the creativity of musical compositions. Specifically, she sought to investigate these issues by determining the inter-judge reliability of the Consensual Assessment Technique when used by different groups of judges- composers,
theorists, teachers, and children. Twelve randomly selected compositions created by 5th graders were derived from Hickey’s (1995) dissertation. Five groups of judges served as participants in the study. The group of 17 music teachers was comprised of those with instrumental teaching experience, general/choral teaching experience, and mixed instrumental/choral/general teaching experience. Three professional composers, four college music theory professors, 14 seventh grade students, and 24 second grade students also served as participant groups.

The previously generated compositions were randomly recorded onto audiocassette tapes, in which the randomized order was different for each group. The composers and theorists listened to and rated the compositions independently, while the teachers listened together but rated independently. The groups of children first discussed the differences between the terms “liking” and “creative”, then listened to the compositions together, and rated them independently. The rating forms used modified versions of the CAT. The composers and theorists were given an 18-item rating form developed in a previous study (Hickey, 1995), while the teachers received a 3-item form with 7-point Likert scales for creativity, craftsmanship, and aesthetic appeal. The children rated each composition only for “Liking” and “Creative” on continuous scales. No explicit definitions were provided on any rating forms.

Inter-judge reliabilities were calculated, resulting in an overall alpha coefficient of .48. However, because the composers showed no relationship in their ratings, reliabilities were calculated again without the composers, revealing an overall reliability of .78. The resulting inter-judge reliabilities for each group’s creativity ratings ranged from .04 for the composers to .81 for the general/choral music teachers. Significant correlations were
found between the groups of teachers, between the teachers and theorists, and between the groups of children. Weak or negative correlations were found between the composers and the other groups. Findings from the study found the *Consensual Assessment Technique* was moderately reliable when used by the most knowledgeable raters within a context. The best “experts” were found to be the teachers that actually teach the children—the general/choral teachers. Composers were found to be the worst, perhaps due to their professional endeavors that do not allow for much work with children. Lastly, close examination of the relationship between the “Liking” and “Creativity” scores revealed that the children were unable to separate the two concepts, which was similar to Daignault’s (1996) findings in which judges struggled to distinguish between creativity and craftsmanship.

In addition to identifying who should be considered “experts” for the evaluation of creative products, interest has also been shown in discovering which rating conditions are optimal for this type of assessment. Priest (2006) sought to examine the reliability of judges’ assessments of compositions under the three conditions of (a) only using an audio recording, (b) only using traditional notation, and (c) using both a recording and traditional notation. The study also explored the relationship between creativity, craftsmanship, expressiveness, personal preference, rhythmic interest, and melodic interest. Forty-seven undergraduates enrolled in a music fundamentals course participated in the study. The students were asked to compose a piece for soprano recorder in E minor using at least 4 pitches, and to group the shortest underlying sound/duration into groups of 6 (3+3 or 2+2+2). Of the submissions, five compositions were chose because they met the task criteria, provided a diverse response to the task, and were performed well.
Twenty-one undergraduate music majors rated the level of creativity and craftsmanship using the Consensual Assessment Technique. Students were asked to use their own definition of creativity and a more explicit definition for craftsmanship to rate the compositions on a scale of 1-5, with five being highest quality. Sixty-nine music teachers were asked to rate not only creativity and craftsmanship, but also expressiveness, personal preference, rhythmic interest, and melodic interest using the same 1-5 scale. All dimensions were framed with global or implicit definitions. For example, rhythmic interest was defined as “the degree to which you find the melody had rhythmic interest.” In addition, teachers were split into the audio only (AO), audio and score (A&S), or score only (SO) conditions. The undergraduate student raters were only in the audio only condition.

Reliability analysis for creativity, craftsmanship, and all other dimensions were calculated. Hoyt’s analysis was used to develop means to compare reliabilities among the different number of judges in each group and condition. Highly significant ($p < .01$) correlations were found among creativity, craftsmanship, personal preference, expressiveness, rhythmic interest, and melodic interest in the AO group, suggesting that when assessing creative compositional products, audio only should be considered. The lowest reliability coefficients in all six dimensions were consistently found in the SO condition, suggesting that the use of scores to assess the creativeness of compositional products is problematic for various reasons discussed by the researcher. Furthermore, reliability results of judges’ ratings of the open-ended creativity item versus the explicitly defined craftsmanship item support findings that judges are more reliable when responding to global/implicit definitions.
Summary and Discussion. Amabile’s (1982, 1983, 1996) Consensual Assessment Technique (CAT) appears to be generally considered a moderately to highly reliable technique for evaluating creative musical products, as evidenced by reliability analyses throughout the literature. However, as with any assessment technique, great care must be taken to adhere to the procedural requirements and inclusion of key components within the research study design in order for the technique to be successful (Hennessey & Amabile, 1988). While an attractive and largely successful option for creativity assessment, the CAT is not without its problems.

First, design and implementation of the Consensual Assessment Technique can be daunting. More than one expert rater is required to prevent individual bias and also to assess inter-rater reliability to provide construct validity. Raters must also make their assessments independently and in random order to avoid the influence of other raters. In addition, larger numbers of raters are useful to avoid fatigue, particularly when assessing large sample sizes. Also, the assessment form should assess other dimensions in addition to creativity in order to distinguish it from other constructs. Furthermore, the dimension of creativity should avoid explicit definition on the assessment form and should instruct raters to evaluate items in relation to others in the sample rather than against an absolute standard. Lastly, because of the implicit description and lack of explicit rating criteria, this assessment should be avoided when the goal is to create an explicit standard of creative criteria.

It is important to note that interjudge reliability when using the CAT is sensitive to the range of possible scores, wording of instructions or definitions for raters, and the nature of items being assessed (Baltzer, 1990). The studies included in this review tended
to utilize continuous rating scales of 5-point or 7-point designs, which seemed to prove successful throughout. Although judges mostly agreed on the higher and lower ratings, they tended to disagree on those falling in the middle, which occasionally resulted in the middle third group of scores being removed when utilizing 7-point scales (Hickey, 1995; Daignault, 1996; Priest, 2001a, 2001b). This suggests that use of 5-point scales would allow for less variance, and therefore may prove more desirable. Furthermore, both participants and raters were more reliable and more comfortable with open-ended or implicit use of the term “creativity” in item evaluation (Webster & Hickey, 1995; Brinkman, 1999; Priest, 2006). Perhaps the combination of predicting factors of creativity, such as originality, craftsmanship, and aesthetic appeal (Brinkman, 1994), to be used as items rather than explicitly trying to discriminate from “creativeness” would produce more reliable results.

Amabile (1982, 1983, 1996) stressed the importance of the use of “expert” raters that must be knowledgeable in the particular area being examined due to the subjective nature of evaluating creativity. However, Hickey’s (2001) findings that the music teachers that actually worked most closely with the age group of participants (5th graders) were the most reliable “experts,” in this case, the general/choral music teachers. This suggests that not only should the raters be knowledgeable in the domain being assessed, but also the context in which participants’ creativity is being assessed. Therefore, further research is needed to better determine who the best “experts” are for different areas of musical creativity assessment.
Another concern revealed in the literature was that raters sometimes struggled to distinguish between different concepts or constructs being evaluated. Daignault’s (1996) study found that the judges struggled to differentiate between creativity and craftsmanship, while judges in the Priest (2001a) study found difficulty distinguishing between creativity and performance assessment. In the Hickey (2001) study, both 7th-grade and 2nd-grade groups of children were unable to separate the two concepts of “liking” and “creative”. These issues support the need for further research in developing and refining reliable rating scales (Webster & Hickey, 1995; Hickey, 2001).

Despite the concerns and daunting nature of implementing the Consensual Assessment Technique appropriately and effectively, existing literature supports its use for evaluating creative musical products. Because creativity is arguably subjective in nature, the use of subjective judgments by expert raters is most appropriate, as evidenced by the consistency of high reliabilities found in the literature. Implications of its use in research appear promising, and further investigation regarding its translation into practitioner settings may prove beneficial. Because of the plethora of ways in which compositions are created in educational settings today, further research using this technique to evaluate different approaches and contexts is needed. Lastly, further research combining objective aspects with subjective assessments in exploration of social and contextual influences on creative musical products may prove valuable for providing optimal creative experiences in music education, and making this technique appropriate for the current study.
Conclusion

The field of creativity is extremely broad, and despite many attempts, no theory of creativity has been widely accepted. However, there seems to be growing consensus in the inclusion of multiple social, psychological, and contextual components in the assessment of creative products. These components can be classified within “the four P’s” of creativity: person, process, product, and place. Research on these areas (especially person, process, and product) has provided a breadth of knowledge and promise for richer investigations, particularly with the theoretical attempts to bind musical outcomes and social psychology. While this study attempts to examine only certain aspects of person, product, and place, the combination of these three sections should prove insightful to researchers and practitioners alike.

The literature has shown that Amabile’s (1982, 1983, 1996) Consensual Assessment Technique (CAT) is considered a reliable technique for evaluating creative musical products, as evidenced by reliability analyses throughout the literature. Given its conceptual sensitivity to various contexts, this will be an appropriate method of measuring the creativity of students’ digital compositions. However, as with any assessment technique, great care must be taken to adhere to the procedural requirements and inclusion of key components within the research study design in order for the technique to be successful (Hennessey & Amabile, 1988).

This review of literature has attempted to provide background and theoretical contexts behind the rationale of the study. Additionally, the review has shown clear justification for the inclusion of the latent factors of motivation, affect, and classroom environment as predictors of creativity. Classroom environment seems to be an
increasingly important part of musical achievement, however research in its relation to musical creativity is still, in many ways, in its infancy. To date, no studies currently exist that examine the contextual or person-level factors influencing compositional creativity of computer-mediated contexts specifically. Additionally, no examinations of the combined influence of these factors on creative outcomes as defined by the Consensual Assessment Technique exist. An examination of these interactions via structural equation modeling should therefore provide a deeper understanding of the connection between classroom environment and social psychological factors as related to creative products.
CHAPTER THREE

METHOD

The main purpose of this study was to examine the influence of the social psychological factors of affect and motivation, and the contextual factor of classroom environment on the creativeness of secondary students’ computer-based music compositions. Through the use of structural equation modeling, the following research questions were addressed:

1. What interrelationships exist within and between the latent factors of affect, motivation, classroom environment, and creativity?
2. Which combination of latent factors of affect, motivation, and classroom environment best predicts the latent factor of creativity?
3. What model of the variables best predicts creativeness of computer-based compositional products in secondary music students?

For the remainder of this chapter, I describe the participants, measurement instruments, and research design used to answer these research questions. Data analysis through structural equation modeling methodology will be outlined in relation to the research questions.

Participants

Students

Previous literature suggests that the use of music technology in schools for compositional activities tends to increase with age, particularly at the high school level (Dammers, 2012; Savage, 2010; Webster, 2012). Additionally, music technology is more likely to be used in general music settings than in performance settings (Dorfman, 2008;
Reese, 2002; Reese & Rimmington, 2000). Therefore, the participants selected to participate in the study were based on several criteria: (a) formal enrollment in a high school (grades 9th-12th) non-traditional music course that utilizes computer-based music technology; (b) course utilization of GarageBand for at least one semester prior to study; (c) teacher-volunteer or staff resources to sufficiently execute data collection, and (d) ease of electronic communication with both teachers and students.

