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Executive Function Improvement of Third-Grade Students with Varied Adverse Childhood Experiences After an Arts-Enhanced Instructional Approach.

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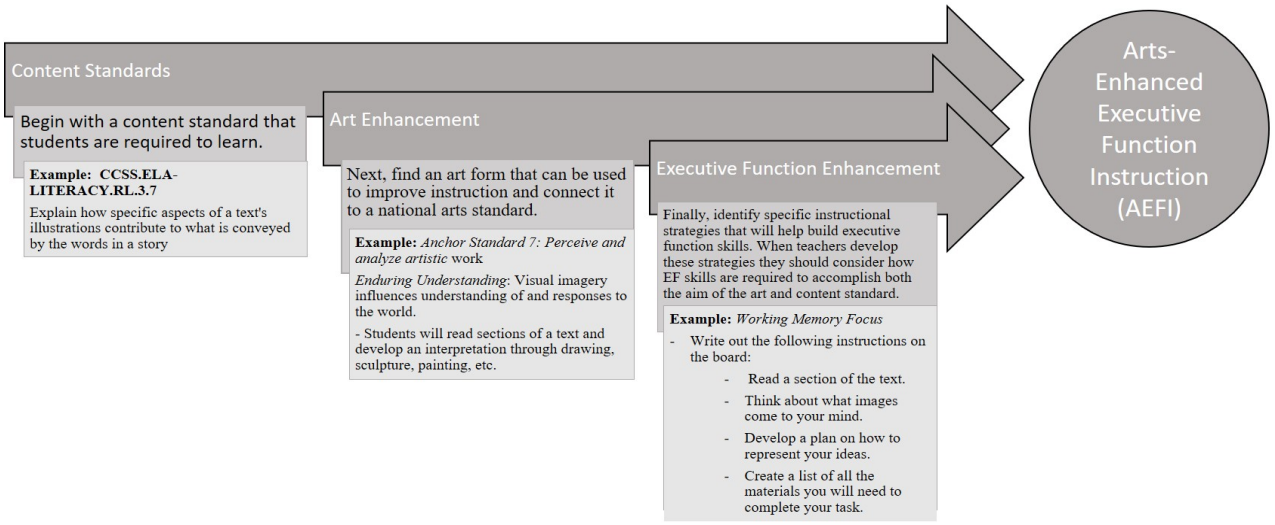
Abstract

This paper shares the results of an exploratory study that measured the change in Executive Function (EF) skills of At-Risk third-grade students with varying Adverse Childhood Experiences (ACEs) before and after an Arts-Integration (AI) program. Student EF skills were measured using the Minnesota Executive Function Scale (MEFS) and a statistically significant increase in EF skills was observed in the post-test. In addition, a regression analysis was conducted to determine if students with a high level of ACEs improved at a different rate than students with a low level of ACEs and it was found that the number of ACEs was a significant predictor of improvement on the MEFS. The article describes why students with high ACEs would likely have EF skill deficiencies, why EF skills are important for success in school, and how using the arts in curricula can help develop EF skills in students.

Introduction

The aim of this paper is to share the results of an exploratory study that measured the change in Executive Function (EF) skills of a group of third-grade students with varying Adverse Childhood Experiences (ACEs) before and after an arts-enhancement program. The authors created an approach called Arts-Enhanced Executive Function Instruction (AEFI) by taking state-level content standards, pairing them with a National Coalition for Core Arts Standards (NCCAS), identifying EF skills embedded in the NCCAS, and designing an art-enhanced lesson plan focused on the EF skills required to complete all of the tasks (see Figure 1).



In this study, the authors partnered with a group of third grade teachers at a school that is dual-labeled as a federally-identified low-income school and a School in Need of Assistance (SINA). The teachers were required to perform daily review lessons on previously taught Common Core literacy or math content. The partnering teachers indicated that all the students in the study had consistently performed below grade-level expectancy on assessment. Furthermore, previous review lessons designed for using a direct-instruction approach did not result in any significant improvement of test scores. The authors worked with the teachers to design review lessons, but added a type of art-enhancement to the instruction to determine if they had any effect on the students' EF capability. This study did not measure improvement of academic success on these standardized measures, but, instead, focused on how the intervention that the authors designed had affected the students' EF abilities, as these skills are the building blocks for success on academic tasks (Alexander, 2019).

