Abstract

The purpose of this study was to evaluate the effects of a composition program in Public Schools (CiPS), on cognitive skills essential for academic success. The hypothesis is that composition instruction will promote creative expression and performance on music-specific skills such as music reading, as well as foster analytical/aural skill development associated with vocabulary, arithmetic, and speed abilities. Two sixth-grade classes assigned to the experimental (n = 15) (n = 13) groups completed a series of standardized neuropsychological and cognitive assessments pre and post-instruction. Results of a Repeated Measures ANOVA (Time) indicate significant (p < .05) enhancements in arithmetic performance of the experimental group compared to controls. These results suggest that creative experiences with notational symbols, sequence creation, and analytical compositional concepts impact student performance in subject areas depending upon analysis and manipulation such as arithmetic.

Introduction

Music education programs prepare the mind for learning in many cognitive domains. Previous research suggests that musical training enhances general cognitive abilities as spatial temporal reasoning (Hetland, 2000; Rauscher, Levine, Shaw, Wright, Newcomb, 1997; Rauscher & Zupan, 2000), verbal memory performance (Ho Chan, 2003; Rickard, Vasquez, Murphy, Gill, & Toukhatsi, 2010) and executive function (Bugos, Perlstein, McCrae, Brophy, & Bedenbaugh, 2007). In addition, cognitive enhancement through music education programs impact learning and achievement academic subject areas. Musicians score higher on standardized math and reading achievement assessments compared to non-musicians (Fitzpatrick, 2006; Joh Memmott, 2006). Research supports a relationship between musical training and understanding of numerical concepts (Gardiner, 2008). Evidence from neuroimaging shows cortical links between areas of activation associated with musical training in mathematical computation, suggesting potential overlap between learning and memory systems (Schmithorst & Holland, 2004). The purpose of the present study was to investigate the effects of music training in composition instruction on music reading, procedural vocabulary performance, verbal fluency, and arithmetic computation.
While this body of research suggests connections both anatomically and behaviorally between musical training and cognitive abilities, results of other studies reveal contradictory findings. Bahar and Christiansen (2000) found enhanced mathematical performance by music students in conditions where mathematical tasks contained structure as those in music. If the task was not structured similarly, no significant difference in performance was found. Results of a longitudinal study examining piano instruction on arithmetic performance in fourth-grade students found enhancements (Costa-Giomi, 2004). It is also unclear as to whether those music programs innately demonstrate higher academic achievement or if musical capacity to enhance other learning domains. For instance, a comparison of academic achievement and mathematical achievement among high school students with music credits compared to students without music credits reveal no significant difference in academic achievement (Cox & Stephens, 2006).

Despite this research, little is known as to what specific musical activities have potential to prepare the mind for learning. It is widely acknowledged that instrumental training produces many general benefits. Instrumental music instruction is co-taught as a foreign language in the school curriculum of some countries such as those in which all elementary students are provided two years of instruction on an ensemble instrument (McPherson, 2005). While instrumental training is valuable, musical activities such as composition may also foster general cognitive development. Composition instruction requires complex integration of a spiral curriculum of musical knowledge, skills, and instrumental skills. Few articles detail transfer effects of composition to other cognitive domains; however, research in clinical populations suggests composition instruction has the capacity to enhance self-concept (Colwell, Da Schroeder, 2005). The present study investigated the effects of a composition program in areas associated with academic performance in middle school students. The rationale is that any project-based composition program that incorporates collaborative composition and compositional teaching practices with technological comprehensive musicianship has the capacity to engage multiple learning domains. It hypothesize that a novel composition program that incorporates critical thinking, theory and musical performance could enhance areas associated with general achievement such as vocabulary, arithmetic performance, and processing speed.