Additionally, in order to ameliorate the inherent differences within digital audio workstations (DAWs) as a possible confounding variable, GarageBand was the only creative platform utilized for the study. Participants also must have had at least one semester of coursework involving GarageBand in order to ensure basic facility with the software.

The participants of the study were high students ages 14 to 18 ($N = 146$), enrolled in non-traditional computer-based music courses at two charter high schools in Illinois and a private high school in New York. All of the school sites in the study offered at least one non-traditional computer-based music course in addition to at least one “traditional” course of band, choir, and/or orchestra, and were solicited via convenience sampling due to difficulty in identifying these sparsely scattered and varying classroom settings.

The private high school in central New York was located in a suburban area, and offered a wide variety of music electives, including concert choir, wind ensemble, music theory, composition, and several technology-based music courses. Sixty-one ($n = 61$) students from this site, all of which were enrolled in at least one technology-based course that utilized GarageBand, participated in this study. One of the two charter schools in Illinois was also used in a previous study (Davenport, 2015) in which the composition
task procedures and the evaluation of creativeness via the Consensual Assessment Technique were piloted. This school was located in a west-side neighborhood of Chicago, and offered several technology-based music courses as well as a guitar ensemble, choir, and jazz band. Fifty-eight ($n = 58$) students from this site participated in the study. Lastly, the second charter school in Illinois, located in a northern neighborhood of Chicago, was the most traditional in its course offerings of two choirs, a concert band, and a jazz band. The only technology-based music course offered was an elective that was initially supported through a local university’s outreach program to encourage Science, Technology, Engineering, Arts, and Mathematics initiatives of program integration in the schools. Twenty-seven ($n = 27$) students from this site participated in the study.

Despite their uniqueness, each course utilized Garageband as a core tool for music-making in the technology-based music courses, and fit within the criteria needed for participation. The course curricula for the computer-based music courses were generally similar across all sites in that they focused mostly on project-based creative activities such as music production, editing, composition, songwriting, and multi-media tasks to approach classroom learning, using GarageBand as the main workstation platform. Two of the schools offered advanced courses that utilized software such as ProTools, however these classes were not included in the study.

All three sites utilized the teachers as facilitators and coaches rather than lecturers, despite differences in methods of content delivery. For example, one of the Illinois school sites provided each student with a laptop instead of textbooks, and each teacher was responsible for designing the curriculum and content for each course. Students at this site received content solely via their online content management system,
but paper and multi-modal approaches were supplemented as needed. Interestingly, all sites also shared a similar daily routine of spending the first half of the class introducing new tasks, reviewing previous concepts, and navigating broad troubleshooting questions, and then allowing self-paced digital project activities throughout the remainder of the class. With the exception of one class at one Illinois school, students at all three sites were typically allowed the freedom to move around the room as needed, either to work with others, or use different instruments. The physical classrooms were set up in differing arrangements of computer lab formats, with keyboards and headphones at each station, and instruments such as guitars and drum pads dotting the rooms in strategically placed and readily accessible locations. The New York music classroom was also outfitted with an adjoining recording studio space equipped with a drum set and enough room for two other students as well. Despite the minor differences of physical arrangement, and quality and amount of equipment, the classrooms and approaches to music teaching and learning were more similar than anticipated.

**Judges**

Because of the need to rate compositions using a consensual assessment technique (CAT), the use of multiple judges was required. Through extensive work with evaluating creative products through the use of this technique, Amabile (1982) has established that in order for the ratings of judges to be considered valid, the judges themselves must be considered experts in the field through experience. In order to meet the procedural requirements of the consensual assessment technique listed by Amabile (1982, p. 1002), and discussed later in this chapter, “…judges should have some experiences with the domain…” For purposes of this study, the judges were (1) trained musicians, (2) had at
least two years of experience with musical composition activities, and (3) had at least two years of experience in teaching non-traditional music courses to secondary students. Based on Hickey’s (2001) study regarding the reliability of judges when using the consensual assessment technique to rate creativity of original music compositions, graduate music education students and educators who have had at least two years teaching the same age group and context as the participants were found to be the most reliable judges using the CAT. Therefore, 11 graduate music education students that met these criteria were selected to judge the digital compositions.

Procedure

Once University of Miami IRB approval had been granted, recruitment and data collection began. Due to the specific criteria needed for participation, purposive sampling took place and suitable classroom sites were recruited through direct contact of teachers, appropriate administrators, and review boards by the researcher via email. Data collection began at the selected school sites during time periods agreed upon by the researcher, classroom teacher/facilitator, and site administration. Prior to data collection, the classroom teachers and administrators received information pertaining to review boards/site permissions, student assent, parental consent, scheduling and logistics, survey administration, task administration, and unanticipated issues with the study.

The researcher obtained parental consent and child assent, using IRB-approved consent and assent forms. Upon distribution, the researcher and classroom teacher described the study and fielded questions from the participants. Upon receipt of consent and assent forms, the researcher coded the participants by assigning letters denoting their site and numbers denoting participants in random order. For example, Jane Smith’s music
course was administered at the second school site and was the fifth in a randomized class list. Therefore, her code was SEC1005. A key with each participant’s name and corresponding code was emailed to the participant’s teacher for their reference. Once coding was complete and teachers had confirmed receipt of the codes, the researchers’ copy of the key was destroyed. After initial identification coding procedure, the researcher set up corresponding private coded accounts on the Edmodo site. Edmodo is an interactive, youth-friendly, secure, online content management system that allows students to track their progress within each stage of the study. This site served as the “hub” for all student-level content within the study while also allowing for participants to have constant anonymous access to the researcher when questions arose throughout the study.

Four types of data were be collected from each participant: (a) the Positive and Negative Affect (PANAS), (b) the Asmus Measure of Motivation: Magnitude of Motivation Measure (AMM:MM), (c) the Classroom Environment Scale (CES), and (d) the Creativity Task. The participants were asked to complete the PANAS, AMM:MM, and CES, using the University of Miami’s Qualtrics survey tool, which was accessible via the Edmodo site. In addition, the participants were asked to create a digital music composition, free of parameters, with the following exceptions: (A) Compositions must be created within the digital audio workstation, GarageBand. (B) Compositions must be completed within the week of the teacher’s administration of the task. However, participants were advised to save and edit compositions as often as necessary until they
were satisfied with the finished product (Hickey, 1996), according to time allowances by the site teacher. (C) Final composition products had to be saved as an easily sharable audio file—either .mp3 or .wav file.

The total proposed timeline of data collection was one school week (five days) per school site after permissions had been obtained, and participant coding had been completed. Because many music teachers are understandably reluctant to give up an entire week of class time due to time constraints, Davenport (2015) found that facilitation and scheduling of the tasks should be flexible to allow for some regular class activities to continue throughout. Though this timeline and order varied slightly depending upon the site, the general anticipated time for each task was as follows: (30 minutes) Initial entry into Edmodo site and completion of AMM:MM; (15 minutes) Completion of CES; and (10 minutes) Completion of PANAS. Participants were given various time allotments throughout the week, at the teacher’s discretion, to work on their digital compositions.

Upon completion, participants uploaded their audio file to their coded account on the secure Edmodo website. After student-level data collection, judging of compositions for the creativity latent took place. Composition files were uploaded onto the secure online Qualtrics survey tool using the corresponding participant code, with the Likert-type Consensual Assessment Technique rating form. Qualtrics administrative settings allowed files and coinciding rating items to be randomized for each individual rater, but also allowed for judges to choose which order they assess the items within the page, ensuring that the CAT followed procedural requirements suggested by Amabile (1982).
Judges were also allowed to listen to the compositions as many times as desired and were not given explicit definitions for the Creativity latent subscale variables of Craftsmanship, Originality, and Aesthetic Appeal.

Because of the large number of compositions to be rated for creativity, rater fatigue was recognized as a potential threat to internal validity (Cook & Campbell, 1979). In an attempt to accommodate for this issue, judges were asked to rate only 1-2 groups of compositions per week, with each group averaging between 30-40 compositions. However, most completed the rating task within two weeks. The average length of the student compositions was 1.39 minutes. Additionally, all compositions within each group were randomized for each rater. Rating began within one week of each site’s completion of data collection, lasting for roughly three weeks.

**Latent Predictors of Creativity**

The purpose of statistical modeling in this study is to reveal any causal relationships that may exist between latent variables in the proposed model. However, because the initially specified model has been dictated by theoretically-based hypotheses (Huck, 2012), it is important to understand its underlying structure. Similar to the way in which a mechanic might understand the intricacies of a vehicle’s operating structure, an understanding of the model is best examined through the latent variables and the theoretical paths that connect them. In the figures found throughout this study, latent variables are depicted as ovals and measured variables are depicted as rectangles (Figure 3.1), as is commonplace for most structural equation modeling literature (Kline, 2011).
Figure 3.1. Initial structural equation model.

This section will provide an explanation of each latent variable independently, and then provide theoretical and empirical rationalization for the initially proposed paths and connections to the other latent constructs. “This is analogous to understanding the human form through its skeleton” (Denison, 2015, p. 71). The latent predictors and the outcome variable are shown in Figure 3.2 as part of the a priori theoretical structural model.
Figure 3.2. Theoretical latent path model of classroom environment and social-psychological predictors of musical composition creativity.

**Affect**

Affect, also described in research as mood or emotional state, has shown to have a significant influence on creative outcomes (Isen & Reeve, 2005; Isen, 2000). While research directly investigating affect and musical creativity outcomes is virtually nonexistent, known effects on musical performance outcomes and ability have been discussed, as evidenced in Schmidt’s (2011) Social Psychological Model of Musical Ability. Because musical compositions are products of process, they can be considered as performance outcomes as well. It is in this light, and the known influences of affect on creative outcomes in other domains such as organizational management and business, that the inclusion of affect as a latent construct is justified.

However, both positive and negative affects have also been shown to influence motivation as well (Isen & Reeve, 2006; Erez & Isen, 2002). While direct effects of positive and negative affect on creativity are well documented, indirect effects should also be considered as mediated by motivation (Byron, Khazanchi, and Nazarian (2010).
It is important to note, however, that the relationship between motivation, affect, and creativity is unclear (Amabile, 1999) and differs by theory (Weiner, 1986). Asmus (1996) suggests that motivation influences affect through attributional sequences. Watson (1994) argues that while affect influences outcomes, it is mediated by motivation. While the initial model includes motivation as a mediating factor of affect on creativity (Figure 3.3), consideration of the converse arrangement in future model testing may prove useful.

![Diagram](image)

*Figure 3.3. Affect as latent factor in isolation.*

**Motivation**

Extensive research, particularly in the field of organizational management, has shown the effects of motivation on the creativity of products (Amabile, 1982, 1983, 1996; Hennessey & Amabile, 1993, 2010). Additionally, a meta-analysis of studies published between 1990 and 2010 revealed a significantly positive relationship between intrinsic motivation and creativity related to products (Jesus, Rus, Lens, and Imaginario, 2013). Bangs (1992) found that motivation significantly influences the creativity of music compositional products.