The teachers in the study had a daily schedule that did not allow for any deviation in their instruction time, so a separate lesson was not an option. Instead, the authors simply adjusted the lessons during their allotted review time by adding art-enhancement in order that the intervention did not require the teachers to adjust their instructional schedules. The authors chose to work with a school with a high percentage of students whose parents or guardians qualify as low Socio-Economic Status (SES) or live below a measure of the poverty index. These identifiers typically correlate with high ACE scores (Last, Lawson, Breiner; Shonkoff, &

Garner, 2012; Steinberg, & Farah, 2018), which, in turn, correlate with a deficiency of EF development (Barta, 2018; Treat, Sheffield, Williamson, Hays-Grudo, & Laurin, 2019), including issues with memory (Diamond & Taylor, 1996), following a list of simple directions (Greenberg, Riggs, & Blair, 2007), and ability to overcome failure (Rothbart, Posner, & Kieras, 2006).

These school-based competencies are challenging for students with underdeveloped EF skills and will likely result in their falling behind their peers on academic tasks (Alexander, 2019; Goldberg, 2001). A recent survey found that almost half of the students in the United States have experienced at least one ACE, and one fifth of the students have experienced more than one, which can manifest itself in extreme, acute behavior issues and long-term learning and physical complications (Sacks, Murphey, & Moore, 2014). The large number of students who are exposed to ACEs is alarming, and all members of the education community should take note of this trend.

Gilhooly, Fioratou, Anthony, and Wynn (2007) found that individuals with better developed EF capacity were able to switch their problem solving strategies more easily than those with lower EF capacity, highlighting the importance of developing these skills as a critical aspect of the process of understanding content. Most students enhance their EF capabilities by learning how to navigate relationships and conflict at home and in school (especially elementary). However, shifts in accountability legislation have caused teachers to spend more time on interventions designed to raise test scores and less time on activities that promote non-academic skills, such as self-regulation, task initiation, and organization through play or the arts (Diamond & Lee, 2011; Tough, 2016; Robinson, 2015). After the No Child Left Behind Act (NCLB, 2002) was passed, funding streams flowed toward subjects like math and reading, because school accountability was directly connected to scores on standardized tests in those areas (Beveridge, 2009). The effects of this shift have resulted in a reduction in funding for the arts in schools and a change in instructional practice that center on core subjects that would potentially better prepare students for success on assessments required for advancement to the next grade level (Dee & Jacob, 2011; Vargas, 2017). With teachers and administrators facing immense pressure to improve standardized test scores, it has become difficult to invest instructional time on non-traditional pedagogy when much of their day is focused on preparing for those mandatory assessments.

An underutilized way to address student lack of EF skills is to use the arts as instructional practice or enhancement to traditional pedagogy (Diamond & Lee, 2011). Recently, the Harvard's Graduate School of Education through the Center on the Developing Child (2014), released a list of resources for educators and parents to help develop EF skills in students. Some of their suggestions include song and movement games, physical activities, drama, imaginary play, storytelling, and yoga.

With these ideas in mind, the authors developed the AEFI approach to help students who did not score proficiently on assessments when the topics were initially taught using more traditional instructional methods (i.e., direct instruction). These lessons were taught to all students and took only 20 minutes of instructional time each day for five months. In addition, a meta-analysis by Moss, Benus, and Tucker (2018) indicated that teaching through the arts improves the academic achievement of students in low Socio-Economic-Status (SES) and suggested that a reason could be that the approach enhances EF skills. This study builds on that work and aims to measure if EF skills improved before and after the AEFI program, thus looking

at a potential explanation for some of the variance in this academic improvement Moss et al. (2018) have reported. In the following sections, the framework of the study, research design, results, and impact for future work will be discussed.

