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The Role of Poetry in Cultivating Attentiveness, Curiosity, and Affinity in the Science Classroom

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Abstract

Poetry is endemic to classical education and often studied for its own sake. However, poetry is also posited to possess a pedagogical power not shared by prose or formal scientific language. Poetry's distinctive effects on learning outcomes have been well articulated by philosophers since Plato and Aristotle, but their claims have not been subjected to an empirical test. We fill that gap in this study. We collaborated with a local classical grammar school and divided kindergarten, first grade, and second grade classrooms into two groups for a two-week science unit. One group of classrooms integrated poems about the topic of study into the science unit, while the other group of classrooms did not. Measuring students' levels of affinity, attentiveness, curiosity, and enjoyment of poetry both at baseline and after the poetry intervention, we found that poetry increased students' attentiveness and their enjoyment of poetry. There was less evidence of poetry's impacts on affinity and curiosity. Implications about the role of poetry for teaching and learning and the place of empirical research for classical education are discussed.

Keywords: Poetry, Classical Education, Program Evaluation

The Role of Poetry in Cultivating Attentiveness, Curiosity, and Affinity in the Science Classroom

In the final act of Shakespeare's A *Midsummer Night's Dream*, Theseus remarks, "Lovers and madmen have such seething brains, / Such shaping fantasies, that apprehend / More than cool reason ever comprehends. / The lunatic, the lover and the poet / Are of imagination all compact."[1] This observation suggests that poets possess a perceptive ability not shared by those who rely solely on rational thinking. Poetry, by extension, might reveal insights that straightforward prose or a formal, systematic presentation cannot. This insight is often called poetic knowledge, which James Taylor describes as "an encounter with reality that is nonanalytical, something that is perceived as beautiful, awful (aweful), spontaneous, mysterious…when the mind through the senses and emotions, *sees* in delight, or even in terror, the significance of what is really there."[2]

Poetry is also endemic to classical education, a feature that potentially affects student learning in distinctive ways. In this empirical study, we test claims about the pedagogical power of poetry in the context of a grammar school science curriculum. We divided kindergarten, first grade, and second grade classrooms into two groups for a two-week science unit. One group of classrooms integrated poems about the topic of study into the science unit, while the other group of classrooms did not. For instance, first graders learned about birds during the two-week unit. One class was taught the curriculum with the addition of a series of poems about birds, such as Emily Dickinson's "A Bird, came down the Walk." The other first grade class covered the same curricular content without poetry.

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[1] William Shakespeare. *A Midsummer Night's Dream* (New York: Simon and Schuster, 1993): 143
[2] James Taylor. *Poetic Knowledge* (Albany: State University of New York Press, 1988), 5.

We specifically focused on the effects of integrating poetry on four outcomes: affinity, curiosity, attentiveness, and enjoyment of poetry. Affinity refers to the degree to which students are delighted by the topic of study. Curiosity is defined as the extent to which students want to learn more about the topic, while attentiveness is defined as the extent to which students notice and pay attention to the topic of study in their everyday lives. Previewing the results, we find that students in classrooms that integrated poetry into the science unit grew in attentiveness and their enjoyment of poetry. We did not find differences in affinity and curiosity between the two types of classrooms.

The remainder of the article is divided into four sections. We begin in the next section with a review of the literature on the pedagogical power of poetry, focusing on its capacity to cultivate affinity, curiosity, attentiveness, and further enjoyment of poetry. In the second section, we describe the intervention, our study sample, measurement instruments, and analytical methods. Results of our analysis are presented in the third section. We discuss the implications of our results for teaching practice and offer concluding remarks in the fourth section.

The Pedagogical Power of Poetry

Scientific and Poetic Language and Knowledge

"Epic poetry, tragedy, comedy, dithyrambics, as also, for the most part, the music of the flute and of the lyre—all of these are, the most general view of them, imitations," writes Aristotle (*Poetics*, 1447a). Poems attempt to represent something true about the human experience, the natural world, or any other aspect of reality. All poems share this aim, though they may differ in a variety of ways, such as the form the author uses, the thing that the poem tries to represent, and the medium in which the poem is delivered—the three aspects that Aristotle identified in *Poetics.*

Shakespeare's Theseus recognized this imitative attribute of poetry. Continuing his remarks quoted at the beginning of this article, he states "The poet's eye, in fine frenzy rolling, / Doth glance from heaven to earth, from earth to heaven; / And, as imagination bodies forth / The form of things unknown, the poet's pen / Turns them to shapes, and gives to airy nothing / A local habitation and a name."[3] Poets observe and, through their words, give substance to things that, in some sense, were always there but until then had eluded recognition because there was no language attached to it. As the sound of a tree falling in the woods exists but is not received without a listener present, things throughout the cosmos exist but are not received without language to name it. Poetry, therefore, is a means by which people come to know what is true about themselves and the world they inhabit.

However, poetry is not the only medium through which such naming work is accomplished. Scientific language, specifically, aims to systematically describe things with precisely-defined, technical terms. Indeed, the entire scientific enterprise is grounded in proposing theories and formal models about the material world and empirically testing them through prescribed methods of inquiry that involves measurement and quantitative data.[4] In his book *How Does a Poem Mean?*, John Ciardi contrasts this scientific "language of classification" from the "language of experience" endemic to poetry.[5] Professor John T. Guthrie similarly observes that "[P]oetry is not merely cognitive….the poem gives rise to experience with a spectrum of affects, as well as truth with an array of propositions, our response to it cannot be captured in sensible prose."[6]

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[3] Shakespeare, A Midsummer Night's Dream, 143.
[4] Karl Popper. *The Logic of Scientific Discovery* (New York: Basic Books, 1959).
[5] John Ciardi *How Does a Poem Mean?* (Boston: Houghton Mifflin, 1975).
[6] John T. Guthrie. "A Psychology of Poetry?" *Journal of Reading* 27, no. 6 (1984): 574-576.