Direct effects of motivation on music performance outcomes have also been shown in previous studies (Asmus, 1996; Austin & Vispoel, 1994; Linnenbrink-Garcia, et al., 2011). Logically, the effects of motivation on music performance outcomes could
also translate into creative music outcomes such as compositional products. The known relationships of motivation on creativity support the inclusion of motivation as a latent construct in this model (Figure 3.4).

![Figure 3.4. Motivation as latent in isolation](image)

**Classroom Environment**

Research regarding social and contextual factors of learning environments have shown significant influences on creative outcomes (Amabile, 1982; Hennessey & Amabile, 2010). These factors of classroom environment have shown to play a significant role in music creativity (MacDonald, O’Donnell, and Davies, 1999; Miell and MacDonald, 2000) and both in products and processes of computer-mediated contexts (Jennings, 2005; Gall & Breeze, 2005; Seddon, 2007). These findings justify the inclusion of the classroom environment latent variable in the model as a predictor of creativity.

Studies have also found that environmental factors tend to influence positive and negative moods related to creative outcomes (George & Zhou, 2002; Hirt et al., 1996; Martin & Stoner, 1996). Furthermore, in a meta-analysis on stressors and creativity, Byron, Khazanchi, and Nazarian (2010) indicated that motivation could function as a mediator of environmental influences on creativity. Therefore, as a parsimonious
suggestion, the initial model displays classroom environment’s influence on creativity as being mediated by motivation, which is then again mediated by affect (Figure 3.5).

Figure 3.5. Classroom Environment as latent in isolation.

**Indicator Variables**

In structural equation modeling, observed variables are referred to as indicators (Keith, 2006; Kline, 2011), and are visualized as rectangles within the model figures. This section will explain the associations between the latent variables and their indicators as viewed in individual measurement models, as well as provide descriptions of measurement instruments to be used for data collection.

**Affect**

The two proposed indicators of affect, positive affect (PA) and negative affect (NA), was measured with the Positive and Negative Affect Schedule (PANAS; Watson & Clark, 1999; Watson, Clark, & Tellegen, 1988), depicted in Figure 3.6 (Appendix B). The PANAS contains 10 single-word items that are markers of positive affect (e.g., enthusiastic, determined, and inspired) and 10 single-word items that are markers of negative affect (e.g., scared, nervous, and distressed). Since the timeframe of task completion was one week in length, this study measured how participants felt “this
week”, rather than other time frames such as “today” or “this moment” offered by the PANAS. Responses to the items were on a 5-point Likert scale ranging from “very slightly or not at all” to “very much,” and both mood scales have acceptably high reliabilities, ranging from .86 to .90 for PA and from .84 to .87 for NA, regardless of time frame used. Additionally, the shorter 10-item scales are internally consistent and have exceptional convergent and discriminant correlations with lengthier and more cumbersome measures of mood factors, such as the STAI State Anxiety Scale (Watson, Clark & Tellegen, 1988).

Figure 3.6. Affect indicators.

Motivation

The latent variable of motivation was indicated by the factors of ability self-concept, personal commitment, school music, and music class compared to other activities (Figure 3.7, Appendix A). These motivation factors were measured using the Asmus Measure of Motivation: Magnitude of Motivation Measure (AMM:MM; Asmus, 1989), which is the second measure of the AMM. The measures for the AMM were
originally developed from statements made by music students in grades 4 through 12 and were then refined with high school students (Asmus, 1986). The AMM measure provides sub-scores on the quantitative motivation scales of personal commitment, school music, and music compared with other activities. Two of the items included in the AMM:MM also provided an index of students’ self-concept of musical ability. Subscales for the four areas consisted of statements to which participants indicated their extent of agreement or disagreement on 4-point Likert-type scales, for a total of 23 items. The scales have shown adequate reliabilities ranging from .79 to .86 and construct validity when the subscales are combined in the same measure (Asmus, 1989).

Figure 3.7. Motivation indicators.

Classroom Environment

The proposed indicators of classroom environment (Figure 3.8) include: (1) student involvement- attentiveness, time, and energy students invest in classroom activities; (2) affiliation- how well students get to know each other, whether they build
friendships, and whether they work cooperatively; (3) teacher support and involvement—whether or not the teacher shows personal interest in students and is involved in learning activities; (4) task orientation—the importance of staying on task and completing assignments; (5) competition—prevalence of competitiveness for grades and teacher recognition among students; (6) order and organization—the importance placed on the organization of the class and orderly behavior of students; (7) rule clarity—the importance placed on following a clear set of established rules; (8) teacher control—the strictness of the teacher and frequency and severity of punishment for infractions; and (9) innovation—whether or not the teacher uses a variety of teaching strategies and encourages creative activities (Lind, 1999). These indicators measure students’ perceived social interactions between student-student(s) and between teacher-student(s), which are suggested as some of the important differences within computer-mediated settings (Horn & Staker, 2015).

The nine dimensions of classroom environment were assessed using a short form of the Classroom Environment Scale (CES) (Moos & Trickett, 1974). Class reliabilities of the original subscales of the CES were found to range from 0.74 to 0.86, and discriminant validity indexes ranged from 0.20 to 0.31 (Moos & Trickett, 1974). The CES Form S (Moos & Trickett, 1974), developed for use with groups of high school students, uses the first 36 items of the of the lengthier original Form R 90-item survey. The CES Form S (Appendix C) contains 36 true/false questions; four randomly distributed questions for each of the nine scales. The shorter form, when compared to the original CES (Form R), was found to have acceptable internal reliability (.59 to .78), high correlation to the original form (.78 to .95), and significantly discriminated between groups of students while providing a more efficient administration (Fraser, 1982; Fraser
& Fisher, 1983). However, because each subscale on the Form S consists of only four items, the combination of subcales into fewer during analysis may be useful, particularly to account for the lower reliabilities of certain subscales (Kline, 2005).

Figure 3.8. Classroom Environment indicators.

Creativity

The digital compositions were rated by 11 expert judges using a modification of the Consensual Assessment Technique (CAT; Amabile, 1982). The rating form consisted of five-point Likert-type scales ranging from low to high for each of the three creativity dimensions of originality, craftsmanship, and aesthetic value (Figure 3.9, Appendix D). The use of the CAT for the assessment of creative products has shown to be a moderate
to highly reliable technique, especially in regards to social psychological and
environmental contexts (Bangs, 1992; Brinkman, 1994, 1999; Byrne, MacDonald, &
Carlton, 2003).

The CAT has several key components to provide validity of the approach. First,
more than one rater is required in order to prevent issues of individual bias and to also
assess inter-rater reliability. The inter-rater reliability of consensual assessment by
experts is the equivalent of construct validity. Additionally, the “experts” must be
knowledgeable in the particular area being examined since the rating of creativity is
subjective in nature (Baltzer, 1990). Amabile (1982) asserts that the CAT provides
“ecological validity as a measure of creativity” (p. 1009) by allowing both the creative
task and its assessment to mimic the real world. The use of the three dimensions of
originality, craftsmanship, and aesthetic value furthers the goal of ecological validity. “If
a teacher is suggesting changes in a student’s composition, suggestions about
craftsmanship, aesthetic value, and originality would be given, rather than simply stating
the need for more creativity” (Brinkman, 1994, p.47).

Several procedural requirements should also be addressed when using the
consensual technique (Amabile, 1982; Hennessey & Amabile, 1988). Raters should have
some experiences with the domain in question in order to be considered “experts.”
Second, raters’ judgments should not be influenced by the other raters, and should
therefore make their assessments independently. In addition, their judgments should also
not be influenced by the researcher, and should not receive special training for the
assessment. Further, the raters should assess other dimensions in addition to creativity,
such as craftsmanship and aesthetic appeal, in order to distinguish creativity from other
dimensions. Lastly, each should experience the items in a different random order, and also be instructed to rate the items in relation to others in the sample rather than against an absolute standard. A product is then considered creative if the experts in the domain agree it is creative. The use of this consensual assessment avoids the problems with objective and abstract creativity tests (Hickey, 1995), and is optimal for addressing contextual influences on creativity.

In order to meet these requirements listed by Amabile (1982, p. 1002), modifications and their implementation in the study are described below (format adapted from Brinkman (1994):

1. “…judges should have some experiences with the domain…” For purposes of this study, the judges were (1) be trained musicians, (2) have had at least 2 years of experience with musical composition activities, and (3) have had at least 2 years of experience in teaching non-traditional music classes of secondary students. The judges were 11 graduate students in music education who met the above criteria. Hickey (2001) found that graduate music education students and educators who have had at least 2 years teaching the same age group and context as the participants were found to be the most reliable judges using the CAT.

2. “…the judges must make their assessments independently.” The judges were instructed to rate the compositions on a five-point Likert-type scale without consulting the other judges.

3. “…judges should be asked to make assessments on other dimensions in addition to creativity.” Amabile’s consensual assessment technique was
modified by scoring the dimensions of originality, craftsmanship, and aesthetic value to obtain a composite creativity score. Because these dimensions were not defined for the raters, the judging task maintained the undefined character advocated by Amabile (Brinkman, 1994).

4. “…judges should be instructed to rate the products relative to one another on the dimension in question rather than rating them against some absolute standard…” The judges were instructed to rate the compositions relative to one another.

5. “…each judge should hear the products in a different random order” Each judge received the digital compositions embedded on a website in different random orders. The judges were able to rate for the three dimensions in whatever order they chose.

*Figure 3.9. Creativity indicators.*
Data Analysis

Data collected were analyzed using IBM SPSS Statistics 24.0 and Mplus 7.1.4 statistical software. Data were initially analyzed with descriptive statistics to test for normality, homogeneity, sphericity, and missing data. The descriptive statistics were then evaluated for inferential analysis.

1. What relationships exist within the latent factors of affect, motivation, classroom environment, and creativity?

In order to address the first research question regarding the interrelationships within and between the latent factors of affect, motivation, classroom environment, and creativity, significant bivariate correlations were examined, which produced a correlation matrix used for further analysis.

2. How well do the observed variables represent the latent factors of affect, motivation, classroom environment, and creativity?

To address the second research question, the indicators on the latent factors were examined through Confirmatory Factor Analysis (CFA) of the measurement model (Figure 3.10). The goal of a CFA is to determine if the hypothesized factor structure fits the observed data (Bowen & Guo, 2012). To do this, the indicators were regressed on the latent factors in order to produce beta weight results. The CFA also measured covariances between the latent factors.
3. What is the predictive influence of the variables and latent factors of affect, motivation, and classroom environment on creativity?

In order to answer the third question involving the development of an overall model to predict the creativity of computer-based compositional products, the use of structural equation modeling was applied. Generally speaking, SEM is a statistical technique “used for representing, estimating, and testing a network of relationships between variables” (Suhr, 2006, p. 1). At its simplest level, Huck (2012) described structural equation modeling as “the simultaneous analysis of relationships among variables using regression and correlation techniques, and it provides sets of weights
which can be thought of as relationship strength indications.” (p. 505). The goals of SEM are to (a) understand the patterns of relationships among a set of variables; and (b) to explain as much of their variance as possible with the model specified (Kline, 2011). In music education, SEM has most often utilized as a combination of path analysis and confirmatory factor analysis (CFA) (Stefanic, 2015). In path analysis, a hypothesized series of causal relationships between measured variables is investigated. The relationships are visually displayed using a diagram with arrows indicating the direction of causality between the variables. Then multiple regressions are used to calculate coefficients, which represent the amount of change in an outcome variable with a given change in the predictor variable.