Theoretical Framework

Adverse Childhood Experiences and Executive Function Skills

ACEs are stressful events that include physical or mental abuse, witnessing domestic violence, food insecurity, and other traumatic experiences (Felitti, 2009; Franke, 2014). These emotional strains occur primarily outside of school but can affect student behavior in the classroom, including an inability to focus, lack of inhibitory control, and working memory dysfunction (Arnsten, 2009; National Scientific Council on the Developing Child, 2010). Similarly, Blodgett and Lanigan (2018) noted a correlation between ACEs and behavioral issues, school attendance, and failure to meet grade-level standards in mathematics, reading, and writing.

Numerous other scholars have expressed concerns about ACEs and their effect on students' ability to reason and their contributing factor in off-task behavior (Larkin, Shields, & Anda, 2012; National Scientific Council on the Developing Child, 2014). Consistent experience with ACEs have resulted in observed behavior in school-age students, such as lack of curiosity, low self-esteem, self-sabotaging behaviors, difficulties in regulation, memory impairment, inability to overcome failure, maladaptive self-soothing behaviors, and hyperactivity (Cook et al., 2005; Evans & Wachs, 2010; Loman, & Gunnar, 2010; Perry, 2009; Siegel & Bryson; 2015; Wiik, Loman, Frenn, Pollak, & Gunnar, 2011). Conversely, multiple studies have found a direct correlation between students' EF skills and their success on academic tasks (Bailey, Andrzejewski, Greif, Svingos, & Heaton, 2018; Gumora G., Arsenio 2002; Latzman, Elkovitch, Young, Anna, & Clark, 2010).

The literature that has been discussed sets up a dilemma for teachers who are tasked with improving test scores of students who have multiple ACEs. If these students are not developing EF skills needed for school, it is critical that teachers develop strategies to teach them as a part of their curriculum. However, since schools federally identified as "low-income" are likely going to have a large percentage of students with multiple ACEs, and those schools typically perform poorly on standardized tests, due to the reasons listed above, many of their teachers will feel pressure to raise test scores and decide to use direct instruction to "teach to the test" (Banilower et al., 2018; NRC, 2012).

In addition, recent research has indicated that, when students have multiple ACEs, the compounding effect correlated to students having a negative attitudes toward school is that they are less likely to complete their required homework than children who had no ACEs (McDowell, 2017). A large meta-analysis by Hughes et al. (2017) examined how individuals with multiple ACEs compared to those with no reported ACEs. They found that those with multiple ACEs had higher incidences of physical inactivity, obesity, smoking, heavy alcohol use, cancer, heart disease, and mental health. In another review, Liming and Grube (2018) looked at studies where individuals were exposed to two or more ACEs and found an association between multiple ACEs and negative behavioral, social, emotional, and overall self-reported well-being.

It should be noted that literature about the effects of multiple ACEs and academic outcomes is still ongoing, and most of the research in this area has focused on behavioral and physical outcomes. However, the available research has made a correlation between multiple

ACEs and negative outcomes, such as off-task behavior, lack of EF skills, and physical issues, making it likely that these factors will affect school performance. Since this study focuses on ways to potentially improve EF, the scope of the outcomes will focus on these mentioned skills. One way that the authors attempted to improve EF skills was through the AEFI approach, which will be discussed in the next section.

Art-Enhancement Executive Function Instruction (AEFI)

The authors began their development of AEFI by reviewing the literature on Arts Integration (AI), because there is some evidence that the intervention improves EF skills (Malchioli, 2008; Moreno et al., 2011; Shaheen, 2014). However, instead of using a true AI approach similar to Mishook and Kornaber's (2006) description where the arts and content are "co-equal," the authors focused on the fact that core EF skills like inhibitory control, working memory, and cognitive flexibility are clearly required to complete any type of arts-based task. For example, the Kennedy Center for the Performing Arts defines AI as: "an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objects in both (Silverstein & Lane, 2010, p.10)." When a teacher asks students to conduct a creative task in their classroom, it will require multiple steps, planning, and cognitive flexibility, all of which are aspects of EF.