Crucially, the linguistic dichotomy articulated by Ciardi and Guthrie map onto Taylor's[7] dichotomy of analytic knowledge gained by rational, scientific inquiry and poetic knowledge gained through experience and participation, raising the possibility that poetic and scientific language may lead to different kinds of knowledge. Ciardi and Taylor seem to suggest as such, with poetic language leading to poetic knowledge and scientific language leading to analytic knowledge. In their respective books, both of Ciardi and Taylor cite the example of Bitzer and Sissy Jupe, two characters from Dickens's *Hard Times*. Bitzer demonstrates that his knowledge of horses is reduced to scientific categories: "Quadruped. Graminivorous. Forty teeth, namely twenty-four grinders, four eye-teeth, and twelve incisive."[8] His understanding of horses originates in an education based on facts and quantification. Sissy Jupe's knowledge of horses, on the other hand, is poetic and grounded in her intimate experience of horses by virtue of her father's vocation as a caretaker of horses. The different ways in which Sissy Jupe and Bitzer know horses validates Thesus's claim that "Lovers and madmen have such seething brains, / Such shaping fantasies, that apprehend / More than cool reason ever comprehends."[9]

The distinction between poetic and scientific language and knowledge is a topic addressed by C.S. Lewis in "Meditations in a Toolshed." He begins the essay by recounting a moment in which he observed a beam of light first by looking at it from the side. He then stepped into the light to look along the beam. With this anecdote, Lewis distinguishes between two ways of how humans come to know something: looking at versus looking along. He explains:

> A young man meets a girl. The whole world looks different when he sees her. Her voice reminds him of something he has been trying to remember all his life, and ten minutes

[7] Taylor, *Poetic Knowledge.*
[8] Charles Dickens. *Hard Times* (New York: W.W. Norton & Co., Inc.), 7.
[9] Shakespeare. *A Midsummer Night's Dream*, 143.

> casual chat with her is more precious than all the favours that all other women in the world could grant. He is, as they say, "in love". Now comes a scientist and describes this young man's experience from the outside. For him it is all an affair of the young man's genes and a recognised biological stimulus. That is the difference between looking along the sexual impulse and looking at it.[10]

Science, Lewis argues, tends to look at things. The observer stands at a distance from the observed, presumably so that the observer can approach the observed with a disinterested posture so as to not subjectively bias the data. The scientist in the example attempts to understand love from this posture. In doing so, the scientist also breaks down the phenomenon into disparate components parts, constructs, and causal factors—namely, genetics and biological stimulus. Poetry, in contrast, looks along the object for insight, that is, to experience and to know it "from the inside."[11] The man in love, in particular, comes to know what love is by being himself immersed in the very experience of being in love. He also experiences love as a single, unified phenomenon.

Notably, Lewis does not claim that looking at is always more legitimate than looking along. He exhorts his readers to exercise discernment because in some instances, one way of seeing will be more valid than the other way. Other times, both ways of seeing may be equally valid or even equally invalid. The implication for educational practice is the potential for students to come to know things by either looking at or looking along. The question remains, nonetheless, whether a particular way of knowing is more conducive to possess either scientific or poetic knowledge. In the next section, we consider how poetry, in particular, potentially cultivates poetic knowledge.

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[10] C.S. Lewis "Meditation in a Toolshed." *God in the Dock* (Grand Rapids, MI: Eerdmans, 1970), 212-215.
[11] Ibid.

Enhancing Science Instruction with Poetry

Poets and scientists make observations. Their eyes are "in fine frenzy rolling" moving "from heaven to earth, from earth to heaven."[12] However, poets and scientists fundamentally relate to objects differently. The project of modern science is often understood as "Man's conquest of Nature," to use a descriptor found in Lewis's *Abolition of Man*.[13] That is to say, science is a means to gain knowledge about how to efficiently manipulate the material world to overcome particular human constraints. Such an understanding contrasts with that of the natural philosophy that predates it. Natural philosophy aims to understand nature so that humans can live in accordance with it. While modern science aims to seize and instrumentalize nature, natural philosophy aims to receive nature as gift and to steward it. Modern science also has a tendency to reduce, categorize, and break down nature to achieve those ends. Scientists define technical terms and construct formal models to organize nature into rational systems. Conversely, natural philosophy attempted to see the coherence and integrity of all things as they are. These two views reflect the different ways Bitzer and Sissy Jupe understood horses.

The distinctiveness of modern science raises the issue of whether there are ways to enhance contemporary science instruction and to recover elements of natural philosophy in science education. Given the differences between the language of poetry and language of science, could poetry play a particular role in helping educators, as Guite mused, "imagine a new natural philosophy" where students can be "truly human" and "participate" in "that great ritual / Pattern of nature, beauties branching out / The cosmic order, ceremonial, / Regenerate science, seeing from within…?"[14]

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[12] Shakespeare, *A Midsummer Night's Dream*, 143.
[13] C.S. Lewis. *The Abolition of Man* (New York: HarperOne, 2009), 53.
[14] Malcolm Guite (2013). "Imagine." *The Singing Bowl* (London: Canterbury Press Norwich, 2013), 60.

Might poetry help students see, for instance, daffodils not merely as *narcissus pseudonarcissus* but as Wordsworth did: "…a crowd / A host, of golden daffodils / Beside the lake, beneath the trees, / Fluttering and dancing in the breeze" which later "flash upon that inward eye," causing his heart to rejoice and dance along with "such a jocund company"?[15] Although Wordsworth "wandered lonely as a cloud" at the beginning of the poem, he ends in deeper communion with his Lake District environs only after grasping something true about the interconnectedness and coherence between the daffodils, the waves in the lake, the trees, the breeze, the stars, and, more importantly, himself. Does Wordsworth's use of poetry—with all of its constituent parts like rhyme, meter, imagery, affective language, and metaphor—to describe his encounter help readers participate in the same "pleasure" and "wealth the show…had brought" to him in ways that prose cannot? Do readers of Wordsworth's poem "apprehend" something besides what they could ever "comprehend" with "cool reason"?

Empirical research about poetry would suggest as much. For instance, the use of metaphor in poetry appears to help readers develop analogical thinking, which may play a role in helping them recognize the interconnectedness of the cosmos as Wordsworth did.[16] Other research suggests that the use of rhyme and meter in poems leads to higher levels of aesthetic appreciation and emotional responses.[17] These aesthetic and emotional responses lie at the core of an experience of perceiving beauty. Importantly, scholars since Aquinas have argued that beauty possesses an intelligibility—a unity (i.e., *integritas*) and a harmony (i.e., *consonantia*)—that radiates (i.e., *claritas*). These three characteristics of beauty not only generate delight in the

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[15] Wordsworth, W. "I Wandered Lonely as a Cloud." *Poetry Foundation*, 2022, https://www.poetryfoundation.org/poems/45521/i-wandered-lonely-as-a-cloud

[16] Keith J. Holyoak and Stemković, Dušan. "Metaphor Comprehension: A Critical Review of Theories and Evidence." *Psychological Bulletin* 144, no. 6 (2018): 641-671.