At this stage, a factor structure for the set of measured variables is hypothesized based on theoretical deduction (Stefanic, 2015). Factor analysis models test how well observed variables measure latent constructs. Factor analysis models are also called measurement models since they focus on how latent constructs are measured (or represented) by a set of observed variables (Bowen & Guo, 2012). Confirmatory factor analysis specifically seeks to determine if the hypothesized factor structure fits the observed data. Therefore, SEM “combines the structural aspect (causal relationship) of path analysis with the measurement aspect (hypothesized factor structure of latent variables) of CFA” (Stefanic, 2015, p. 258).

Therefore, the third research question involved structural regressions to discover path coefficients, standard error, confidence intervals, and p-values of the a priori model between the latent variables. Finally, model-fit was to be addressed using the heuristics of fit indices (Kline, 2011).
CHAPTER FOUR

RESULTS

In order to evaluate the fit and appropriateness of the hypothesized theoretical model, a preliminary analysis of the data through descriptive and reliability procedures was necessary in order to examine the suitability of the data collected. Following these preliminary analyses, subsequent analyses were conducted to answer the three research study questions:

1. What relationships exist within the latent factors of affect, motivation, classroom environment, and creativity?

   Pearson’s product-moment correlation analysis using IBM SPSS Statistics 24.0 software was used to determine the strength and direction of linear relationships between the observed variables within the proposed latent factors. Additionally, because each subscale on the CES Form S (Moos & Trickett, 1974), consisted of only four items, a factor analysis was conducted to investigate the possibility of combining some of these subscales, particularly due to the non-normal distributions and lower reliabilities of certain subscales (Kline, 2005).

2. How well do the observed variables represent the latent factors of affect, motivation, classroom environment, and creativity?

   To address the second research question, the indicators on the latent factors were examined through confirmatory factor analysis (CFA) of the measurement model using MPlus 7.1.4 statistical modeling software. Factor analysis models test how well observed variables measure latent constructs. Confirmatory factor analysis specifically seeks to determine if the hypothesized factor structure fits the observed data (Bowen & Guo,
2012). To do this, the indicators were regressed on the latent factors in order to produce beta weight results. The CFA also measured covariances between the latent factors. However, a non-positive definite covariance matrix due to the affect latent prevented further analysis of the CFA. In order to understand the confounding variable, and to ensure no further complications such as high cross loadings between factors existed, an exploratory factor analysis was conducted (Ciorba & Russell, 2014; Kline, 2005), revealing strong factor loadings on three latent constructs. A new CFA was then used to test the fit of the respecified measurement model. Model-fit was addressed using the heuristics of fit indices (Keith, 2006).

3. What is the predictive influence of the variables and latent factors of affect, motivation, and classroom environment on creativity?

In order to answer the third question, the use of structural equation modeling was applied in which multiple regressions were used to calculate coefficients, representing the amount of change in an outcome variable with a given change in the predictor variable.

A factor structure for the set of measured variables was hypothesized based on theoretical deduction (Stefanic, 2015), and results of the EFA and CFA. Structural regressions, used to discover unique path coefficients, standard error, confidence intervals, and $p$-values of the a priori model between the latent variables were determined.
Descriptive Analysis Results

Affect. Table 4.1 shows descriptive results for the affect variables. Affect, as measured by the Positive and Negative Affect Scale (PANAS), indicated a high positive affect, and was normally distributed for both the positive affect and negative affect variables. Second, both subscales had high levels of reliability. The positive bias, as well as the high negative kurtosis in positive affect, indicated that a low presence of negativity during the data collection timeframe. Additionally, during normality testing during creation of the PANAS, the authors found that as the rated time period increased from “this moment” to “this day” to “this week” and so on, the probability that a participant will have experienced a significant amount of a given affect also increases (Watson, Clark, & Tellegen, 1988), and thus means would be expected to increase. Therefore, the moderate indication of negative affect experienced by participants rated for “this week” was expected.

Table 4.1

Affective Characteristics (PANAS)

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Skew</th>
<th>Kurt</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Affect</td>
<td>146</td>
<td>32.35</td>
<td>7.40</td>
<td>0.08</td>
<td>-1.13</td>
<td>.87</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>146</td>
<td>15.40</td>
<td>2.72</td>
<td>0.14</td>
<td>-0.67</td>
<td>.80</td>
</tr>
</tbody>
</table>

Note. High scores indicate greater affect.

Motivation. Table 4.2 shows descriptive results for the observed motivation variables. Scores for motivation variables, as measured by the AMM:MM were normally distributed and acceptable levels of reliability were indicated by Cronbach’s alpha. Participants appeared to be highly motivated in music, and also highly committed to
music. However, when the music class was compared to other activities, the participants appeared slightly less motivated. Additionally, participants appeared to have a moderately strong self-concept of their musical competence, which was expected of music students with at least one-semester of experience using GarageBand in their computer classes.

Table 4.2

Motivational Characteristics *(AMM:MM)*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Skew</th>
<th>Kurt</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Concept</td>
<td>146</td>
<td>5.55</td>
<td>1.61</td>
<td>-.45</td>
<td>-.61</td>
<td>.78</td>
</tr>
<tr>
<td>Personal Commitment</td>
<td>146</td>
<td>21.82</td>
<td>4.63</td>
<td>-.64</td>
<td>-.47</td>
<td>.82</td>
</tr>
<tr>
<td>Music Class Compared</td>
<td>146</td>
<td>17.62</td>
<td>5.29</td>
<td>-.12</td>
<td>-.79</td>
<td>.88</td>
</tr>
<tr>
<td>School Music</td>
<td>146</td>
<td>19.55</td>
<td>4.86</td>
<td>.18</td>
<td>-.66</td>
<td>.89</td>
</tr>
</tbody>
</table>

*Note.* High scores indicate greater motivation

**Classroom Environment.** Table 4.3 shows descriptive results for the classroom environment variables. Due to negative wording, certain subscale items were coded reversely in order to prevent falsely negative correlations (Kline, 2011). Scores for classroom environment variables, as measured by the CES, showed mostly unacceptable distribution. The similarities between the means and deviations suggest that the participants experience similar classroom environment characteristics. Because of the small number of items per subscale, non-normal distributions, and lower internal reliabilities found in the CES Short Form S, a principal component factor analysis was conducted to investigate the combination of subscales (Kline, 2005).
Table 4.3

Classroom Environment Characteristics (CES- Short Form S)

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Involvement</td>
<td>146</td>
<td>3.40</td>
<td>.91</td>
<td>-1.39</td>
<td>.801</td>
</tr>
<tr>
<td>Teacher Involvement</td>
<td>146</td>
<td>2.83</td>
<td>.99</td>
<td>-.80</td>
<td>.22</td>
</tr>
<tr>
<td>Affiliation</td>
<td>146</td>
<td>3.04</td>
<td>1.07</td>
<td>-1.04</td>
<td>.51</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>146</td>
<td>3.36</td>
<td>.83</td>
<td>-1.36</td>
<td>1.41</td>
</tr>
<tr>
<td>Competition</td>
<td>146</td>
<td>3.11</td>
<td>.88</td>
<td>-.65</td>
<td>-.31</td>
</tr>
<tr>
<td>Order and Organization</td>
<td>146</td>
<td>3.11</td>
<td>.89</td>
<td>-1.00</td>
<td>.50</td>
</tr>
<tr>
<td>Rule Clarity</td>
<td>146</td>
<td>3.45</td>
<td>.85</td>
<td>-1.28</td>
<td>.41</td>
</tr>
<tr>
<td>Teacher Control</td>
<td>146</td>
<td>2.39</td>
<td>.96</td>
<td>.13</td>
<td>-.98</td>
</tr>
<tr>
<td>Innovation</td>
<td>146</td>
<td>2.56</td>
<td>.89</td>
<td>-.50</td>
<td>-.04</td>
</tr>
</tbody>
</table>

Note. Scores indicate average student perception of classroom environment characteristics.

Creativity. Table 4.4 shows descriptive results for the creativity indicator variables. Scores for the variables, as measured using the Consensual Assessment Technique, showed normal distribution. Raters appeared to generally rate creativeness and craftsmanship of the students’ digital compositions higher than aesthetic appeal qualities. Additionally, standard deviations of the aesthetic appeal variable indicated less agreement among raters. This was likely due to the subjective nature of the rating scales, since what is considered “appealing” is a matter of preference, and therefore varies more from person to person.

Table 4.4

Creativity Characteristics (CAT)

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craftsmanship</td>
<td>146</td>
<td>3.14</td>
<td>.63</td>
<td>-.10</td>
<td>-.42</td>
</tr>
<tr>
<td>Originality</td>
<td>146</td>
<td>3.39</td>
<td>.63</td>
<td>-.50</td>
<td>-.12</td>
</tr>
<tr>
<td>Aesthetic Appeal</td>
<td>146</td>
<td>2.92</td>
<td>.73</td>
<td>.07</td>
<td>-.55</td>
</tr>
</tbody>
</table>

Note. Scores represent average rater responses on students’ digital compositions.
Correlational Analysis Results

**Affect.** Using a Pearson’s product-moment correlation analysis, a small negative correlation was found between positive affect and negative affect ($r = -0.26, p < .01$). This is consistent with the relationships evidenced during test creation and test-retest results, which consistently presented low negative correlations (Watson, Clark, & Tellegen, 1988). This suggests discriminant validity and quasi-independence between the subscales, which was confirmed by participants’ responses in this study.

**Motivation.** Table 4.5 shows the relationships among the variables of motivation as measured by the AMM:MM. A Pearson’s product-moment correlation showed moderately positive correlations between self-concept and personal commitment and between self-concept and school music. Strong positive correlations were found between self-concept and music class compared to others, between personal commitment and music class compared to others, and between school music and music class compared. While significant correlations between indicators is evident, their distributions were varied enough that these variables could be considered unique parts of the motivation construct and were retained for further analysis.

Table 4.5

<table>
<thead>
<tr>
<th>Pearson Bivariate Correlations of Motivation Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Commitment</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Self-Concept</td>
</tr>
<tr>
<td>Personal Commitment</td>
</tr>
<tr>
<td>Music Class Compared</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Note.* **Correlation is significant ($p < .01$).
**Classroom Environment.** A principal components factor analysis was run on the CES subscale items in order to investigate parsimony. The suitability of factor analysis was assessed prior to analysis. Inspection of the correlation matrix showed that five items had no correlation coefficients greater than 0.3, and were thus removed. Additionally, upon observation of the anti-image correlation matrices, individual Kaiser-Meyer-Olkin (KMO) measures for several items were well below the minimum of 0.5. Those items were therefore removed. The overall KMO measure of the analysis post removal of these items was 0.6 with individual KMO measures all greater than 0.7. Bartlett’s Test of Sphericity was statistically significant ($p < .0005$), indicating that the data were likely factorizable.