However, when the authors developed their approach, they recognized that they did not meet the specific definition of art-integration, and their ideas aligned more toward Eisner's (2008) perspective that arts provide students an experience that creates meaningful links between the content they are required to learn and experiences that are meaningful to them. When the authors designed the AEFI lessons, they considered an art modality that would enhance the typical lesson plan, so they made the arts component a key aspect of the instruction. However, they did not develop an assessment for the arts, nor did they focus on ways to improve the art form as a part of the lesson. Instead, the lessons connected to the students' personal perspectives of the content through the arts, but also focused on the EF skills required to be successful in the lesson. After considering all of the factors outlined in the introduction and the theoretical framework, the authors defined AEFI as: *An instructional approach that enhances traditional lessons by asking students to connect their personal understanding of content through the arts and focuses on specific executive function skills that make the lessons more successful.*

For example, when the authors designed an AEFI unit aligned to Common Core Math Standard 4.NF.B.3.B - (*decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation),* they began by brainstorming ideas on how to present the content in a non-traditional way that included a form of art. The team decided on having students complete the "fraction pie art" unit where students would create a picture out of shapes and break down each part of the picture by fractions.

Next, the authors looked at NCCAS Media Arts Anchor Standard 1: Generate and conceptualize artistic ideas and work (specifically, *MA: Cr1.1.3- Develop multiple ideas for media artworks using a variety of tools, methods and/or materials*) and identified the following EF skills nestled into the standard:

- Students draw a picture of their favorite animal and identify the different body parts (head, body, legs, etc.).

    - *Working memory* is involved in retrieving the image of the animal from the students' minds, encoding that image and making a model of it through drawing, and retrieving memories of where the animal's body parts are.
        - Students must visualize the animal and begin to plan on what the final product will look like.
        - Instructional Aid: Before the students draw, the teacher will ask the student to close their eyes and visualize what the animal looks like in their mind and to "see" each body part before they draw.
- Hand out multiple pieces of the same shape and ask students to make the animal out of the shapes (see Figure 2).

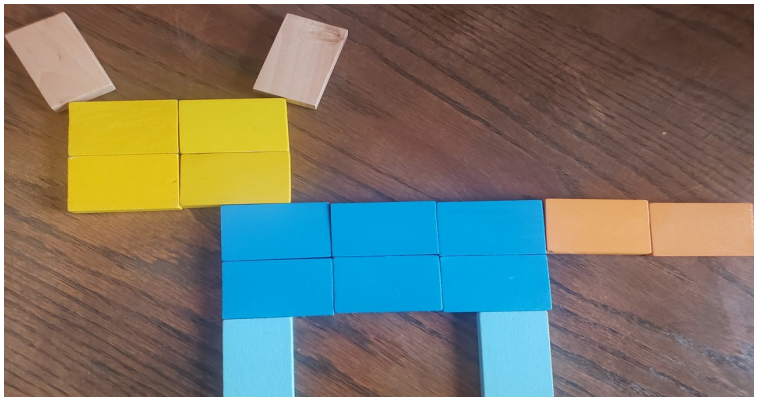


Figure 2- Example of Fraction Art

    - *Cognitive flexibility* is involved when students are asked to shift attention between task sets (drawing to picture art), and change perspectives of what the animal looks like in their drawing, because they will have to make some creative edits when creating the body parts of the animal out of shapes not typically used when drawing the image.
        - Students will generate and conceptualize ways to create the various body parts of the animal by using the shape of choice.
        - Instructional Aid: Ask students to think about how they would make a leg with the shapes they have. The teacher asks the students to make a plan on how they will build each body part of the animal.
- After the students connect all of the pieces to make the animal, ask them to count the total number of pieces used. Have the students write down the total number of pieces used, then the number of pieces used for each body part. Then have students write out a number sentence using the fractions for each part to demonstrate how they add up to a whole (⅛ + ⅛ + ⅜ + ⅜ = 8/8)
    - *Working memory* is involved when students have to retrieve the fraction from each body part, hold that information in their memory, and combine it with the other fractions to add up to a whole.