[17] Christian Obermeier, Winfried Menninghaus, Martin von Koppenfels, Tim Raettig, Maren Schmidt-Kassow, Sascha Otterbein, and Sonja A. Kotz. "Aesthetic and Emotional Effects of Meter and Rhyme in Poetry." *Frontiers in Psychology* 4 (2013): Article 10.

perceiver but also understanding. Beauty, then, is a means through which knowledge and wisdom are gained.[18] Within a classroom context then, learning may be enhanced insofar as poetry enables students to perceive the beauty of the topic under study.

Prior Research of the Effects of Arts Education on Student Learning

One might submit, then, that Wordsworth's use of poetic form was necessary to convey the depths of his experience, while scientific language would be not be capable of such a task. In this study, we empirically examine the pedagogical potential of poetry cultivate poetic knowledge within the context of science instruction in kindergarten through second-grade classrooms. We specifically assess whether the integration of poetry influences four outcomes related to possessing poetic knowledge: curiosity, affinity, and attentiveness. Affinity towards and curiosity about a topic, respectively, refer to the degree to which students are delighted by the topic and want to learn more about the topic. Attentiveness is defined as the extent to which students notice and pay attention to the topic of study in their everyday lives.

Prior research has documented that poetry can improve psychological wellbeing by increasing a sense of life purpose and positive affect.[19] Other poetry research suggests that engagement with poetry nurtures dimensions of creativity such as divergent thinking, which underlies the ability to generate ideas.[20] Other research, though not focused on poetry, finds that arts education programs and art therapy can enhance empathy, social-perspective taking, and

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[18] Jacques Maritain. *Art and Scholasticism with Other Essays*, trans. J.F. Scanlan (Whitefish: Kessinger Publishing, 2003).

[19]Adam M. Croom. "The Practice of Poetry and the Psychology of Well-Being." *Journal of Poetry Therapy* 28, no. 1, (2014): 1–20

[20] Malgorzata Osowiecka and Alina Kolańczyk. "Let's Read a Poem! What Type of Poetry Boosts Creativity?" *Frontiers in Psychology* 9 (2018): 1-12.

social awareness.[21] Like this existing scholarship, we empirically test the effects of poetry on particular student outcomes.

However, our study differs from prior empirical literature in a key way. Existing scholarship on the effects of poetry and other arts education focuses a disparate set of social, cognitive, and emotional development outcomes that are instrumental for student achievement or socioemotional health. Our study more fundamentally focuses students' postures towards learning, that is, the way students pursue and receive new knowledge. Classical education aims for the "'re-enchantment' of education," to open students' "eyes to the meaning and beauty of the cosmos," as Stratford Caldecott articulated in his well-known book *Beauty for Truth's Sake.*[22] To receive, contemplate, and apprehend the cosmos is chosen for its own sake and constitutive of a life well-lived. In essence, they are leisurely acts.[23] Our outcomes of attentiveness, curiosity, and affinity as well as further enjoyment of poetry reflect this learning posture rather than the typical instrumental learning outcomes of prior empirical research.

Research Hypotheses

In sum, poetry about the natural world has a particular power to forge a connection between the student and the subject of the poem. We hypothesize that this connection forms the student's posture towards learning about the natural world. Formally, the three hypotheses we test are as follows:

(H1) Integrating poetry into the science unit increases students' attentiveness about the topic of study.

[21] Steven J. Holochwost, Thalia R. Goldstein, and Dennie P. Wolf. "Delineating the Benefits of Arts Education for Children's Socioemotional Development." *Frontiers in Psychology* 12 (2021): 1-11.
[22] Stratford Caldecott. *Beauty for Truth's Sake: On the Re-enchantment of Education* (Grand Rapids: Brazos Press, 2009).
[23] Josef Pieper. *Leisure: The basis of culture*, trans. Alexander Dru (San Francisco: Ignatius Press, 2009).

(H2) Integrating poetry into the science unit increases students' curiosity about the topic of study.

(H3) Integrating poetry into the science unit increases students' affinity for the topic of study.

We additionally raise a fourth hypothesis, namely, that exposure to poetry begets more enjoyment of poetry. Prior research of school field trips demonstrates that visits to art museums, the theater, or the symphony increases students' desire to engage with more art.[24] Formally, we hypothesize:

(H4) Integrating poetry into the science unit will increase students' desire to engage with poetry.

In the next section, we detail the data, research design, and analytical plan to test these hypotheses.

Methods

Poetry Intervention and Study Sample

Our sample consists of 66 students in kindergarten, first grade, and second grade who attend Sager Classical Academy (SCA), a grammar school located in Tontitown, Arkansas. Enrollment at SCA is large enough such that there are three kindergarten classes, two first grade classes, and two second grade classes. Within each grade level, we assigned classrooms to receive the poetry intervention. In other words, one first grade class and one second grade class were selected to receive the intervention while the other first grade class and second grade class was not. At the kindergarten level, we selected two out of the three classrooms to receive the poetry intervention.

[24] Jay P. Greene; Brian Kisida, and Daniel Bowen. "The Educational Value of Field Trips." *Education Next* 14, no. 1 (2014): 78-86; Heidi H. Erickson, Angela R. Watson, and Jay P. Greene. "An Experimental Evaluation of Culturally Enriching Field Trips." *Journal of Human Resources* (forthcoming).

In the end, the control group, which received science instruction without poetry, comprised 30 students, 14 of whom were girls. The treatment group, which received science instruction with poetry, comprised 36 students, 21 of whom were girls. We did not collect any additional demographic background information about the study participants.

Data Collection and Instruments

Approximately one week before the beginning of the poetry intervention, we visited SCA and administered surveys to all 66 students to collect pre-intervention measures of affinity, curiosity, attentiveness, and enjoyment of poetry. Because these students were young, we interviewed each student individually, reading the items on the survey aloud and recording their responses. A copy of the survey questionnaire is included in the Appendix B. Approximately three weeks later, after the end of the poetry intervention, we visited SCA again and administered surveys to all students in the study to collect post-intervention measures of our outcomes of interest. As before, we interviewed students individually.

We computed Cronbach's Alpha for each outcome measure by grade level and found their reliabilities to be sufficiently high with values greater than or equal to 0.7. The only exceptions were lower Cronbach's values of 0.62 and 0.66 for kindergarteners' curiosity and attentiveness measures, respectively, as well as a Cronbach's value of 0.68 first graders' attentiveness measure. These lower values are to be expected given the greater level of random measurement error that may arise when younger children respond to survey questions, but they are not low enough to be of too much concern.

