

ABSTRACT

TUNSTALL, KALI. Handwriting Fluency as a Predictor of Written Expression. (Under the direction of Dr. Ann C. Schulte).

In the present study, the relationship between handwriting fluency and writing quality of fourth grade students was examined. Writing quality was measured using two writing samples, a five-minute probe, scored using number of correct word sequences (CWS); and a Classroom Writing Project, collected over multiple days, and scored using both CWS and an analytic scoring rubric. Under all conditions, handwriting fluency was correlated with writing quality. To assess the extent to which a speeded task or a fluency-based scoring method contributed to the relationship between handwriting fluency and writing quality, correlations between handwriting fluency for timed and untimed writing samples scored with CWS were compared, and between the timed writing sample scored with CWS and the untimed sample scored with the analytic scoring method. When the correlations between handwriting fluency and the quality of either timed or untimed writing samples (measured using CWS for both) were compared, no significant difference was found between the strength of the correlation for the timed and the untimed writing sample. However, the correlation between handwriting fluency and writing quality was significantly higher with a timed writing sample and fluency-based writing scoring method than when an untimed sample was scored with an analytic scoring rubric.

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Handwriting Fluency as a Predictor of Written Expression

by
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DEDICATION

I dedicate my thesis to my husband, parents, and brother. Christopher, you have been beside me every step of the way and supported me even when things seemed insurmountable. I could never have done this without you. Mom and Dad, you gave me the tools to create my own path and follow my dreams. I will always be grateful to you for teaching me to go after what I want and to knock down doors until I get it. Lukas, you support me in so many ways. You are no longer my baby brother, but my equal and my friend. I love you all so much. Thank you for everything.

BIOGRAPHY

Kali Tunstall was born on September 2, 1986 in Raleigh, North Carolina. She graduated from Smithfield-Selma High School in 2004. She received her Bachelor of Arts in Psychology and minor in Dance from Appalachian State University in 2008. After graduating from ASU, she worked as a Toddler Teacher at Bright Horizons Family Solutions for two years. During that time, she also worked as a research assistant for Dr. John Begeny and his work with the HELPS Reading Fluency Intervention. In 2010 she began graduate school at NC State University in School Psychology. While attending NCSU, she also taught Job Skills classes to adults with Autism and worked in the Psychoeducational Clinic at NCSU. In her position in the clinic, Kali worked as a clinic assistant and completed Academically Gifted and Early Kindergarten Entry testing, worked as a Cogmed Coach, and an Academic Coaching for Educational Success (ACES) Coach for middle school, high school, and college students who needed help with organizational and study skills. After completing her Master's degree in December of 2014, she plans to work as a school psychologist in the Wake County Public School System.

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Helping children achieve literacy, or the ability to understand and create written communication, is one of the primary goals of schooling. There is no argument that learning to read, and learning to read fluently, is important. Writing is also a critical component of literacy. Writing can be used to communicate with others removed by distance or time, to preserve a sense of heritage amongst large groups of people, to persuade others in public forums or law courts, or to express one's self through chronicling experiences or creating alternative realities (MacArthur, Graham & Fitzgerald, 2006).

Although there have been striking advances in understanding the skills that underlie proficient reading and the development of interventions to foster these skills (Biancarosa & Snow, 2006), there have been far fewer advances in the field of writing. Critical research questions remain unanswered including how to teach writing, and how to improve rates of proficient writers (Wagner, Puranik, Foorman, Foster, Wilson, Tschinkel, & Kantor, 2011). Illustrative of these unanswered questions is the fact that 65% of 8th grade students, and 75% of 12th grade students are scoring below proficient in writing on national assessments (Salahu-Din, Persky, & Miller, 2008). Clearly, students are struggling with learning to write, and better models of how to improve writing are necessary to increase rates of proficiency.

Among the many unanswered questions in the area of writing is how handwriting fluency and written expression are related. Here, handwriting refers to the production of graphic symbols that represent words, portions of words, or the alphabet; and written expression refers to the act of conveying one's own ideas or thoughts through written text. Researchers consistently report that the speed at which students can copy letters or words, or

write them from memory (i.e., handwriting fluency) is correlated with measures of how well they express themselves in writing (Aitken & Martinussen, 2013; Christensen, 2005; Connelly, Dockrell & Barnett, 2005; Graham, Harris, & Fink, 2000; Graham & Weintraub, 1996; Jones & Christensen, 1999; Wagner et al., 2011). Although this finding is not surprising for beginning writers who are still learning how to pair written letters and names, and form the orthographic symbols (written representations) for each letter, the correlation is also observed well after students have mastered these skills, even as late as college (e.g., Connelly et al., 2005). There have been varied explanations for this finding. Some researchers have viewed the relationship as merely correlational, perhaps caused by a third variable, such as the introduction of instruction in both handwriting and written expression at the same point in schooling (Graham, Berninger, Weintraub & Schafer, 1998). Others have viewed the relationship as causal, speculating that underdeveloped connections between graphic representations of letters and words may lead writers to devote too much attention to this aspect of writing and not enough to the message they are trying to convey (Berninger & Graham, 1998). A third explanation, examined in the present study, is that researchers' use of short, timed writing tasks accounts for the correlation, at least in part. If this last explanation is true, using written expression tasks that allow students to compose at the pace more typically seen in the classroom should result in a reduced relationship between handwriting fluency and written expression.