- Remind students that they visualized the whole animal and now they will deconstruct each part.
- Instructional Aid: Ask students to write out the fraction for each body part and then draw the entire shape, but shade in each part separately. For example, if they used 10 squares to make an image of a cat and used 2 squares for the leg, they will write 2/10 and shade in the two squares used for the leg (see Figure 3).

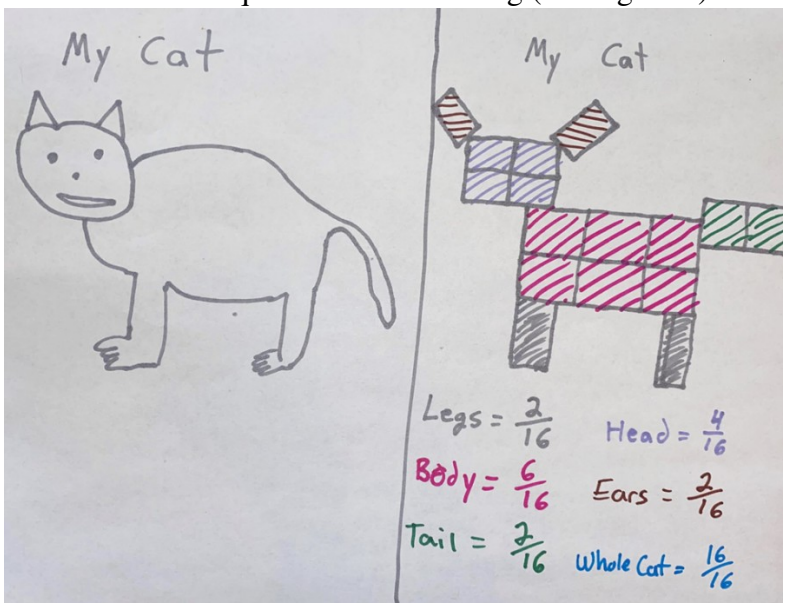


Figure 3- Final Representation of the original drawing and fraction cat.

- Students will take their original drawing and draw a picture of their fraction art next to it. Next, they will shade each body part and write out the equivalent fraction, showing that all pieces add up to a whole. The teacher will put out each student's work, and the class will conduct a gallery walk where students will look at each picture and check to see if the math adds up on each picture.
    - *Inhibitory control and cognitive flexibility* is involved, because students must inhibit their impulses of thinking about how they created their drawing and recognize that different fraction art presentations have different fractions.
        - Students will compare and contrast the different pictures of fraction art.
        - Instructional Aid: Remind students that this gallery walk is a first draft and that they should expect to see errors. Tell students that everyone will have to revise their picture and make a final draft after the gallery walk.

Research Methods

Questions

1. Do daily arts-enhanced executive function lessons improve executive function skills of third grade students?
2. Does a high or a low number of Adverse Childhood Experiences impact the improvement of executive function skills after an arts-enhanced executive function program?

Participants

Four third-grade teachers and their students in a federally-identified low-income school served as the participants in this study. All of the students received AI review sessions described in the previous sections. However, only 62 of their 88 students completed both the pre and post EF assessment. (Students who did not return the participation form, moved, or were absent and did not complete both the pre and post-analysis are not included in the study.) Of the 62 students, 22 are African-American (36%); 16 Caucasian (26%), 10 Hispanic (16%); 9 (14%) are two or more races; and 89% of the students (n=55) qualified for free-and-reduced lunch.

Methods

EF was measured using the Minnesota Executive Function Scale (MEFS; Carlson & Zelazo, 2014). The MEFS is a measure that allows for assessment of executive function skill level, beginning at age 24 months and extending through a lifespan. The MEFS has been used with over 35,000 children and been found to be reliable (Beck, Schaefer, Pang, & Carlson, 2011) and valid (Carlson & Harrod, 2013). It is normed on a U.S. representative sample of 7,410 children, ages 2-13 years, and 553 adults.