Analytic Strategy

To test our three hypotheses, we compared the measures of affinity, curiosity, attentiveness, and enjoyment of poetry for students in the treatment group with those for students

in the control group. We do this in two ways. First, we present graphs of the baseline and post-intervention outcome measures by treatment status. These graphs allow us to visually inspect differences between students in the treatment group and students in control group before and after the intervention.

We then take a parametric approach, estimating differences for each outcome measure using ordinary least squares regression techniques. Within the regression framework we run models that include controls for the student's gender, grade level, and pre-intervention measures of each respective outcome. These covariates are important to include to account for potential confounding factors that may explain differences in outcomes between the treatment and control groups. For instance, the treatment group consisted of a larger proportion of girls than the control group. Without accounting for this difference in our models, observed differences in outcomes between the two groups might be driven by differences in gender composition rather than the inclusion of poetry. For the same reason, we control for pre-intervention measures of the outcome variables and grade level of the student in our models.

Formally, we can express our model as:

$$Post\_Outcome_i = \beta_0 + \beta_1 Treatment_i + \beta_2 Pre\_Outcome_i + \beta_3 Girl_i + \boldsymbol{\beta_4 Grade_i} + \varepsilon_i . \quad (1)$$

In Equation (1), *Post_Outcome* is the post-intervention measure of one of our four outcomes of interest for student *i*, and $Treatment_i$ is a binary variable equal to 1 if student *i* received the poetry intervention and 0 otherwise. $Pre\_Outcome_i$ is pre-intervention measure of the outcome of interest, while $Girl_i$ is a binary variable equal to 1 if student *i* is a girl and 0 if not. Finally, $\boldsymbol{Grade_i}$ is a vector of binary variables for the student *i*'s grade and ε_i is the error term. The coefficient of interest is β_1, which is an estimate of the difference in affinity, attentiveness,

curiosity, or enjoyment of poetry between students in the treatment group and students in the control group. The results of these regression analyses are discussed in the next section.

Results

Intervention Fidelity Check

We begin by presenting a brief check for the fidelity of the intervention. That is to say, if the intervention was implemented as planned, we should observe students in classes that were chosen to integrate poetry into the science curriculum to actually engage with more poetry within the two-week intervention time frame. Indeed, this is what we find in our data. As shown in Table 1, students in the classrooms that integrated into the science curriculum exhibited higher scores on our measure of how frequently they engaged in poetry. This measure is an average of three five-point Likert-type items from the survey asking students how frequently they listed to, read, and memorized poetry. According to the model in column 1 that does not include the full set of control variables, students who were in classes that were chosen to integrate poetry into the science curriculum scored nearly 67 percent of a standard deviation higher on that measure of engagement with poetry than students who were in classes that did not integrate poetry. This difference is statistically significant at the 0.01 level. As shown in column 2, this finding is robust to the inclusion of gender and a variable measuring how much the student enjoyed poetry taken prior to the intervention. As indicated by the positive coefficients on grade level, first and second graders seemed to engage with poetry more often than kindergarteners, the omitted grade level category in the model. However, only the difference between kindergarteners and second graders in the model that controls for gender and baseline enjoyment of poetry is statistically significant at the 0.1 level.

Table 1: Frequency of Engaging with Poetry

	Frequency of Engaging with Poetry	
	(1)	(2)
Poetry Class	.672***	.651***
	(.238)	(.229)
Female		-.333
		(.231)
Grade		
First	.104	.248
	(.289)	(.281)
Second	.413	.486*
	(.289)	(.276)
Baseline Score		
Enjoyment of Poetry		.312***
		(.111)
Constant	-.539**	-.089
	(.253)	(.374)

Note: N = 66. Standard errors are in parentheses. ***, **, and *, *indicate the coefficient is statistically significant at the .01, .05, and .10 levels, respectively. Grade fixed effects included in all models.*

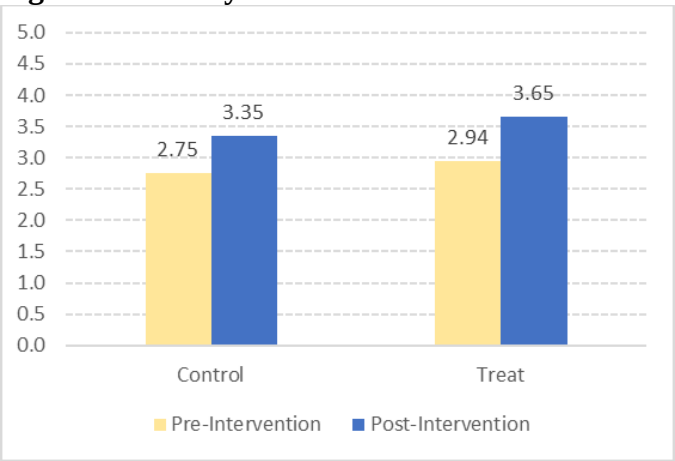
Visual Depictions of Main Results

Figures 1 through 4 display measures of the four outcomes of interest. In each figure, there are four bars. Values of the outcomes for students in the control group, namely, those who did not receive science instruction with poetry, are plotted with the first pair of bars. The second pair of bars plot the values for students in the treatment group, who received science instruction with poetry. Within each pair of bars, the first bar plots baseline values, that is, the values of the outcome measure prior to the intervention. The second bar plots the post-treatment values, that is, the values of the outcome measure after the conclusion of the intervention.

We first consider the results for our measure of affinity in Figure 1. As indicated in the figure, the control and treatment groups scored, on average, 2.75 and 2.94 points on the affinity scale at baseline, respectively. After the intervention, the control group averaged 3.35 points on the affinity scale, while the treatment group averaged 3.65 points. Though there appears to be

slightly greater growth in affinity for the treatment group, the difference is not statistically significant at conventional levels.

Figure 1: Affinity Results



In Figure 2, we display the results regarding curiosity. The control group at baseline scored an average of 2.89 points on that scale, while the treatment group scored an average of 2.98 points. After the intervention, the control group average rose to 3.29 points, while the treatment group average rose to 3.43 points. As in the affinity results, there appears to be greater growth among the treatment group. However, the differences are not large or estimated precisely enough to conclude that they are statistically distinguishable at conventional levels.