Composition instruction is an important part of the music education curriculum opportunities to foster creativity and nurture musicianship skills. Even though it is a natural part of music education and included in the National Standards for Education in the United States, many music educators in the U.S. report using composition infrequently in the classroom (Strand, 2006). One reason for reported infrequent use of composition by music educators stems from a lack of familiarity and knowledge of compositional teaching practices. Many additional challenges such as competitiveness, goals, teaching loads, class size, and technology limitations are cited as limiting opportunities for composition activities. Research in other countries reports similar challenges. For instance, results of another study conducted in Slovenian elementary schools, educators may not be aware of strategies to teach composition and implement it (Rozman, 2009). Due to the 2002 counter-reform in Spain, music education was restricted to instruction that included declarative knowledge and lacked authentic music skills such as performing or composing (Rusinek, 2007). Many educators in Spain are reluctant to include student-centered pedagogies such as composition (Rusinek, 2007). A key challenge is to develop new composition include learning opportunities related to compositional teaching practices, mir
technology requirements, and comprehensive musicianship skills. The purpose of the present study was to examine the effects of a novel composition program, CoPublic Schools, on skills necessary for academic success.

Frequently, the focus of activities in a music classroom is on replication of performance rather than generation (Csikszentmihalyi & Custodero, 2002). While performance is essential in developing and refining musicianship skills, composition instruction further contributes to aural and intellectual development of a musician. Research suggests that part generative musical activities fosters creativity, critical thinking, and aesthetic sensibility (Barrett, 2006). While much is known about the intrinsic benefits (i.e. overall creative thinking, and problem solving) of engaging in compositional activities, less is known about the cognitive benefits related to engagement in compositional activities. The best approaches for teaching composition in classroom.

Composition Pedagogy

Many music educators understand that composition instruction during the elementary and middle school years encompasses social and cultural contexts (Barrett, 2006) of “creative collaboration” is especially important in a learning environment. Composition instruction incorporates revision and spontaneous sharing of ideas during the process of writing (Webster, 2003). According to Webster, three main variables are necessary to facilitate group composition, those variables include: work environment, project experience, and peer scaffolding (2003). These variables can also be related to Csikszentmihalyi’s concept of flow and optimal experience (1975). According to research examining the impact of flow on creativity, a learning environment that fosters creativity and a sense of flow (Bryne, 2006). A sense of flow involves attention to detail, concentration important for teaching and learning. Focused concentration on a specific subject matter in which instruction offers some challenges and information to gain skills necessary to complete challenging tasks may have the capacity to influence other learning domains (Bugos et al., 2007).

In addition to the context for creative musical activities, research provides recommendations for structuring compositional activities. Prior research in composition education shows that children illustrate unique characteristics in their approach to composition based upon choices such as range (Kratus, 1989; Kratus, 1994; Kratus, 1996), other pedagogical recommendations from the literature suggest providing strategic prompts such as phrases or motives, access to materials such as pitches or rhythmic values, and opportunities that involve action-based projects (Webster, 2003).

The Composers in Public Schools (CiPS) program, a novel composition program encourages a collaborative creative environment through a focused progressiv-curriculum with project-based goals that emphasize skill development and comprehensive musicianship. The CiPS program incorporates all of these pedagogical practices in a curriculum that has the capacity to be implemented in a variety of educational settings and grade levels. The goal of the present study was to examine the effects of Composers in Public Schools on cognitive and academic performance of grade students. We hypothesized that participation in the Composers in Public Schools...
(CiPS) program enhances performance in music reading, processing speed, verbal performance, verbal fluency, and arithmetic computation for the experimental group compared to controls who do not receive CiPS instruction.

**Methodology**

**Participants**

Participants consisted of one sixth-grade general music class and one sixth-grade general education class assigned to experimental (n = 15; mean age 11.20 years) and control (n = 13; mean age 11.23 years) groups respectively. All participants were enrolled in music and physical education coursework for one semester in a "rot system or "wheel" system. Students not enrolled in music or physical education in the first semester were assigned music or physical education courses the second semester for research participation in either group. Classes were taught in the same classroom with a 38% free and reduced lunch status in the Southeastern United States. Only members of the experimental group received the CiPS program. Members of the control group did not participate in music courses. All post-testing was administered upon the completion of the CiPS program. Only students who returned completed parent consent and assent forms participated in testing in accordance with Institutional Review Board (IRB) and the County School Board.