The analysis initially revealed six factors with eigenvalues greater than one. However, visual inspection of the scree plot indicated that four components should be realistically retained (Cattell, 1996). The four-component solution explained 61.2% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability and the rotated solution exhibited a mostly “simple structure” in which any cross-loadings were interpreted based on strength of loading (Thurstone, 1947), literature, and logic. No cross-loadings were found to be above .4 (Tabachnick & Fidell, 2013). The interpretation of the data resulted in four factors: (a) a relationship factor, composed primarily of items focused on social interactions and affiliation; (b) a control factor that included items focused on competition, task orientation, and rule clarity; (c) an orderliness factor, comprised mostly of behavioral management items; and (d) an involvement factor,
comprised of student and teacher involvement items. This is consistent with findings in Wright and Cowen’s (1982) study, which suggests four factors instead of the initial nine (Trickett & Moos, 2002). Table 4.6 displays the retained factors, variables, and loadings.

Table 4.6

*Principal Components Factor Analysis of CES with Varimax Rotation*

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Relationships</th>
<th>Orderliness</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q31</td>
<td>.860</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>.829</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q14</td>
<td>.674</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q25</td>
<td>.600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q10</td>
<td>.792</td>
<td>.724</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q19</td>
<td>.724</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q21</td>
<td>.721</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q22</td>
<td>.665</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q33</td>
<td></td>
<td></td>
<td>.810</td>
<td></td>
</tr>
<tr>
<td>Q24</td>
<td></td>
<td></td>
<td>.796</td>
<td></td>
</tr>
<tr>
<td>Q29</td>
<td></td>
<td></td>
<td>.786</td>
<td></td>
</tr>
<tr>
<td>Q28</td>
<td></td>
<td></td>
<td></td>
<td>.882</td>
</tr>
<tr>
<td>Q30</td>
<td></td>
<td></td>
<td></td>
<td>.829</td>
</tr>
</tbody>
</table>

*Note.* Factor loadings lower than .40 are not reported.

Each of the retained subscales produced acceptably high levels of reliability, as determined by Cronbach’s alphas of .79, .79, .79, and .75 respectively. In addition, relationship analysis between the variables showed small positive correlations between all variables except relationships and orderliness. Higher correlations between relationship factors and order and organization were also evident in the validity testing of the original CES Form R. This suggests that more orderly computer-mediated classroom environments can promote social interactions. Lastly, all correlations were found to be significant with the exception of control and orderliness. Table 4.7 shows the Pearson’s product-moment correlations between the classroom environment variables.
Table 4.7

*Pearson Bivariate Correlations of Classroom Environment Factors*

<table>
<thead>
<tr>
<th></th>
<th>Relationships</th>
<th>Orderliness</th>
<th>Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Relationships</td>
<td>.32**</td>
<td>.06</td>
<td>.19*</td>
</tr>
<tr>
<td>Orderliness</td>
<td>.75**</td>
<td>.34**</td>
<td></td>
</tr>
</tbody>
</table>
| Note. *p* < .05, **p* < .01

**Creativity.** The validity and reliability of the Consensual Assessment Technique relies on the internal consistency of expert raters (Amabile, 1982). Therefore, an intraclass correlation technique, using mean scale ratings, was used to calculate inter-rater reliabilities for the three observed creativity indicators (Hickey, 2001). The reliability of craftsmanship was .83, originality was .88, and aesthetic appeal was .85, with all coefficients being significant at *p* < .01. Therefore, all three scales were found to have high inter-rater reliability.

Correlations among the variables of creativity as measured using the Consensual Assessment Technique revealed moderately high positive relationships. A moderate positive correlation was found between originality and aesthetic appeal (*r* = .50, *p* < .01). Strong positive correlations were found between originality and craftsmanship (*r* = .63, *p* < .01) and between aesthetic appeal and craftsmanship (*r* = .65, *p* < .01). The strong positive correlations suggested that compositions that were thought to be highly creative also were likely to be considered to have high craftsmanship qualities, and likewise between aesthetic appeal and craftsmanship qualities. While significantly correlated, the differences in their distributions were varied enough to retain them as unique indicators of the creativity construct.
Measurement Model Factor Analyses

A confirmatory factor analysis using maximum likelihood (ML) estimation in Mplus 7.4 was conducted to determine if the observed variables in the data set adequately represented the latent variables of affect, motivation, classroom environment, and creativity. Maximum likelihood estimation is the most commonly used method in factor analysis and SEM models in literature (Kline, 2011). Most fit indices supported the fit of the measurement model to the data. The root mean square error of approximation test (RMSEA= .06, \( p = .17 \)) which tests poorness of fit, showed reasonable fit. Both the Tucker-Lewis index (TLI= .91) and the comparative fit index (CFI= .93) indicated adequate fit. The standardized root mean square residual (SRMR= .07), which tests the strength of the data correlations to the model correlations, indicated a good fit of the model to the data (Keith, 2006). However, the chi-square exact-fit test (\( \chi^2 = 93.781 \) (59), \( p < .01 \)) was significant, and thus revealed poor fit of the model to the data.

While the model terminated normally, the resulting matrix was not positive definite, which meant that further analysis would be invalid. The software output indicated that the problem involved the latent variable of affect. Parameter estimates for the indicators of affect were not significant, with positive affect at 0.15 (\( p = .58 \)) and negative affect having a large negative correlation at -1.01 (\( p = .56 \)). An exploratory factor analysis (EFA) using maximum likelihood estimation and varimax rotation was performed (Ciorba & Russell, 2014). The specific purposes of this analysis were to discover any unforeseen cross loadings or low factor loadings that were confounding the positive definitiveness of the correlation matrix. Using this method, variables with low standardized loadings below .40 were removed (Tabachnick & Fidell, 2013).
The factor analysis initially extracted four factors, and this was confirmed through observation of the resultant scree plot. However, while the observed variable positive affect had a moderate loading of .60 on the affect factor, the observed variable negative affect had only low loadings below .30 across all factors and was dropped from the model. Unfortunately, in order to effectively conduct CFA and then continue with SEM analysis, each latent factor must have a minimum of two observed variables (Kenny, Kashy, and Bolger, 1998; Kline, 2011). Therefore, because the negative affect variable had to be discarded, the entire latent construct of affect was removed from the model.

Three factors were ultimately extracted from the correlation matrix after the removal of the Affect factor. These factors were supported by literature and a priori theory: motivation, creativity, and classroom environment. There were no cross loadings above .40. Table 4.8 displays the retained factors, variables, and loadings.

Table 4.8

**Exploratory Factor Analysis with Varimax Rotation**

<table>
<thead>
<tr>
<th>Variable/Factor</th>
<th>Motivation</th>
<th>Creativity</th>
<th>Classroom Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Class Compared</td>
<td>.929</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commitment</td>
<td>.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Music</td>
<td>.750</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Concept</td>
<td>.680</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craftsmanship</td>
<td></td>
<td>.876</td>
<td></td>
</tr>
<tr>
<td>Aesthetic Appeal</td>
<td></td>
<td>.732</td>
<td></td>
</tr>
<tr>
<td>Originality</td>
<td></td>
<td>.701</td>
<td></td>
</tr>
<tr>
<td>Relationship</td>
<td></td>
<td></td>
<td>.630</td>
</tr>
<tr>
<td>Involvement</td>
<td></td>
<td></td>
<td>.460</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td>.432</td>
</tr>
<tr>
<td>Orderliness</td>
<td></td>
<td></td>
<td>.430</td>
</tr>
</tbody>
</table>

*Note.* Factor loadings lower than .40 are not reported.
Figure 4.1 shows the respecified model based on a priori theory, literature, preliminary analyses, exploratory factor analysis, and logic. By removing the lower loadings (and thus the affect latent) that confounded a positive definite matrix, the resulting factor loadings produced a positive definite covariance matrix.

![Diagram of the respecified proposed model]

**Figure 4.1.** Respecified proposed model.

In order to confirm the choices made in the EFA, a new confirmatory factor analysis (CFA) was used to test the fit of the measurement model (Ciorba & Russell, 2014). The syntax used for the CFA in Mplus 7.4 can be found in Appendix E. The 146 model observations correspond to the 146 participants that completed the study tasks. The model had 36 freely estimated parameters, based on direct effects, error, and covariances.
All fit indices supported the measurement model fit, indicating that the second measurement model fit the data better than the first. Indices of model fit revealed a non-significant chi-square estimate ($\chi^2=56.245 (41)$, $p = .06$), indicating that the model is consistent with the data (Keith, 2006). The RMSEA ($0.08, p = 0$) showed reasonable fit. Both the Tucker-Lewis index (TLI= .96) and the comparative fit index (CFI= .97) indicated good fit. The SRMR (.06) indicated a good fit of the model to the data.

Examination of the measurement model analysis provided evidence that the 11 measured variables adequately represented the three suggested constructs. The respecified theoretical measurement model with standardized parameter estimates is shown in Figure 4.2. The curved double-arrowed lines represent the covariance between each latent factor. The low values confirm that they are unique factors, with minimal shared variances. The long straight lines represent the predictive power of the latents on the indicator variables, indicated by standard estimates. All standard estimates are large (Keith, 2006) and were statistically significant at $p <.01$. The shorter lines to the right of the indicators represent the variance not explained by the latent variable, indicated by standard error values. The good fit of the CFA suggests that estimation of the predictive latent model is plausible.
Figure 4.2. CFA with standardized maximum likelihood parameter estimates. **p < .01

**Structural Equation Model**

The final structural model was respecified based on the exploratory factor analysis (EFA), and then finally the confirmatory factor analysis (CFA) of the measurement model. Identification of the measurement model indicated that a unique set of parameter estimates was theoretically possible (Kline, 2011). The two-step process of using confirmatory factor analysis to inform and respecify a structural model is considered stronger than a one-step process as it allows for unique examination of both the measurement and structural models independently. Structural equation modeling provides more information regarding the true relationship between latent constructs.
through the filtering out both measurement and unique error, thus providing less ambiguous common variance (Keith, 2006, Kline 2011; Ciorba & Russell, 2014). Figure 4.3 shows the respecified structural model with standardized parameter estimates.

Figure 4.3. Structural model with standardized maximum likelihood path estimates.

Structural equation modeling (SEM) using maximum likelihood (ML) estimation in Mplus 7.4 was conducted to determine the predictive relationships between the latent constructs in the hypothesized structural model. The syntax used for the SEM in Mplus 7.4 can be found in Appendix F. Relative fit indices also supported model fit. The RMSEA (.08, p= 0) showed reasonable fit. Both the Tucker-Lewis index (TLI= .96) and the comparative fit index (CFI= .97) indicated good fit. The SRMR (.06) indicated a good fit of the model to the data. However, because the respecified structural model was “just-identified,” meaning the number of free parameters equaled exactly the number of known values, the latent model fit was then perfect, and the full structural model fit was instead identical to the fit of the measurement model (Kenny, 2011; Kline, 2011; McCallum, 1995; Muthen & Muthen, 2008). Therefore, while fit indices are indicated, they are of
little importance at this second stage of the two-step process. More importantly, despite
being saturated, the model was still identified and thus unique parameters were estimated,
revealing the predictive power between the latent constructs.