The initial MEFS was conducted in early January, 2019, and the post-assessment was conducted in late May, 2019. During the five-month period, the four third grade teachers allowed the authors to create daily review lessons for their students using an AEFI approach. The teachers had 20 minutes of "Concept Review" time built into their schedule at the beginning of the school day, and they allowed the authors to teach at that time. The authors received a topic that had previously been taught by the teachers, and then they created a five-day review lesson plan where they used an AEFI approach and focused on improving EF skills (see Table 1 for an example).

Table 1. *An Example of a Five-Day Unit Plan and explanation of Executive Function and NCCAS addressed.*

Monday	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
Introduce symphony and paint image.	Finish painting and brainstorm the story	Begin writing the story	Work on their story	Present/frame their picture and story.
		EF Skill Emphasis		
Students will use inhibitory control to wait and listen before they paint their pictures.	Students will use their working memory by taking the sound from the symphony and transfer it to a story.	Students will use cognitive flexibility by thinking about how they could change the music into a story.	Students will use cognitive flexibility by thinking about how they could change the song into a story	Students will use their cognitive flexibility by comparing the stories/painting of their classmates to their own work.
		National Art Standard and Connection to EF Skills		
NCCAS: Visual Arts. Identify and describe the presentation conditions, and take on roles and processes in presenting or distributing media artworks. Anchor Standard 6: Convey meaning through the presentation of artistic work.				
Students will develop a personal interpretation of the music and give meaning to the symphony.	Students will have to "keep the end in mind" by visualizing what their final product will look like.	Students will take the story they developed in their mind and articulate it into written words.	Students will look at the story and their painting / drawing and decide if they need to make revisions to either so their presentation is coherent and accurately demonstrates their connection to the music.	During the presentation students should explain how the painting / drawing conveys their personal meaning of the music.

Note – The five day plan was aligned to Common Core Standard RL.3.3 Describe characters in a story (e.g., their traits, motivations, or feelings) and explain how their actions contribute to the sequence of events.

All lessons were taught by the authors or a pre-service teacher who was trained on AEFI through a course taught by two of the authors. In the fall of 2018, a Professional Development

School (PDS) was created between the university and the school that the students in the study attended. Five pre-service teachers who were enrolled in the PDS were recruited to help with the project and trained each week on how to teach the review lesson. The pre-service teachers were paid a stipend for their work through a small grant provided by the university.

For Research Question 1, a paired-samples *t*-test was conducted of the pre and post standard scores on the MEFS to determine if there was a statistically significant change in the scores. The outcome variable used to measure EF was the standard score provided by the MEFS.

For Research Question 2, the authors first had to determine if the number of ACEs predicted improvement on the MEFS, so the authors sought to ask each student to take the Porsche, Costello, & Rosen-Reynoso (2016) National Survey of Children's Health ACEs survey. However, due to the sensitive nature of the questions on the survey and a lack of waiver forms returned from the parents, the information was not obtained. Subsequently, an alternative solution of asking the teachers and the principal to estimate how many ACEs the students in the study had experienced was used to obtain information for Research Question 2. This approach was used because the teachers and principal know detailed background information of every student in the study. Both *in loco parentis* stakeholders were asked to look at the Porsche et al. (2016) survey and estimate if the students in the study had experienced zero or one ACEs, or two or more ACEs.

The authors chose to determine an ACE score of zero or one as "low" and two or more as "high," based on existing research on the topic. Even though one experience with an ACE could cause lasting trauma, some studies noted a correlation between adverse outcomes in children who have experienced more than one ACE and those who reported only one (Chapman et al., 2004; Chartier, Walker, & Naimark, 2010). Other studies have found that, when individuals experience over two ACEs, the risk of short-term and long-term negative outcomes are likely (Felitti, 2009; Mersky, Topitzes, & Reynolds, 2013; Rutter, 1979).