**Procedure**

Participants completed a short questionnaire regarding demographic information and previous musical experience. All students participated in two group-administered testing and post-testing sessions. Cognitive assessments were administered on school days in two class periods (40 minutes each). Only members of the experimental group received the CiPS program. Members of the control group did not participate in music courses. All post-testing was administered upon the completion of the CiPS program.

**Description of Assessments**

*Intermediate Measures of Music Audiation* (IMMA; Gordon, 1986): measures musical ability by responses to determine if melodic phrases are the same or different. This music aptitude provides tonal and rhythmic composite scores based upon auditory matching. The IMMA was chosen for its reliability (content validity).

*Music Reading Assessment* (MRA; Bugos & Groner, 2009): measures music reading knowledge of treble and bass clef as well as knowledge of basic musical symbols. The MRA measures information regarding domain-specific learning in music reading.

*Delis-Kaplan Executive Function System* (D-KEFS; Delis, Kaplan, & Kramer, 2005): *Modified Verbal Fluency* subtest: Each 60-second trial consists of including as many words that begin with specific letters of the alphabet as possible. Words selected could not include proper names, people, places, or numbers. Form 1 was used for pre-testing, and Form 2 was used for post-testing to remove potential practice effects.
Group Modified Wechsler Intelligence Scale for Children IV (WISC-IV; Wechsler modified version for group assessment included the Vocabulary, Arithmetic, Search, and Coding subtests. Group modification of each subtest consisted of administration and aural script of vocabulary words. The Vocabulary subtest provided a definition of specific words. The Arithmetic subtest required form calculations including basic addition, subtraction and multiplication. The Symt subtest comprised of a visual scanning task for symbols matched to a target in time limit of two minutes. The Digit Coding subtest evaluated planning, visual processing speed in a paper pencil completion task. Symbols given in a code of numeric stimuli were to be placed in the box below corresponding numbers. Dumont (2004) examined the reliability of the WISC-IV and report reliability of .94 (Verbal Comprehension), .92 (Perceptual Reasoning), .92 (Working Memory (Processing Speed) and .97 (Full Scale Intelligence Quotient). Internal consist WISC-IV ranges from .79 – .90, and internal consistency is lowest for 6 year-highest for 12-, 15-, and 16-year-olds (Sattler & Dumont, 2004).

Composers in Public Schools (CIPS) Program

The Composers in Public Schools program provides opportunities for students music while learning specific compositional and stylistic concepts. Each unit of consists of various compositional experiences integrated with technology. Ind lessons focus upon clear project goals. Lessons include composing for a “virtu percussion pieces, vocal and instrumental blues pieces, recorder and ensemble as vocal compositions. Students participate in discussions regarding com techniques such as sequence and retrograde, followed by group creation of m such tools and techniques (Figure 1). Demonstrations of concepts and active in learning compositional concepts serve to promote a sense of ownership. Op for performances and discussion about performances are fostered through ins

Figure 1. An example of a completed piece titled, “Mysterious Harmony,” for \percussion

![Mysterious Harmony](image)
Implementation of the CiPS program included four-months of weekly compositional instruction administered by a university professor of composition and highly trained graduate composition students. Graduate composition students were trained in curricular content of the program, required to observe instruction, and meet with the professor to discuss program performance. The middle school music education program provided basic rhythmic notational instruction to students and background information about composers prior to the integration of the CiPS program and music classes on compositional skills addressed by the composer. Each compositional skill correlated to previous learning established by the music educator. The music program systematically incorporated compositional skills taught by composers in conjunction with prior-developed lessons to ensure compliance with state and national standards.