Classroom environment had a moderately sized positive effect (Keith, 2006) on
Creativity ($\beta = .14$) after controlling for motivation. Classroom environment also had a
moderately sized, but negative, direct effect on motivation ($\beta = -.17$). Motivation had a
small but meaningful positive effect on creativity ($\beta = .08$) after controlling for classroom
environment. Additionally, the specific indirect effect of motivation was meaningless in
size ($\beta = -.01$, $p = .26$), and was therefore not a significant mediator of classroom
environment’s effect on creativity. These findings are insightful as this is the first model
in which social psychological and classroom environmental factors have been used to
predict creative outcomes in computer-based secondary school music students.

**Discussion**

The purpose of this study was to examine the influence of affect, motivation, and
classroom environment on creativity of secondary students’ computer-based music
compositions in the form of a predictive model. A range of statistical analyses were
utilized in order to understand the data, test the proposed model, and answer the
following research questions:

1. What relationships exist within the latent factors of affect, motivation,
classroom environment, and creativity?

2. Do the observed variables in the data set adequately represent the latent
variables of affect, motivation, classroom environment, and creativity?
3. What is the predictive influence of the latent factors of affect, motivation, and classroom environment on creativity?

**Relationships**

In order to answer the first research question, descriptive and correlational analyses were employed to understand the data at an intimate level, and discover the relationships between the indicator variables within their proposed latent factors. Descriptive analysis was congruent with previous findings during normality testing of the PANAS, in which an increase in the time period rated (“this week” versus “today”) typically reflected an increased likelihood that participants experienced both moods (Watson, Clark, & Tellegen, 1988). The weeklong time frame helped to ensure that the scale was measuring mood states and not traits (George & Zhou, 2002). This was reflected in the means for both positive affect and negative affect. A bias of positive affect was also present, and has been found in previous research regarding music students (Denison, 2015), in creativity research in organizational management (George & Zhou, 2002), in research based on flow and visual creativity (Cseh, Phillips, & Pearson, 2015), as well as during the development of the PANAS (Watson, Clark, & Tellegen, 1988). This bias was expected from students that choose computer-mediate music courses as a course option in school. Correlational analysis ($r = -.26, p < .01$), which was consistent with previous creativity research (Cseh, Phillips, & Pearson, 2015; George & Zhou, 2002; Watson, Clark, & Tellegen, 1988), also confirmed the general understanding that when students have higher positive moods, their negative mood tends to be less, although this is not a clear-cut dynamic.
Descriptive analysis of the motivation variables indicated that participants appeared to be highly committed to, and motivated in their music class, which is expected from students that chose the computer-mediated music courses as a course option within their school curriculum. Additionally, they appeared to be highly motivated, albeit to a slightly less degree, in their music class when compared to other classes. Participants also indicated moderately high self-concept of their musical competence, which was also expected of music students with at least one-semester of experience using GarageBand in their music classes. Correlations between the motivation indicators of self-concept and personal commitment \(r = .50, p < .01\), and between self-concept and school music \(r = .46, p < .01\), were moderately positive. This indicated that as participants’ self-concept of their musical abilities increased, so did their personal commitment to music and motivation in their school music class. This supports previous research regarding students’ motivation to study music (Eccles, 1982).

Although strong positive correlations were found between self-concept and music class compared \(r = .65, p < .01\), between personal commitment and music class compared \(r = .75, p < .01\), and between school music and music class compared \(r = .68, p < .01\), they were retained in the analysis due to the variety in their distributions. Additionally, these high correlations are unsurprising, as these motivational factors are logically closely related. It is reasonable to assume that as a student’s motivation in music class increases in comparison to other classes, that student’s personal commitment to music would also increase (Gumm, 2004). Additionally, as their self-concept of musical ability increased, it makes sense that their motivation in music would increase as well.
(Eccles, 1982; Coughlin, 1994). Moderate and high correlations were also found during scale validation testing (Asmus, 1989) and in previous studies (Denison, 2015).

Because of the non-normal distributions of the classroom environment variables, as well as lower reliabilities found in previous studies, a principal component factor analysis was conducted to develop a stronger set of indicator variables. The analysis resulted in four factors, which was consistent with previous studies (Trickett & Moos, 2002; Wright, Cowen, & Kaplan, 1982). The four factors (Control, Relationship, Orderliness, and Involvement) all provided a “simple structure” with no cross-loadings above .4 (Tabachnick & Fidell, 2013). Wright, Cowen, and Kaplan (1982) also reduced the scale items due to distribution issues, resulting in the four factors of involvement, control, order and organization, and affiliation. Though not completely identical, the factors identified through the principal components analysis in this study shared much of the same construct elements within the four factors. Small, positive, and significant relationships were found between almost all variables except relationships and orderliness, in which a strong positive significant correlation was found ($r = .75, p < .01$). This strong correlation indicated that as the class structure and organization increased, social interactions and affiliations also increased. This was expected as music classes are often structured in ways that promote a sense of community and collaborative music making. Conversely, control and orderliness had a very small, positive, but non-significant correlation. This non-significant relationship was interesting and somewhat counter-intuitive since control items such as rule clarity and task orientation would seem closely related to behavioral management, all of which are inherently part of a teacher’s
classroom management approach. However, a linear relationship was barely present indicating that these two factors were quite unique in this study.

Descriptive analysis of the creativity variables indicated that the judges tended to rate creativeness and craftsmanship of the compositions higher than the aesthetic appeal. Additionally, judges tended to have less agreement on aesthetic appeal. This was likely due to the personal preference of what one considers appealing aesthetically, and this preference can vary greatly between individuals. The strong, positive, and significant correlations between originality and craftsmanship and between craftsmanship and aesthetic appeal indicated that compositions with high craftsmanship were generally found to be more aesthetically appealing and original. This is unsurprising given that technical qualities, appeal, and originality tend to be inherent in what many consider creative within the arts (Amabile, 1982), and that complete separation of these qualities is impossible. However, the discriminant validity was evidenced in that it was at least possible to somewhat separate these dimensions given that correlations were strong, but not reaching a perfect correlation. Moderate and high correlations were also found in several validity test studies utilizing the Consensual Assessment Technique (Amabile, 1982) and in its use in musical creativity research (Hickey, 1995).

Factor Analyses and Models

The preliminary descriptive and correlational analyses indicated that the data were suitable for further investigation. Therefore, in order to answer the second question of whether or not the observed variables adequately represented the latent variables of affect, motivation, classroom environment, and creativity, several factor analyses were necessary. Literature across various domains theoretically supported the effect of social
psychological and contextual factors on creative outcomes. In particular, the literature supported the inclusion of affect, motivation, and classroom environment as predictors of creativity regarding secondary students’ digital compositions.

An initial confirmatory factor analysis (CFA) was conducted in order to address the second research question. However, a non-positive definite covariance matrix due to the affect latent prevented further analysis of the CFA. In order to understand the confounding variable, and to ensure no further complications such as high cross loadings between factors existed, an exploratory factor analysis was conducted (Ciorba & Russell, 2014; Kline, 2005). Despite its support of inclusion in the model, the affect latent was dropped due to low loadings of the negative affect variable across multiple factors and best practices of needing at least two observed variables for confirmatory factor analysis (Kenny, Kashy, and Bolger, 1998; Kline, 2011). It should be noted that the affect latent, when indicated using the PANAS subscales, was also found to be problematic, confounding of a positive-definite covariance matrix, and ultimately dropped from a predictive model in a previous study (Denison, 2015). This issue occurred in both studies despite differences in correlations, and therefore warrants further investigation. The resulting EFA with the 11 retained observed variables produced a simple-structure on the three remaining factors with no cross-loadings above .40. By removing the confounding variable, a positive definite covariance matrix was produced through a respecification of the measurement model.

In order to confirm the decisions made in the EFA, and again attempt to address the second research question, a new CFA was used to test the fit of the respecified measurement model. All fit indices supported the measurement model fit, providing
evidence that the 11 indicator variables adequately represented the three theorized latent constructs (Kline, 2011). The absolute standardized parameter estimates within the respecified measurement model (Figure 4.10, p. 95) indicate that the latent constructs are unique factors with minimal shared variance, evidenced by low covariance values. The predictive power of the latent factors on the indicator variables were large and statistically significant at $p < .01$ (Keith, 2006). The good fit of the CFA suggested that estimation of the predictive latent model was possible.

To answer the third question regarding the predictive influence of the latent exogenous variables on the outcome variable of creativity, a final structural model was respecified without the affect latent, based on the EFA and CFA of the measurement model. Structural equation modeling (SEM) was then conducted to determine the predictive influence of classroom environment and motivation on creativity. The model identification was then “just-identified” since the newly specified model dropped the latent construct of affect. This meant that model fit statistics only concerned the measurement model of the full SEM. However, just-identified models still indicate that a unique set of parameter estimates for the structural model is possible (Keith, 2006; Kenny, 2011; Kline, 2011; McCallum, 1995).

The standardized parameter estimates within the respecified structural model (Figure 4.11, p. 96) are compelling, as this the first attempt at understanding the interaction of social-psychological and classroom environment factors on the creativity of secondary music students’ digital compositions. In addition, this is the first attempt to combine these factors within a predictive model while utilizing the Consensual Assessment Technique as the measure of indication for creativity in music.
CHAPTER FIVE
SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary

Despite the lack of a widely accepted theory of creativity, there is growing consensus regarding the inclusion of multiple social, psychological, and contextual components in the assessment of creative products. An understanding of how this particular context interacts with the person-level aspects of creativity, with the added pervasiveness of technology in music classrooms, was of particular interest. This study sought to derive a clearer understanding of how the interactions between the computer-mediated context and social-psychological factors influenced the creativity of digital music composition products in secondary students. The approach to aid in this understanding was to test a theoretically proposed statistical model of these factors.

The review of literature revealed support for various possible relationships between the contextual element of classroom environment, and students’ affect and motivation on creative music outcomes. However, the interaction and influence of these factors has not been clear-cut. Affect has been shown to directly influence creative outcomes (Isen, 2000; Isen & Reeve, 2005), mediating motivation on creativity (Asmus, 1996), and being mediated by motivation on creativity (Isen & Reeve, 2005; Erez & Isen, 2002; Byron, Khazanchi, & Nazarian, 2010; Watson, 1994). This is perhaps due to the influence of context (George & Zhou, 2002). Motivation has also been supported as a predictor of outcomes, as well as a moderator in regards to many factors (Hurley, 1993).
If social psychological variables such as affect and motivation can have a direct and simultaneously dynamic influence on creative musical outcomes, how then does the context impact these interactions? While several studies had qualitatively investigated the creative processes of students composing in computer-mediated environments (Gall & Breeze, 2005; Jennings, 2005; Reynolds, 2005; Seddon, 2007), none had evaluated the quality of compositional products with consideration of these contexts. Furthermore, no literature was found that attempted to grapple with these factors simultaneously, which would arguably present results more representative of real-life occurrences (Amabile, 1983).

As an avenue for addressing these seemingly dissimilar theories and findings, structural equation modeling provided an appropriate method for combining and investigating the interactions of these factors simultaneously. Due to this study being the first to combine these elements from a music education perspective, as well as the first to examine these elements in the context of computer-mediated classroom environments, the scope and specific methods of investigation had to be limited in order to make such a study plausible.