The authors asked the teachers and principal to look at the Porsche et al. (2016) survey and use their knowledge of the students to label the student as high (2 or more items on the survey) or low (zero or one item). Cohen's κ was run, and a high level of agreement was found among the reviewers ($\kappa = .732$, $p < 0.001$). Based on the responses, each student was dummy coded as high or low, and these data were used as the independent variable in the regression. The difference between pre and post standard scores on the MEFS was used to measure student improvement after the AEFI program. This data point was used as the dependent variable in the regression.

Descriptive Statistics

The school where the lessons were taught is a federally identified low-income school in in an urban setting in a Midwestern state in the United States of America. The school was recognized as a School in Need of Assistance (SINA) due to low performance on a state-mandated standardized test.

For Research Question 1, the mean score of the pre-assessment on the MEFS was 84.78 ($SD = 10.23$), and there was a range of a maximum of 115 and a minimum of 61. The mean score of the post-assessment on the MEFS was 104.34 ($SD = 12.66$), and there was a range of a maximum of 124 and a minimum of 76.

For Research Question 2, the outcome variable was computed by taking the difference between the pre and post standard scores on the MEFS. The 62 students in the study had a mean

pre/post difference of 18.6 (*SD* = 13.62). The scores had a range of a maximum improvement of 55 and a minimum improvement of 0. The number of students considered to have high ACEs was 35, and the number of students considered low was 27.

Results

A paired-samples *t*-test was used to determine whether there was a statistically significant mean difference between the original Standard Scores of students before the AEFI lessons and after the five-month program had ended. The Standard Score provided from the MEFS data base was a useful statistic for this project in allowing for a calculation of the probability of a score occurring within a normal distribution of students in the United States and allows for a comparison of two scores that are from different normal distributions. The Standard Score does this by converting scores in a normal distribution to z-scores in what becomes a standard normal distribution. Standard Scores were used in the analysis, because the MEFS data team took national z-scores and converted them to a Standard Score. The assumption of normality was not violated, as assessed by Shapiro-Wilk's test (p = .780). According to Table 2, students scored significantly higher (p < 0.001) on the MEFS after the AEFI lessons than the initial screening before any intervention. The increase in standard scores on the MEFS for students who participated in the AEFI program suggests that the intervention had a positive influence on the students' executive function skills. It should be noted that the researchers were not able to secure a control group for this study. However, the Standard Scores for the MEFS are age-normed (students in the United States), and these results tell us that the within-samples *t*-test run indicates that the students in the study improved more than would be expected by age/maturation alone.

Table 2. Comparison of Means Pre / Post Treatment.

	Pre Treatment		Post Treatment		t-test
	M	SD	M	SD	
Executive Function Skills	84.8	10.2	104.5	12.4	-10.29**

** p < .001 *Note.* Executive Function Skills were measured using the Minnesota Executive Function Scale (MEFS). Pre and Post were measured as a normed Standard Score calculated from the MEFS database.

For Research Question 2, a linear regression was carried out to investigate whether high or low exposure to ACEs predicted improvement on the MEFS. The results of the regression indicated that the estimated number of ACEs did contribute significantly to the regression model ($R_{2\ adjusted}$ = .644, F (1, 60) = 111.39, p < .000; see Table 3). The model explained 64.4% of the variance, which according to Cohen's (1988) guidelines indicates a large effect size.

Table 3. *Regression results*

Variable	*B*	*SE B*	ß	*t*	*p*	CI 95% Lower	CI 95% Upper
Low ACEs	5.24	1.78	-	2.95	.00	1.68	8.79
High ACEs	23.07	2.19	.81	10.55	.00	18.70	27.44

Note- The independent variable (number of ACEs) was collected by a school-wide survey and dependent variable was the change in Standard Score on the MEFS.