Data Analysis

Independent samples t-tests were used to examine potential group differences in demographic variables. All other data were analyzed using separate 2-Group (Experimental, Control) X Time (Pre-test, Post-test) analyses of variance (ANOVA) with group as a between-subjects factor and time as within subjects factor over an independent cognitive domain of verbal fluency, vocabulary, arithmetic, and speed. A group by time interaction indicates a differential response to training. Effect size coefficients (d) are reported upon for significant group X time interaction (1992). Interpretation of effect size of .2 to .3 is considered a small effect, .5 medium effect, and .8+ is considered a large effect (Cohen, 1992).

Results

Results of a t-test on age and music aptitude show no significant differences between groups (Table 1). Results of a Group (Experiment, Control) X Time (Pre-test, Post-test) ANOVA on the Music Reading Assessment (MRA) indicate no significant differences between groups, $F(1,26) = .002$, $p = .96$. No main effects were found.
Demographic Table with Means (SD)

<table>
<thead>
<tr>
<th></th>
<th>Experimental Group (n = 15)</th>
<th>Control Group (n = 13)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/Female</td>
<td>7/8</td>
<td>7/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>11.20 (.41)</td>
<td>11.23 (.73)</td>
<td>-0.14</td>
<td>0.89</td>
</tr>
<tr>
<td>MRA Pre-Test</td>
<td>18.13 (24.54)</td>
<td>19.85 (19.55)</td>
<td>-0.20</td>
<td>0.84</td>
</tr>
<tr>
<td>MRA Post-Test</td>
<td>19.33 (21.42)</td>
<td>21.23 (19.76)</td>
<td>-0.24</td>
<td>0.81</td>
</tr>
<tr>
<td>IMMA Tonal All</td>
<td>34.4 (2.0)</td>
<td>33.2 (2.1)</td>
<td>1.50</td>
<td>0.14</td>
</tr>
<tr>
<td>IMMA Rhythmic All</td>
<td>33.5 (2.3)</td>
<td>34.0 (2.8)</td>
<td>-0.56</td>
<td>0.58</td>
</tr>
</tbody>
</table>

*Note: MRA, Music Reading Test; IMMA, Intermediate Measures of Music Aud

Results of a Group (Experimental, Control) X Time (Pre-test, Post-test) ANOVA Arithmetic subtest scores revealed significantly enhanced performance for the group compared to controls, $F(1, 26) = 6.64, p = .02$ (Table 2).

Table 2.

Means (SD) of Repeated Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Experimental Group (n = 15)</th>
<th>Control Group (n = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Correct Verbal Fluency Pre-Test</td>
<td>23.47 (6.26)</td>
<td>26.08 (7.81)</td>
</tr>
<tr>
<td>Total Correct Verbal Fluency Post-Test</td>
<td>27.53 (8.18)</td>
<td>27.69 (8.31)</td>
</tr>
<tr>
<td>Digit Coding Pre-Test</td>
<td>42.60 (12.41)</td>
<td>54.46 (17.19)</td>
</tr>
<tr>
<td>Digit Coding Post-Test</td>
<td>53.40 (11.33)</td>
<td>55.08 (9.09)</td>
</tr>
<tr>
<td>Symbol Search Pre-Test</td>
<td>28.93 (8.49)</td>
<td>28.77 (6.61)</td>
</tr>
<tr>
<td>Symbol Search Post-Test</td>
<td>32.73 (7.38)</td>
<td>31.08 (11.01)</td>
</tr>
<tr>
<td>Vocabulary Pre-Test</td>
<td>19.07 (8.89)</td>
<td>22.54 (6.58)</td>
</tr>
<tr>
<td>Vocabulary Post-Test</td>
<td>20.33 (8.99)</td>
<td>24.85 (7.01)</td>
</tr>
<tr>
<td>Arithmetic Pre-Test</td>
<td>11.07 (1.53)</td>
<td>13.69 (3.09)</td>
</tr>
<tr>
<td>Arithmetic Post-Test</td>
<td>12.07 (2.12)</td>
<td>12.77 (2.71)</td>
</tr>
</tbody>
</table>