Figure 2: Curiosity Results

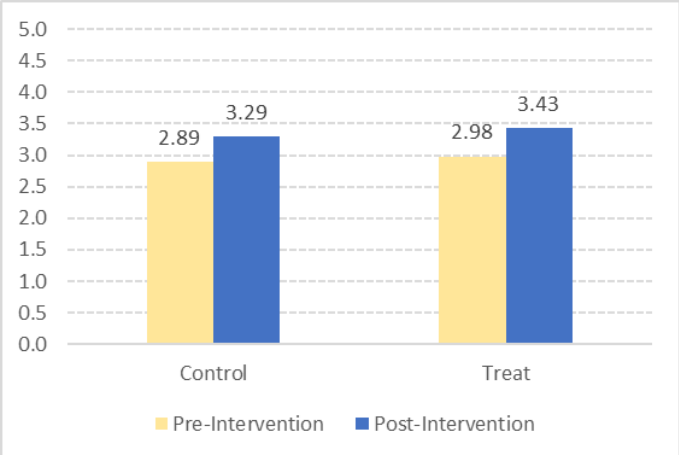
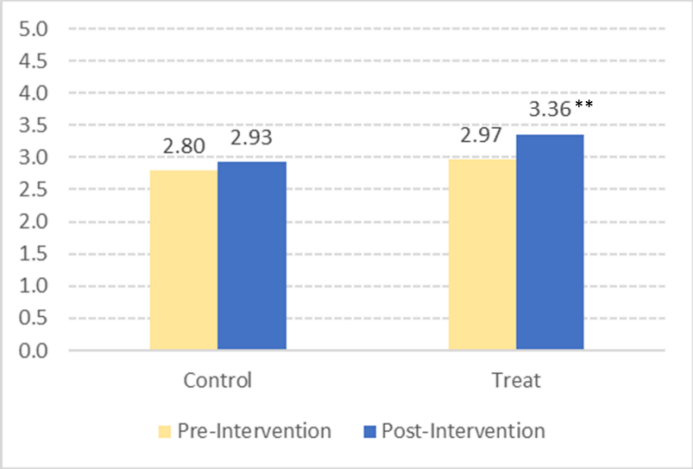


Figure 3 displays the results for attentiveness. On this measure, the control group experienced little change from baseline to after the intervention, on average, scoring 2.80 and 2.93 points on the attentiveness scale at the two respective time periods. On the other hand, we observe noticeable growth among the treatment group students. Students, on average, in classrooms that integrated poetry into the science unit scored 2.97 points on the attentiveness scale before the intervention and 3.36 points afterwards. This result is statististically distinguishable at the 0.01 level.

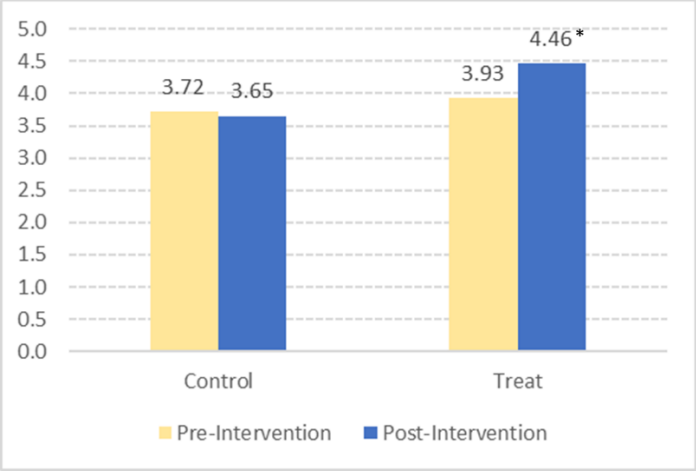
Figure 3: Attentiveness Results



Note: **Indicates statistical significance at the 0.01 level.

Finally, Figure 4 displays results for students' enjoyment of poetry. On this measure, the control group experienced little change over the course of the intervention period. However, we observe a visible change among treatment group students. Before the intervention, they scored 3.93 points on the Enjoyment of Poetry scale. This average rose to 4.46 points after the intervention in which they were exposed to more poetry. The difference between the control and treatment group students on their enjoyment of poetry after the intervention is statistically significant at the 0.05 level.

Figure 4: Enjoyment of Poetry



Note: * Indicates statistical significance at the 0.05 level.

Regression Results

We now turn to our regression results, which, unlike the visual depictions above, estimate the results of the intervention while controlling for potential confounding factors such as grade level, gender, and baseline scores. Coefficient estimates of Equation (1) are displayed in Table 3. For each of our four outcome variables, we present two sets of results. The first set of results, shown in the odd-numbered columns of Table 3, comprise estimates of the difference in a particular outcome for students in the classrooms that integrated poetry compared to students in the classrooms that did not integrate poetry. These models do not account for any other background variables except for student grade level since the experiment was conducted between classrooms of different grade levels. The second set of results, shown in the even-numbered columns of Table 3, come from models that controls for student grade level as well as student gender and their pre-intervention score for the outcome of interest.

Consider columns (1) and (2), which display the results for affinity. Without accounting for the students' gender and their pre-treatment measure of affinity, students in classrooms that integrated poetry into the science unit scored 32 percent of a standard deviation higher on the

post-treatment measure of affinity compared to students in classrooms that did not integrate poetry into the science unit. While the difference is large, it is not statistically significant and so we cannot conclude with certainty that exposure to poetry increased students' affinity towards the topic of study in their science curriculum. Indeed, as shown in column (2), when we account for gender and pre-treatment measures of affinity, the difference in affinity between the two groups of students shrinks to a mere 3 percent of a standard deviation. The coefficient for the variable indicating whether the student if female or not and the coefficient for the pre-treatment measure of affinity are both substantively large and statistically significant, suggesting that those factors, rather than the exposure to poetry, explain most of the variation in post-treatment affinity scores. In fact, as we mentioned in Table 1, classrooms that integrated poetry already had a higher proportion of girls and, on average, higher pre-intervention scores on the affinity scale.