The observed variables chosen to indicate the overarching latent factors of affect, motivation, classroom environment, and creativity were based on literature, logic, experience, and theory. Affect was indicated by positive and negative affect, as measured by the Positive and Negative Affect Scale (PANAS; Watson & Clark, 1999; Watson, Clark, & Tellegen, 1988). Motivation was indicated by the variables of ability self-concept, personal commitment, school music, and music class compared to other activities, as measured by the Asmus Measure of Motivation: Magnitude of Motivation.
Measure (AMM:MM; Asmus, 1989). Classroom environment originally indicated the following nine factors: (1) student involvement, (2) affiliation, (3) teacher involvement, (4) task orientation, (5) competition, (6) order and organization, (7) rule clarity, (8) teacher control, and (9) innovation. It was measured using the classroom environment scale (CES; Moos and Trickett, 1974). From these combinations of proposed factors, a theoretical model was created. The three research questions sought to examine the correlations and modeling of the observed variables, and then also test the proposed influences of the latent factors. The proposed full structural model included all variables that were deemed relevant to the study.

The evaluation of the creativeness of students’ digital music compositions in relation to the dynamic interactions between social psychological and contextual factors was insightful, and the method of assessing creativity was another important aspect in this study. The use of the Consensual Assessment Technique (Amabile, 1982) provided a uniquely appropriate measurement for of creativity given its contextual sensitivity. For this study, the three observed variables were based on the three constructs cited within CAT literature: originality, craftsmanship, and aesthetic appeal.

The participants of the study were high school music students enrolled in non-traditional computer-based music courses at two charter high schools in Illinois and one private high school in New York. IRB and site permissions were granted from the University of Miami, as well as all schools involved. Information and permission forms were sent to and collected from students and parents, and a Skype presentation was made to each site regarding the purpose and procedures, and to answer any questions prior to data collection. Initially, 228 students were solicited for participation, however only 173
returned all necessary consent and assent forms. The total number of participants that completed all tasks for the study and returned all forms was \( N = 146 \), and thus provided the data used for analysis.

In addition, due to the use of the CAT subscales (measurement indicators for creativity), a creative task was necessary and the use of multiple raters was required. In order to meet several validity requirements of the CAT, and for the purposes of this study, the raters were (a) trained musicians, (b) had at least 2 years of experience with musical composition activities, and (c) had at least 2 years of experience in teaching non-traditional music courses to secondary students. Eleven graduate music education students that met these criteria were selected to judge the digital compositions.

Data collection consisted of several components, all of which were completed digitally over the course of one week for each site: a motivation survey (AMM:MM); a classroom environment survey (CES); an affect survey (PANAS); and a creative digital composition task using Garageband. Participants used Edmodo secure content management system as the route to access links to all surveys and to upload their digital compositions. All surveys utilized Qualtrics online survey software. Raters \( (N = 11) \) were then asked to judge, using Qualtrics online software, roughly 30-40 compositions a week. The data collection period lasted three months.

Data analysis employed IBM SPSS Statistics 24.0 software for descriptive, correlational, reliability, and exploratory factor analyses. Mplus 7.1.4 software was used for confirmatory factor analysis and structural equation modeling.
The first research question sought to determine the relationships within the latent factors of affect, motivation, classroom environment, and creativity. Preliminary statistical analyses generally revealed that the indicator variables for affect, motivation, and creativity showed normal distributions, correlations that support their relevance to each other while remaining unique, and acceptable levels of reliability. However, analysis also revealed non-normal distributions and low reliabilities in the classroom environment measures, and therefore principal components factor analysis with Varimax rotation was used to eliminate cross loadings and to combine factors. The factor analysis resulted in four factors: relationship, control, orderliness, and involvement, all of which had acceptable levels of reliability.

The second research question sought to determine if the observed variables adequately represented the latent constructs of affect, motivation, classroom environment, and creativity. A confirmatory factor analysis using maximum likelihood estimation was used in order to assess the fit of the measurement model and covariance between the latent variables. However, this resulted in a non-positive definite matrix, preventing further model testing at this stage. An exploratory factor analysis with Varimax rotation revealed low and cross loading with the negative affect variable, resulting in the dismissal of the affect latent from the model. Confirmatory factor analysis using maximum likelihood estimation was applied to the respecified measurement model, and resulted in a positive definite matrix. All observed variables revealed strong path coefficients and strong correlations to the latent factors. Low standardized covariance values between the latent variables indicated that they were unique within the model. Absolute and relative fit indices all supported good model fit.
The third research question sought to determine the predictive influence of the variables and latent factors of affect, motivation, and classroom environment on creativity. Structural equation modeling was applied to the respecified structural regression model, which tested the direct effects of classroom environment on motivation and creativity, and of motivation on creativity, and the indirect effect of motivation as a mediator between classroom environment and creativity. Classroom environment had a moderate positive direct effect on creativity and a moderate negative direct effect on motivation. Motivation had a small but meaningful positive direct effect on creativity. However, the indirect effect of motivation was too small to be meaningful, and was therefore not a significant mediator of classroom environment on creativity. Because it was dropped from consideration during testing of the measurement model, the influence of affect was not realized.

**Conclusions**

Several conclusions can be drawn based on the results of the data analysis. A predictive model of the creativity of digital music compositions in secondary students can be created and tested. Furthermore, the good fit of the measurement model supports the use of the AMM:MM, CES, and Consensual Assessment Technique subscales as indicators of the motivation, classroom environment, and creativity latent constructs.

Positive and negative affect indicators had a low, but significant, negative correlation, which was unsurprising. It is reasonable to expect one’s positive mood to decrease as negative mood increased, and vice versa. However, the small value of correlation suggests that this shift in mood is not black and white; mood can be thought of as being on a spectrum rather than one or the other. This is fitting considering the
various possible dynamics at play within any classroom setting that may influence both positive and negative affect simultaneously. Furthermore, the EFA revealed that positive affect had a moderately strong loading on the affect factor, but negative affect did not. More importantly, a large negative correlation of negative affect revealed during the original CFA indicated that this variable was problematic. Because it was necessary to drop the affect latent from the model, its predictive influence on creativity and as being possibly mediated by motivation remains unknown. Lastly, support for PANAS subscales as indicators of an affect latent construct was voided.

The motivation of high school students in computer-mediated classroom environments has a small positive influence on the creativeness of their compositional products. However, the classroom environment negatively impacted their motivation. As the music classroom context and social interactions increase, students become less motivated, have less self-concept, and are less committed in and to the music class. Importantly, self-concept, commitment to music, motivation in music class, and motivation in music class compared to other classes are all highly significantly related, which would be expected in music courses elected by secondary students. These elements all strongly contribute to students’ overall motivation regarding their computer-mediated music course. However, motivation is not a significant mediator of classroom environment’s influence on creativity.

The classroom environment of computer-mediated music courses has a moderate influence on the creativeness of digital compositions in high school students. The classroom environmental variables of control, orderliness, relationships, and involvement all contributed largely to the latent factor of classroom environment. Therefore, as the
music classroom context and social dynamics such as relationships, teacher and student involvement, organization, structure, and teacher control increase, so does the creativity of the digital composition products, but at a moderate level.

Originality, aesthetic appeal, and craftsmanship all largely contribute to the latent construct of creativity. While raters are able to discriminate between these qualities, they are least able to do so between aesthetic appeal and craftsmanship. In fact, all three variables presented moderate to strong correlations, and were significantly correlated. This is supported by previous literature (Daignault, 1996; Hickey, 1995, 2001; Priest, 2001a). Despite these correlations, the raters were able to discriminate between these dimensions, as evidenced in the descriptive analysis. This supports the discriminant validity of the Consensual Assessment Technique (Amabile, 1982). Raters agreed the least on aesthetic appeal, which supports the notion that aesthetic appeal is largely based on personal preference and can vary greatly between individuals. Despite this slight variance in consensus, the importance of aesthetic appeal as a contributing element of what one considers creative was validated in this study.

**Recommendations for future research**

While the information gleaned from the results of this study are insightful, more questions and implications for further investigations also became apparent. Replications of the originally proposed model with a larger sample size are recommended to confirm the structural model. While both an EFA and CFA were employed to select and confirm the structure prior to SEM, this resulted in a number of items being removed. Therefore further improvements to this model are recommended.
One of the most glaring implications is regarding the necessary removal of the affect latent. The negative affect indicator presented particular problems within the covariance matrix, inhibiting valid CFA results. However, the PANAS test has been well-supported throughout factor analysis literature and therefore further investigation is warranted. Often when issues such as these arise in statistical modeling software outputs, it indicates some model misspecification, usually suggesting the need for more factors (Muthen & Muthen, 2012). It is then possible that an expansion of this model would make inclusion of the factor functional in analysis. The PANAS as measured indicators of a latent confounded the positive definitiveness of previous research analysis matrices (Denison, 2015), and is of particular curiosity. Furthermore, investigating the use of other measurements of affect or mood states in order to provide additional measures of the latent construct may add robustness and parsimony to the model in this regard.

Questions remain regarding the lack of normal distribution as possibly weakening some variables’ indications on the factor analysis and models. This question is particularly relevant for the CES scale, which had some undesirable skewness and kurtosis on several items before being factor analyzed. Further investigation of this particular data set using resampling techniques such as bootstrapping may be useful. Additionally, the utilization of the full CES Form R, rather than the Short Form S, may also aid in stabilizing and strengthening the data, as the Form R contains more items per subscale.

While this study reveals insightful information about predicting creative outcomes with general computer-mediated music learning environments, many variations of these settings, such as hybrid, flipped, blended, and online, exist (Horn & Staker, 2014).
Therefore we still have much to learn about the nature of these environments in regards to musical creativity. Replications of the model testing and comparisons of the effects within the various computer-mediated learning environments, as well as comparisons to traditional environments, might prove especially insightful. Additionally, this study was conducted with high school students, and though not as frequent, computer-mediated music learning contexts do exist with younger populations. Thus, replications of this study with younger populations would also be useful. Lastly, while this study utilized digital compositions as the product assessed for creative qualities, the Consensual Assessment Technique is designed to be applicable to any creative context, and therefore a comparison of this model to a replication utilizing digital improvisation may reveal differences in the manner of interactions between the social psychological and classroom environmental factors.

A focused investigation comparing the different types of computer-mediated environments using the CES would be informative due the variations seen in these learning environments. This would provide understanding of the value of each item on the scale in factor analysis in these contexts, as well as to aid in a more crystallized understanding of these environments and the interactions and climate within them.

The effects of a small sample size cannot be understated in statistical modeling. While the sample size collected in this study was adequate for modeling structure and to detect statistical power, an increase in sample size would enhance statistical power, and may crystalize the influential relationships between the latent variables. Additionally, a larger sample size may also produce more satisfying normality statistics to support the model.
At the proposal stage of the dissertation, the model also included proposed effects of personality and creative style as exogenous latent variables. These two variables were strongly supported through the literature, and further testing of an expanded model is desirable. The variables were dropped from the study due to feasibility and practicality concerns at the recommendation of the dissertation committee. The inclusion of these factors, as well as reconsideration of the affect latent, would offer more opportunities to examine competing models, parsimony, and model fit at the structural stage due to opportunities to create an over-identified model.