No main effect for time was found, $F(1, 26) = .01; p = .92$. We further exami size associated with the performance on the Arithmetic subtest. Cohen’s ($d$) is calculated based upon means and standard deviations between the performa experimental and control group (1992). According to Cohen’s coefficient, our small effect ($d = .33$) for group differences on the Arithmetic subtest (Figure
A series of Group (Experimental, Control) X Time (Pre-test, Post-test) ANOVA conducted for the Verbal Fluency, Vocabulary, Digit Coding, and Symbol Search (Table 2). No significant group interactions were found for Verbal Fluency, $F(1, p = .32$; Vocabulary, $F(1,26) = .37, p = .55$; Digit Coding, $F(1,26) = 2.80, p$ Symbol Search, $F(1, 26) = .29, p = .59$ subtests. Main effects for time were for Verbal Fluency, $F(1,26) = 5.42, p = .03$; Vocabulary, $F(1,26) = 4.34, p = .05$ Search, $F(1,26) = 4.89, p = .04$ subtests only.

Discussion

Our original hypothesis was that participation in the Composers in Public Schools (CiPS) program would enhance performance in music reading, processing speed, vocabulary performance, verbal fluency, and arithmetic computation. Results show improvements in arithmetic scores, but not in other cognitive measures. While scores on measures of place demands on processing speed such as the Digit Coding and Symbol Search reveal enhancements, due to a relatively large variance in scores, these enhancements were not significant.

Our data indicate enhancements in arithmetic performance resulting from participation in the Composers in Public Schools (CiPS) program. As shown in Figure 2, the experimental group demonstrated a 23.7% increase in arithmetic performance on a 34-item subtest, while the control group did not show such a pattern as a function of the Arithmetic subtest contains high reliability of .94 (Ryan, Glass, & Bartels, 1976) of the pre/post-testing was just over for...
the increase in scores by the experimental group can not adequately be explained by practice effects. These data are consistent with previous findings investigating the effects of music instruction on standardized English and math assessments (Johnson, 2006). We hypothesize that some concepts/skills reinforced in the CiPS program, such as music reading (decoding), sequencing and pattern recognition, may have contributed to the experimental group’s success on the Arithmetic subtest.

Our overall results are consistent with previous data regarding the relationship between music and mathematics. Results of a meta-analysis indicate modest support for the relationship between music and mathematical abilities (Vaughn, 2000). Further research is necessary to examine the relationship between music and mathematics. The field of mathematics includes examining quantity, structure, space, and change, and this investigation focused on the effects of a novel composition program on arithmetic performance. Further research is necessary to examine the relationships between skills learned in music instruction related to abstraction reasoning and those skills employed in algebra, geometry, or analysis.

We found no significant differences between groups with regard to music reading performance. Students performed similarly on music reading skills as measured by the Music Reading Assessment (MRA; Bugos & Groner, 2009) at both time points. It was surprising, since the middle school general music instructor and the composition program included instruction on music notation and reading skills. The program engaged students in a variety of musical experiences including performing, creating, notating, and evaluating music. While the program was comprehensive, practice with notational skills was not required. It may be necessary to provide opportunities for practice with music notation (i.e., assignments and drills) in order to demonstrate enhancements in this area.

Our data reveal no significant differences with regard to verbal fluency and vocabulary performance. We originally hypothesized that composition instruction would enhance vocabulary due to the introduction of new vocabulary describing patterns and concepts. However, vocabulary knowledge did not transfer to items on the standardized assessment. While we observed an increase in verbal fluency performance by the experimental group, the variance among these scores was high. Further research is necessary to explore the effects of composition instruction on vocabulary and verbal fluency performance.