Table 3: Linear Regression Results

	Affinity		Curiosity		Attentiveness		Enjoyment of Poetry	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Poetry Class	.316	.026	.105	.039	.633**	.524**	.619*	.437*
	(.250)	(.190)	(.254)	(.228)	(.232)	(.225)	(.236)	(.202)
Female		.447*		.145		.080		.273
		(.193)		(.233)		(.226)		(.204)
Baseline Score								
Affinity		.628**						
		(.097)						
Curiosity				.478**				
				(.111)				
Attentiveness						.379**		
						(.124)		
Enjoyment of Poetry								.507**
								(.098)
Constant	-.057	-.321	.048	-.161	-.036	-.235	-.279	-.564
	(.266)	(.320)	(.271)	(.376)	(.247)	(.369)	(.252)	(.330)

Note: N = 66. Standard errors are in parentheses. ** *and* * *indicate the coefficient is statistically different from zero at the .01, and .05 levels, respectively. Grade fixed effects included in all models. Dependent variable is expressed in standard deviations.*

In columns 3 and 4, we report the results for curiosity. As shown in both columns, the difference in curiosity scores between students in classes that integrated poetry and students in the other classes is neither substantively large nor statistically significant. For instance, in the model that accounts for pre-treatment scores of curiosity, the difference in curiosity scores between the two groups of students is only 4 percent of a standard deviation. Unsurprisingly, pre-intervention curiosity scores are correlated with post-intervention curiosity scores; students who were more curious before the intervention remained more curious after the intervention. An increase of one standard deviation in pre-intervention curiosity scores is associated with an increase of 48 percent of a standard deviation in curiosity—a substantively large change that is also statistically significant at the 0.01 level. In general, levels of curiosity were not influenced by the exposure to poetry and have more to do with students' level of curiosity before the exposure to poetry.

However, we find evidence that the exposure to poetry increased students' attentiveness to the topics they studied in their science unit. As shown column 5, the difference in post-intervention attentiveness scores is 63 percent of a standard deviation. In column 6, which controls for student gender and pre-intervention attentiveness score, the difference in post-intervention attentiveness scores remains over half of a standard deviation. Although students in the classrooms that integrated poetry into their science unit began slightly higher attentiveness scores prior to the intervention, the difference significantly widened after the intervention and can be attributed to the exposure to poetry.

Finally, we address our final research hypothesis, namely that students who are exposed to poetry in their science curriculum will enjoy poetry more than students who were not exposed to poetry. We observe evidence supporting this hypothesis. Without accounting for gender and

pre-intervention levels of students' enjoyment of poetry, students in classrooms that integrated poetry into their science unit scored over 60 percent of a standard deviation higher on the post-intervention measure of enjoyment of poetry. When we account for pre-intervention differences in gender composition and how much students enjoyed poetry across the two types of classrooms, the post-intervention difference persists. Students in classrooms that integrated poetry scored 0.44 standard deviations higher on the measure of enjoyment of poetry compared to their peers in other classrooms.

Discussion and Conclusion

Summary and Limitations

Exposure to poetry is a hallmark of classical education. As a leisurely activity, poetry is read, recited, and studied for its own sake as students engage with a variety of works from enduring traditions.[25] Poetry, however, might also be of pedagogical import. Philosophers and poets since Classical Greece have argued that the poetic language, with its distinctive characteristics such as rhyme, meter, metaphor, imagery, and affective language, has the capacity to teach and convey things in ways that more straightforward prose and scientific language cannot. As Taylor argues, the two different types of language—scientific and poetic—might lead to different types of knowledge, namely analytic and poetic knowledge.[26] However, these arguments about the pedagogical power of poetry have not been subjected to an empirical test. Although psychologists have studied the effects of poetry on outcomes such as creativity and subjective wellbeing, theories about the ability of poetry to cultivate poetic knowledge have not been empirically studied. This study fills that gap.

[25] Piper, *Leisure: The Basis of Culture*; Ciardi, *How does a Poem Mean?*
[26] Taylor, *Poetic Knowledge*.

We compared students in two groups of kindergarten through second-grade classrooms. One group of students received two weeks of science instruction that incorporated poetry about their topic of study. The other group of students received two weeks of the same science instruction without the poetry. We assessed students on their affinity for, curiosity about, and attentiveness towards the topic of study. We additionally assessed whether students enjoyed poetry more if they were exposed to poetry. Reasoning that poetry has the capacity to convey poetic knowledge in ways that scientific prose cannot, we expected to see differences in these learning outcomes. Ultimately, we found some supporting evidence for this claim. Students who received science instruction with poetry exhibited higher levels of attentiveness and enjoyment of poetry. We could not find conclusive evidence for differences in affinity and curiosity.

We raise two reasons for why we did not detect differences in affinity and curiosity. First, it is possible that young students in kindergarten through second grade already exhibit a level of affinity and curiosity that would be difficult to alter with poetry. Educational psychology research has documented a decrease in intrinsic motivation for learning as students progress from elementary to high school.[27] Future research should examine whether poetry affects curiosity among older students, especially if it has the capacity to stem the decline in interest in learning as they age.

The second reason for our inability to detect differences in affinity and curiosity is grounded in the methodological limitations of our study. Specifically, our study sample is relatively small at 66 students. A small sample size, together with outcome measures that demonstrated sufficient but lower levels of reliability, reduces study power. Study power refers to the ability to detect differences in the data when they exist. Whether or not we failed to detect

[27] Nicholas Gillet, Robert J. Vallerand, and Marc-André K. Lafrenière. "Intrinsic and Extrinsic School Motivation as a Function of Age: The Mediating Role of Autonomy Support." *Social Psychology of Education* 15, (2012): 77–95.

differences in affinity and curiosity because of low study power—often referred to as a Type 2 error—cannot be confirmed. Although we found higher levels of affinity and curiosity among students who received science instruction with poetry, we could not conclude that those differences were material. As far as we know, those differences could have obtained by random chance. Subsequent research could replicate this study with a larger sample and measures with even greater reliability to investigate whether study power was the reason behind our findings and whether poetry actually has some influence on affinity and curiosity among younger students.

Subsequent Research

Besides replication, we encourage additional research into the effects of poetry to bring additional empirical evidence to bear on the claims about classical education. How might poetry have unique effects in other curricular areas outside of science? Are there different approaches to teaching poetry that are more promising for cultivating poetic knowledge or other intellectual virtues? Notably, there are many other art forms besides poetry. How might the integration of other art forms enhance teaching and learning across the curriculum?