**Limitations**

Several issues present limitations to this study. First and foremost, although computer-mediated music courses are in existence, they are still sparsely scattered throughout the country in comparison to more traditional music courses, and vary greatly from school to school. This population development is still in its infancy, but has seen rapid growth within the past five years due to budget parsimony, widespread technology integration and daily personal use, and the need for music teachers to find alternative opportunities for music making in schools. However, knowledge of and gateway access to these schools mostly relies on professional networking and word of mouth, providing a practical hindrance to the gathering of large samples. Additionally, as previously mentioned, the variation between these schools is such that defining strict attributes for inclusion in population sampling can be tricky. Often the approaches that music teachers use in computer-mediated settings fall under different camps of model classifications,
such as “flipped,” “blended,” and “fully online,” but these should be thought of as on a spectrum rather than a strict separation. This contributes to issues of definition, attributes, and inclusion criteria.

These participants were all from computer-mediated music courses, and met specific criteria, including having at least one semester in which Garageband has been previously used. This likely controlled for variations in experience and technical facilitation of the program. Also, because they utilized Garageband, this also controlled for variance in software capabilities and sound palettes that would otherwise be evident in the digital tracks. Therefore any generalization of these results can be applied to this particular context, but may not be appropriate in others.

An inherent limitation of latent modeling is the possibility of overburdening participants with various measures of data collection. In addition, four different tasks were asked of the participants, one of which, the creative task, required considerable time and energy. These issues, combined with practical concerns of executing these tasks with minimal disruption to the classroom teacher’s daily planned curriculum and routine, created data collection procedures that reached the maximum request of participation within the one week timeframe. Therefore, the inclusion of additional factors was not practically feasible and would have likely produced burnout for the participants.

The need to utilize expert raters to evaluate the creative qualities of the digital compositions created limitations in regards to pacing of data collection, as well as limitations to sample size in the event a large sample was taken. Although the order of the music tracks was randomized for each rater in order to account for fatigue in
responses, aural exhaustion and burnout were still tendencies present. Therefore, the timeliness of data collection, and use of each rater was limited in this regard.

**Implications for Practice**

The results of this study extend beyond implications for music education research, and into the paradigm of active music teaching and learning. Although the scope of this study is limited, practical applications can be gleaned from the direction and magnitude of the effects seen in the model.

Perhaps most important is the role of classroom environment on creativity. In this study, the social aspects such as affiliation, relationships, and teacher and student involvement, as well as classroom management elements of organization, rule clarity, strictness, orderliness, and control affect student creativity in a positive manner. This implies that as the social interactions and organization increase within the classroom, the students tend to produce more creative digital compositions. Additionally, the strong correlations seen between the classroom environment indicators of relationships and orderliness imply that more structure and organization within the classroom environment will promote more social interaction and affiliations, which in turn enhance creativity.

The Miell and MacDonald (2000) study on the impact of social variables on children’s musical creativity supports this implication, as the compositions created by friend-groups were generally rated as having higher levels of creativity versus those created by children in isolation or those partnered with a child they had not met previously. Therefore, by implementing a more structured and regulated space for students to collaborate, they will
likely develop stronger bonds and communication between themselves and also with the teacher. This may, in turn, promote higher levels of creativity within their digital music products.

Another important role is that of motivation on creativity. Moderate to high correlations between the motivational aspects of self-concept, motivation in school music, personal commitment to music, and motivation in music class compared to other classes, suggest that all are related and will change in a sort of parallel fashion. For example, if a student in the computer-mediated music class feels increasingly motivated in the class, they will also likely feel more committed to music, develop a higher self-concept, and will likely be more motivated in music when compared to the other classes. This relationship is linked to creative output as well. The more students feel motivated in their music class, the more creative their digital music compositions are likely to be. It is important to remember that the predictive power of motivation on creativity, as found in this study, is small but meaningful. While the creativeness is likely to increase, it likely will not be a stark difference that is noticeable immediately.

Lastly, the role of classroom environment on motivation is compelling and creates an interesting situation in practical use. Examined independently, the results suggest that the social aspects such as affiliation, relationships, and teacher and student involvement, as well as classroom management elements of organization, rule clarity, strictness, orderliness, and control affect student creativity in a negative manner. In other words, as the social and management design increase within the classroom, the students tend to be less motivated. The ability for teachers to find balance between these two areas is often a
struggle in which only the most seasoned teachers often execute. However, in computer-mediated environments, the strategic and systematic use of headphones for certain activities, while not for others, can help navigate this discourse.

The model in this study supports the use of motivation and classroom environment as predictors in the creativeness of students’ digital music compositions. This is the first model that includes both contextual and social psychological variables as predictors of creativeness based on the Consensual Assessment Technique in computer-mediated music learning environments. The magnitude of these predictions provide important information for both research and practical use, and support the use of a multi-componential and interactive model when considering creative outcomes in these specific technological environments. This study indicates that the use of contextual and social psychological factors can predict the creative quality of music compositions as evaluated using the Consensual Assessment Technique, and encourages expansion and building of models to provide comprehensive and holistic perspectives on musical creativity.
References


Kirton, M. (1978). Have adaptors and innovators equal levels of creativity? *Psychological Reports, 42*, 695-698. doi: http://dx.doi.org/10.2466/pr0.1978.42.3.695


Webster, P. R. (2002). Creative thinking in music: Advancing a model. In T. Sullivan & L. Willingham (Eds.), *Creativity and Music Education (Research to Practice)* (pp. 16-33). Edmonton, AB: Canadian Music Educators’ Association.


Appendix A

Asmus’ Magnitude of Motivation in Music (AMM:MM; Asmus, 1989)

Test Items

Subscale Codes:
SC: Self-Concept
PC: Personal Commitment
SM: School Music
CO: Music Class Compared to Other Activities

Test Items:
SC  I am a good musician.
PC  Music is a very important part of my life.
SM  I work hard to do well in my music classes.
CO  I like myself best when I am making music.
PC  Listening to music is more important to me than watching television.
SM  I enjoy music class more than other classes I take.
CO  I want to be involved in musical activities more than in other activities.
PC  I would rather make music than read a book.
SM  Music class is my favorite class of the day.
CO  Attending a musical activity is more important to me than attending a sports activity.
PC  If I could, I would spend more time listening to music.
SM  I find music classes to be more exciting than some other classes I take.
CO  I am willing to put more time into my music than any other of my interests.
PC  If I can, I will be involved with music all my life.
SM  Music class is never a waste of time.
CO  I can do without other things, but I have to have music.
PC  I think about music frequently.
SM  I find music class to be very stimulating.
CO  I am willing to work harder on my music than on anything else.
PC  Music is one of my favorite activities.
SM  If I had my way, I would spend more time in music class.
CO  I would like to pursue a career in music.
SC  I am an excellent music student.
Appendix B

Positive and Negative Affect Schedule (PANAS; Watson & Clark, 1999)

Test Items

Positive Affect Items:
- Interested
- Excited
- Strong
- Enthusiastic
- Proud
- Alert
- Inspired
- Determined
- Attentive
- Active

Negative Affect Items:
- Distressed
- Upset
- Guilty
- Scared
- Hostile
- Irritable
- Ashamed
- Nervous
- Jittery
- Afraid
Appendix C

Classroom Environment Scale (CES; Moos and Trickett, 1974)

Short Form R Items

Subscale code:
SI: Student Involvement
TI: Teacher Involvement
AF: Affiliation
TO: Task Orientation
CO: Competition
OO: Order and Organization
RC: Rule Clarity
TC: Teacher Control
IN: Innovation

Test Items:
SI Students put a lot of energy into what they do here.
AF Students in the class get to know each other really well.
TI This teacher spends very little time just talking with students.
TO Almost all class time is spent on the lesson for the day.
CO Students don’t feel pressured to compete here.
OO This is a well-organized class.
RC There is a clear set of rules for students to follow.
TC There are very few rules to follow.
IN New ideas are always being tried out here.
SI Students daydream a lot in this class.
AF Students in this class aren’t very interested in getting to know other students.
TI The teacher takes a personal interest in students.
TO Students are expected to stick to classwork in this class.
CO Students try hard to get the best grade.
OO Students are almost always quiet in this class.
RC Rules in this class seem to change a lot.
TC Students who break rules in this class are sure to get in trouble.
IN What students do in class is very different on different days.
SI Students are often “clock-watching” in this class.
AF A lot of friendships have been made in this class.
TI The teacher is more like a friend than an authority.
TO We often spend more time discussing outside student activities than class-related material.
CO Some students always try to see who can answer questions first.
OO Students fool around a lot in this class.
RC The teacher explains what will happen if a student breaks a rule.
TC The teacher is not very strict.
New and different ways of teaching are not tried very often in this class.

Most students in this class really pay attention to what the teacher is saying.

It’s easy to get a group together for a project.

The teacher goes out of his or her way to help students.

Getting a certain amount of classwork done is very important in this class.

Students don’t compete with each other here.

This class is often in an uproar.

The teacher explains what the rules are.

Students can get in trouble with the teacher for talking when they’re not supposed to.

The teacher likes students to try unusual projects.
Appendix D
Composition Rating Form for Judges

Directions:

1. Rate the melodies on these categories.
   1. Score them against each other rather than some absolute standard.
   2. You may listen to each composition as many times as you would like.
   3. Though it is certainly possible to give similar ratings on all three dimensions, do not allow how you rate on one dimension to effect how you rate the composition on the other two dimensions.
   4. Please rate the compositions independently from the other judges.

<table>
<thead>
<tr>
<th>Composition 1:</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Craftsmanship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Aesthetic Value</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composition 2:</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Craftsmanship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Aesthetic Value</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composition 3:</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Craftsmanship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Aesthetic Value</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composition 4:</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originality</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Craftsmanship</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Aesthetic Value</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Mplus Syntax for Confirmatory Factor Analysis

TITLE: CFA10noaffect

DATA: FILE IS studentdatatotal3.csv;
    NOBSERVATIONS ARE 146;

VARIABLE: NAMES ARE Control Relation Order
           Involve Self Commit School Class
           AA Craft Create Pos Neg;
USEVARIABLES ARE Control Relation Order
              Involve Self Commit School Class
              AA Craft Create;

ANALYSIS: ESTIMATOR= ML;

MODEL:
    Creative BY AA Craft Create;
    Motivate BY Self Commit School Class;
    Cenviro BY Control Relation Order Involve;

OUTPUT: SAMPSTAT CINTERVAL MODINDICES (ALL) STAND RESIDUAL
        TECH4;
Appendix F

Mplus Syntax for Structural Equation Model Analysis

TITLE: Structural Model noaffect

DATA: FILE IS studentdatatotal3.csv;
     NOBSERVATIONS ARE 146;

VARIABLE: NAMES ARE Control Relation Order Involve Self Commit School Class AA Craft Create Pos Neg;
     USEARIABLES ARE Control Relation Order Involve Self Commit School Class AA Craft Create;

ANALYSIS: ESTIMATOR= ML;

MODEL:
     Creative BY AA Craft Create;
     Motivate BY Self Commit School Class;
     Cenviro BY Control Relation Order Involve;

     Creative ON Cenviro Motivate;
     Motivate ON Cenviro

MODEL INDIRECT:
     Creative IND Cenviro;

OUTPUT: SAMPSTAT CINTERVAL STAND RESIDUAL MODINDICES (10);