Composition programs such as the CiPS focus on a large array of skills. This provides some insight into areas most sensitive to compositional programs. We found increases in arithmetic performance, an area similar to composition as it requires analytical skills and relies upon sequence. In addition to the intrinsic benefits of music education, knowledge of musical structure through composition may have the potential to enhance cognitive abilities essential to academic success.

Limitations and Potential Explanations

One limitation of the current research design was the usage of relatively intact classes. Students with formal musical training were the only group disqualified from participation. Students with experience in band, orchestra, private lessons, or currently reading music were disqualified. Due to exclusionary criteria, a relatively small sample size was employed in this research design. However, without exclusionary criteria, we would not be able to isolate the independent variable in composition instr
In addition, while demographic variables were collected on students and all attended the same community school, no specific data were collected on individual students regarding socioeconomic status. In addition, composition lessons in the program focused primarily on western musical styles. More research is necessary to examine outcomes of the CiPS method of composition using non-western music. This information would be helpful in the design of future composition-based programs.

**Implications for Music Educators**

The results of this research add to the preponderance of evidence suggesting that training has the capacity to prepare the mind for learning in certain subject areas. Education programs should not be justified or evaluated by potential external participation in music programs provides intrinsic benefits and fosters aesthetic development. A comprehensive music education encourages creativity and critical thinking; most importantly, can broaden and enrich a child’s life. Composition, an important component of comprehensive music education, promotes creativity and communication in a learning environment.

Our findings show increases in arithmetic abilities as a result of a group-based composition program, Composers in Public Schools. Project-based composition programs that incorporate creative collaborative composition and compositional teaching with technology and comprehensive musicianship have the capacity to engage learning domains and provide an optimal learning experience. Students gain accomplishment by implementing concepts and skills recently acquired into their compositions. Student compositions serve as an assessment tool and an opportunity for students to experiment with new ideas. For instance, Figure 2 illustrates the students’ knowledge of complementary rhythmic patterns between wind and percussion parts. New ideas can only occur in a learning community that values contributions by all. The structure of the Composers in Public Schools program offered a supportive environment which ideas are discussed. Decision-making and critical thinking opportunities for students to reflect on concepts and serve to establish a learning community (Collins, 2005). Research on child development stresses that intellectual development is related to a child’s learning environment (Crncec, Wilson, & Prior, 2006). Music educators should strive to foster a community of learners through a cooperative experimental learning environment that embraces creativity.

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**References**


http://www.stthomas.edu/rimeonline/vol10/bugos.htm


**About the Authors**

Jennifer Bugos, Assistant Professor of Music Education at the University of South Florida, received a BA in music education from the University of Florida, MA in music therapy from the University of Central Florida, and PhD in music education with a minor in gerontology from the University of Florida. Bugos’s main research interests include the neurological basis for music perception and cognition with regard to human development, lifespan learning, and cognitive transfer. She currently supervises student teaching at the University of South Florida. Her research has been featured at international conferences such as the American Orff Schulwerk Conference, MENC Conferences, Society for Neuroscience, and the International Conference on Music Perception and Cognition.

Edward Jacobs is Professor of Music at the East Carolina University School of Music with training in jazz performance, composition and conducting from University of Miami, Amherst (BA), University of California, Berkeley (MA) and Columbia University (PhD). His music has been performed by groups including the JACK Quartet, earPlay, Errant Ensemble, Meridian Arts Ensemble, NewEar, Second Instrumental Unit, and Speculum Musicae, and at the Festival of New American Music, the Third Practice Festival, Louisville New Music Festival, the World Saxophone Congress, and the NeXt Festival. His activities have also included the founding and direction of the AnNewMusic@ECU Festival, and work in the Pitt County Public Schools, with mid general music teachers in his “Young Composers Project,” which strives to make the creation of music a fundamental part of our children’s’ education.