Although we encourage much more empirical research, we do not advocate a logical positivist position. We recognize that empiricism like philosophy is one of many ways to discern what is true. Nonetheless, data plays a significant role in policy. As classical schools continue to be established or expand, whether in the form of charter or private schools, policymakers will evaluate them using data. In an article featuring the Institute for Classical Education, Clare Basil writes for the Fordham Institute:

> Policymakers and philanthropists understandably aim to ground their decisions in a body of evidence and aspire to make “data-driven” decisions. Regardless of the merits of this

> approach, the fact that very little data exist on classical education's potential to form character may be an obstacle to realizing the Institute for Classical Education's plans for expansion….more in-depth, empirically grounded research will be necessary to help verify that the theory of classical character education translates effectively into practice and concrete outcomes.[28]

Moreover, empirical data and research can inform the practice of teaching and learning in classical schools. To that end, we conclude with some remarks about the implications of our research.

Implications for Educational Practice

We found compelling evidence of differences in attentiveness and enjoyment of poetry between students in classrooms that integrated poetry into a science unit and students in classrooms that did not integrate poetry into a science unit. In light of this evidence about the pedagogical benefits of poetry, we encourage educators to consider how they might incorporate poetry across the curriculum. In our study, we presented an example of how poetry can be used to enhance a science unit. What might the analog for a history, math, or philosophy class be? For instance, might incorporating poetry from a historical period under study in a history unit enhance students' connection with and education about that period? We even encourage language arts teachers to consider how they might teach poetry in their curriculum to better prepare students to engage with poetry in other parts of the curriculum. In fact, the use of poetry or other art forms could help students see the coherence of the entire curriculum instead of as disparate disciplines.

[28] Clare Basil. "Classical Education is Growing: Here's how to Keep it that Way," accessed March 31, 2022. https://fordhaminstitute.org/national/commentary/classical-education-growing-heres-how-keep-it-way

Our study, more generally, perhaps hints at the possibility of shaping the poetic knowledge of children. Classical education is distinctive in its aim to foster that type of knowledge as well as to cultivate wonder and to train students' tastes for harmony and beauty.[29] As Plato writes in *The Republic*,

> The man properly reared on rhythm and harmony would have the sharpest sense for what's been left out and what isn't a fine product…having the right kinds of dislikes, he would praise the fine things; and, taking pleasure in them and receiving them into the soul, he would be reared on them and become a gentleman. He would blame and hate the ugly in the right way (401e-402a).

Though Plato's critical views about poetry are well-known and debated, our empirical findings do suggest that poetry may possess a power to accomplish these kinds of formative ends. In our study sample, students became more aware of the topic they were studying if that curricular content was taught with the addition of poetry. How a longer-term, more persistent integration of poetry into the curriculum would affect students' overall wonder and taste for beauty is a topic worth additional empirical inquiry. Nonetheless, the philosophical foundations of classical education together with our empirical results suggest that classical educators would do well to consider how to incorporate poetry or other art forms as a means to accomplish their educative aims.

Finally, we encourage school leaders to continue articulating their reasons for classical education. Philosophical reasons should continue to be raised, but marshalling empirical evidence might enable them more clearly and accurately articulate the nature of classical education to parents and members of their school community.

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[29] Lewis, Abolition of Man.

Appendix A
List of Poems Used in the Intervention

Kindergarten

- “Who has seen the Wind?” by Christina Rosetti
- “Autumn Fires” by Robert Louis Stevenson
- “A Drop Fell on the Apple Tree” by Emily Dickinson
- “The Wind Begun to Rock the Grass” by Emily Dickinson

First Grade

- “Nest Eggs” by Robert Louis Stevenson
- “A Bird Came Down the Walk” by Emily Dickinson:
- “The Eagle” by Alfred Tennyson
- “Old Man with a Beard” by Edward Lear

Second Grade

- “To the Moon” by Percy Shelly: To the Moon
- “Moon” by Emily Dickinson
- “Moonrise” by Gerard Manley Hopkins

Appendix B
Survey Instrument

Curiosity measures

Kindergarten

1) I want to learn more about the rain
   - No, I really don't.
   - A little bit
   - Yes, I want to learn more.
   - Of course, really want to learn more!
2) I want to learn more about the wind
   - No, I really don't.
   - A little bit
   - Yes, I want to learn more.
   - Of course, really want to learn more!
3) I want to learn more about the snow
   - No, I really don't.
   - A little bit
   - Yes, I want to learn more.
   - Of course, really want to learn more!
4) I want to learn more about clouds
   - No, I really don't.
   - A little bit
   - I want to learn more.
   - I want to learn a lot more
   - I really want to learn a lot more
5) I want to learn more about the seasons
   - No, I really don't.
   - A little bit
   - I want to learn more.
   - I want to learn a lot more
   - I really want to learn a lot more
6) I want to learn more about the weather
   - No, I really don't.
   - A little bit
   - I want to learn more.
   - I want to learn a lot more
   - I really want to learn a lot more

1st Grade

1) I want to learn more about birds.
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!
2) How much do you want to learn the names of more kinds of birds?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more names.
   - I want to learn a lot more names
   - I really want to learn a lot more names
3) How much do you want to learn about what certain birds look like?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more names.
   - I want to learn a lot more names
   - I really want to learn a lot more names
4) How much do you want to learn about what certain birds sound like?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more
   - I want to learn a lot more
   - I really want to learn a lot more
5) How much do you want to learn more about how birds find food?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - I want to learn a lot more
   - I really want to learn a lot more
6) How much do you want to learn more about how birds fly?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - I want to learn a lot more
   - I really want to learn a lot more
7) How much do you want to learn more about the lives of birds?
   - No, I really don't.

- A little bit.
- Yes I want to learn more.
- I want to learn a lot more
- I really want to learn a lot more

2nd Grade

1) How much do you want to learn more about the moon?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!
2) How much do you want to learn more about the stars?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!
3) How much do you want to learn more about the sun?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!
4) How much do you want to learn more about the planets?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!
5) How much do you want to learn more about the space?
   - No, I really don't.
   - A little bit.
   - Yes I want to learn more.
   - Of course, really want to learn more!