Scientific or Scholarly Significance of the Study

The results of this study are potentially useful to both the community of researchers in the field of EF and classroom teachers looking to improve ways to instruct students who have multiple ACEs. In addition, an important finding of this study that has not been previously discussed was that amount of instructional time to implement the AEFI approach was minimal. From a pragmatic standpoint, this is critical for schools that are concerned with students who have deficient EF skills, but insist on using a traditional pedagogical approach in math, reading, science and social studies. The intervention used in the study only took 20 minutes per day and the findings suggest that it had a positive impact on the students' EF skills. It could be argued that if the aim of struggling schools is to improve academic outcomes, then strengthening students' EF skills should be a priority, because they are the foundation required to navigate through complex academic tasks.

As we mentioned earlier, schools that are under pressure to raise standardized test scores have been cutting the arts and promoting more traditional instructional strategies. These administrative decisions are likely due to a belief that if students can remember enough basic facts, they will achieve a proficient mark on the accountability measure. However, this view is shortsighted in focus. If students have not developed the necessary EF skills to retain information and manipulate it in a way to help them achieve success on an academic task (i.e., cognitive flexibility and working memory), all of the time spent on "drill work" will fall short of its goal. Since the authors recognize that the data collected in this study focused only on EF skills, it would not be appropriate to make claims that AEFI will improve student retention of content.

However, as noted in the theoretical framework, there have been multiple studies that have linked EF skill improvement with gains in academic tasks. To achieve success in school, students need to manage their emotions, focus attention, reflect on their work, and organize a plan to revise failures. These skills are often referred to as "non-cognitive" or "soft" skills, but are critical for student success on academic tasks like standardized tests and college entrance exams (Tough, 2016). If the results of this study are replicated, it could be an important instructional aide to teachers that would not require extended instructional time or could be incorporated into current re-teach programs. In this study, just 20 minutes of daily AEFI review lessons over five months improved students' EF scores at a statistically significant rate. The fact that a large number of researchers have suggested that EF skills are critical for school success and extremely important for life-long learning, a cost of 20 minutes of instructional time seems like a substantial value for the potential benefits to students.

Another issue with traditional instruction is that teachers are constantly looking for skills the student does not have and spends little time working with student talent. An AEFI approach flips that scenario and asks students to express their understanding of a phenomenon or content using a form of art that allows them to share their interpretation of what they are studying before they are asked to compare and contrast those ideas with evidence found in books or other sources of information. Constant reminders to students of their deficiencies add to their low self-esteem and cause them to lose hope in their ability to achieve success in school. The AEFI approach used in this study built upon the students' interpretation of the content they had been asked to learn and helped develop trust between the teacher and student, thus opening the door for the student to take risks without the fear of being wrong.

The authors recognize that this study has some limitations, including representation of only one grade level at one school. However, despite the convenience sample used in the study, all of the students attend a federally-identified low-income school, and the majority of the students had at least one ACE. These factors were important to the authors, because research indicates that students in these situations typically have under-developed EF skills.

Additionally, it is uncertain if the art-enhancement aspect of the lessons, the specific detail to EF instruction in the lessons, another aspect of classroom instruction, or a combination of the above, was responsible for the significant gains in EF skills observed in the data. However, all of the teachers in the study claimed that they did not change any aspect of their instruction during the treatment period other than the AEFI review lessons. Further research should be conducted to determine if the arts-enhancement alone, the direct EF instruction, or some combination has more of an impact on EF development.

Researchers who work in the field of arts-based instruction are continually looking for ways to promote more of the practice in classrooms. The data in this study suggest that even programs of brief duration can have a positive impact on students' EF skill development. These skills are vital to success in subjects like mathematics where working memory is associated with multiple skills, such as counting, decoding word problems, and pre-arithmetic skills (De Smedt et al. 2008; Raghubar et al. 2010). Other disciplines, such as language arts, have stressed the importance of students using cognitive flexibility to compare and contrast opposing views of a primary text or inhibitory control to withhold judgment until all of the evidence has been collected (Blair& Razza, 2007, Kieffer et al. 2013). If traditional instructional decision making is not promoting these EF skills in populations of students with deficient skills, an alternative approach, like AEFI, should be considered. By refining our understanding of how knowledge is

developed, researchers can further strengthen and justify why teaching through the arts should be considered.

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