Attentiveness measures

Kindergarten

1) How often do you know what the weather is each day?
   - Never
   - Not really
   - Some days
   - Most days

- Every day

2) How often do you notice the weather getting colder these days?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
3) How often do you notice when it is raining outside?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
4) How often do you see the wind?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
5) How often do you hear the rain when it rains?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
6) How often do you see lightening when there is a thunderstorm?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
7) How often do you hear the thunder when there is a thunderstorm?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
8) How often do you notice the weather is cloudy when it is cloudy?
   - Never

- Not really
- Sometimes
- A lot of the time
- All the time

9) How often do you notice if a day is hot or cold?
   - Never
   - Not really
   - Some days
   - Most days
   - Every day

1st Grade

1) I notice birds flying in the air
   - Never
   - Not really
   - Sometimes
   - All of the time
   - All the time
2) I notice birds hopping on the ground.
   - Never
   - Not really
   - Sometimes
   - All of the time
   - All the time
3) When I see a bird, I notice its color.
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
4) I heard birds singing
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
5) When I see a bird, I know what kind of bird it is.
   - Never
   - Not really

- Sometimes
- A lot of the time
- All the time

6) I notice birds resting on a tree, fence, or other place.
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time

2nd Grade

1) I notice the moon in the sky at night.
   - Never
   - Not really
   - Sometimes
   - Most days
   - Pretty much every day
2) I notice when the moon is full.
   - Never
   - Not really
   - Sometimes
   - All the time
3) I notice the moon in the sky during the day
   - Never
   - Not really
   - Some days
   - Most days
   - Pretty much every day
4) I noticed when the moon is a crescent.
   - Never
   - Not really
   - Sometimes
   - All the time
5) I notice how the moon changes in the sky
   - Never
   - Not really
   - Yes I do notice a little
   - Yes I do notice
   - Yes I do notice a lot

Affinity measures

Kindergarten

1) How much do you like talking about the weather?
    - I hate talking about the weather
    - I sort of hate talking about the weather
    - I don't hate or like talking about the weather
    - I sort of like talking about the weather
    - I like talking about the weather
    - I like talking about the weather a lot
2) How often do you think about the weather?
    - Never
    - Not really
    - Sometimes
    - A lot of the time
    - All the time
3) How beautiful do you think autumn leaves are?
    - They are not beautiful
    - They are a little beautiful
    - They are beautiful
    - They are really beautiful
    - They are really really beautiful
4) How beautiful do you think the rain is?
    - They are not beautiful
    - They are a little beautiful
    - They are beautiful
    - They are really beautiful
    - They are really really beautiful
5) How special do you think the weather is?
    - It is not special
    - It is a little special
    - It is special
    - It is really special
    - It is really really special

1st Grade

1) I like watching birds.

- I don't like watching birds
- I like watching birds a little
- I like watching birds
- I like watching birds a lot
- I really like watching birds a lot

2) I like listening to birds sing.
   - I don't like watching birds
   - I like watching birds a little
   - I like watching birds
   - I like watching birds a lot
   - I really like watching birds a lot
3) I like talking about birds
   - I don't like watching birds
   - I like watching birds a little
   - I like watching birds
   - I like watching birds a lot
   - I really like watching birds a lot
4) We should take care of birds.
   - No, birds don’t matter.
   - Yes, but I don’t care that much about birds.
   - Yes, I care about birds.
   - Yes, I care a lot about birds.
   - Yes, I really care a lot about birds!
5) I want to have a bird for a pet.
   - No, I really don’t want a bird for a pet.
   - I don’t care if I have a bird as a pet or not.
   - Yes I want a bird as a pet a little bit.
   - I really want a bird as a pet
6) Are birds beautiful?
   - No
   - A little
   - Yes they are beautiful
   - Yes they are very beautiful
   - Yes they are very very beautiful
7) Do you think bird's are God's gift?
   - They are not a gift at all
   - They are not really a gift
   - Yes they are an ok gift.
   - Yes they are a good gift
   - Yes they are a very good gift
8) How much do you like birds?

- I don’t like birds at all
- I don’t like or dislike birds
- I like birds a little
- I like birds
- I like birds a lot
- I really really like birds a lot

9) How happy to birds make you feel?
   - No, birds do not make me happy.
   - Birds make me a little happy
   - Birds make me feel happy
   - Birds make me feel very happy
   - Birds make me feel very very happy
10) I imagine what it would be like to be a bird.
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
11) I think about birds.
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time

2nd Grade

1) The moon is a gift from God.
   - No it is not a gift at all
   - No it is not really a gift
   - Yes it is an ok gift
   - Yes it is a good gift
   - Yes it is a very good gift
2) Would you like to go to the moon?
   - I do not want to go to the moon.
   - I don't care if I go to the moon or not
   - I would like to go a little
   - I would like to go
   - I would like to go a lot
   - I would really like to go a lot
3) How much do you like staring at the moon?
   - I hate staring at the moon

- I do not like or hate staring at the moon
- I like staring at the moon a little
- I like staring at the moon
- I like staring at the moon a lot
- I really like staring at the moon a lot

4) I like talking about the moon.
   - I hate talking about the moon
   - I don't hate and don't like talking about the moon
   - I like talking about the moon a little
   - I like talking about the moon
   - I like talking about the moon a lot
   - I really like talking about the moon a lot
5) How often do you go look for the moon in the sky?
   - Never
   - Not really
   - Some days
   - Most days
   - Every day
6) How often do you think about the moon?
   - Never
   - Not really
   - Sometimes
   - A lot of the time
   - All the time
7) The moon is beautiful.
   - No
   - A little
   - Yes it is beautiful
   - Yes it is very beautiful
   - Yes it is very very beautiful
8) The moon's light is beautiful.
   - No
   - A little
   - Yes it is beautiful
   - Yes it is very beautiful
   - Yes it is very very beautiful
9) I am happy to see the moon.
   - No, I am not glad about birds
   - I am a little glad.

- I am glad.
- I am very glad
- I am very very glad

Enjoyment of Poetry measures

1) How much do you like school?
   - I really don't like school
   - I sort of don't like school
   - I don't like school but I don't hate school
   - I sort of like school
   - I like school
   - I really like school
   - I really really like school
2) How much do you like listening to poems?
   - I really do not like listening to poems
   - I sort of do not like listening to poems
   - Poems are ok
   - I sort of like listening to poems
   - I really like listening to poems
   - I really really like listening to poems
3) How much do you like memorizing poems?
   - I really do not like memorizing poems
   - I sort of do not like memorizing poems
   - Poems are ok . I sort of like memorizing poems
   - I really like memorizing poems
   - I really really like memorizing poems
4) How much do you like reading books?
   - I really hate reading books
   - I sort of hate reading books
   - I don't hate or like reading books
   - I sort of like reading books a little
   - I like reading books
   - I really like reading books
   - I really really like reading books
5) How much do you like reading poems?
   - I really hate reading poems
   - I sort of hate reading poems
   - I don't hate or like reading poems
   - I sort of like reading poems
   - I like reading poems
   - I really like reading poems
   - I really really like reading poems