How handwriting fluency is related to written expression has important implications for instruction. Contemporary curriculum standards deemphasize teaching students explicit

handwriting skills (Saperstein Associates, 2012), placing more focus on helping students develop and organize their ideas for more effective written communication. However, if skilled written expression consistently depends on ease and rapidity of handwriting, then ignoring students' skill development in handwriting will impede their development into proficient writers. The purpose of the present study is to provide a better understanding of the relationship between skilled writing and handwriting fluency by varying the task conditions under which students produce written work, and the way in which written expression is assessed, and then examining whether the relationship between handwriting fluency and written expression changes. Although a correlational study cannot answer the ultimate question of causality, a better understanding of factors affecting the correlation between handwriting fluency and written expression will be helpful in ruling in and ruling out explanations of the handwriting fluency/written expression relationship that have been proposed in the research literature.

Literature Review

Key Constructs: Definitions and Typical Measures

A number of studies have found correlations and/or causal relationships between handwriting fluency and written expression (Aitken & Martinussen, 2013; Berninger et al., 1992; Berninger et al., 1997; Graham et al., 2000; Jones & Christensen, 1999; Wagner et al., 2011). These studies will be summarized in the next section. However, the findings from some of these studies can be misinterpreted due to variations in definitions for handwriting fluency and written expression, and ways of measuring these constructs. Therefore, before discussing specific studies, I will first clarify how terms are used throughout the research literature, and describe the commonly used types of measures used to assess key constructs.

Handwriting Fluency and Compositional Fluency

In the simplest terms, handwriting fluency is defined as the speed that one can retrieve graphic letter forms from memory and reproduce those letters with pen or pencil on paper. Handwriting fluency is most commonly measured by number of letters in alphabetic sequence, produced in 15 to 60 seconds (Berninger & Graham, 1998). Orthographic-motor integration is defined as the concurrent use of fine motor skills and orthographic knowledge to transcribe written text (Jones & Christensen, 1999). This term is often used interchangeably with handwriting fluency.

Another term used in the research literature is compositional fluency, defined as the ability to quickly produce a written composition. Compositional fluency is most commonly measured by number of words written within 5 to 10 minutes in response to a writing prompt

(Berninger et al., 1997). This term cannot be used interchangeably with handwriting fluency because compositional fluency tasks require the respondent to not only write words and letters, but to organize them into sentences and apply rules of grammar, punctuation, and syntax.

Written Expression

Written expression is the act of conveying one's own ideas through written text. Two of the most challenging aspects of studying written expression are operationalizing good writing and devising a measurement approach that allows reliable judgments regarding the extent to which a particular sample of writing meets this standard.

Quality of written expression. Although there is no national consensus on all of the qualities that must be present for a writing sample to be considered "good," most researchers and educators agree that the ultimate criterion for good writing is that it achieves its intended purpose: that is, that it communicates its points clearly to the target audience. For example, Nauman, Stirling, and Borthwick (2011) maintain that good writing should be clear and easy to understand, have an obvious point, and include details, elaboration, and support.

Although the ultimate criterion of good writing is communication, this global standard does not provide much direction to students learning to write or teachers who are teaching them in terms of the qualities that make up work that is well written. One of the most widely used frameworks for characterizing good writing is the "trait" framework. This framework can be found in many states' writing curricula (e.g., North Carolina Department of Public Instruction, 1999) and published assessment tools (e.g., The Essay subtest of the

Wechsler Individual Achievement Test; Psychological Corporation, 2009). The names and number of traits can vary somewhat with different descriptions of the trait approach, although most frameworks number the traits at six. As summarized in a publication by the Institute of Education Sciences (Coe, Hanita, Nishioka, & Smiley, 2011), these six traits are as follows. “Ideas” refers to the main message, content of the piece, theme, or details that enrich and develop a theme. “Organization” is the internal structure and pattern of ideas within a piece of writing. “Voice” signifies the feelings and conviction of the writer coming out through the words. “Word choice” is the use of rich, colorful, precise language that moves and enlightens the reader. “Sentence Fluency” refers to the flow of the language and the sound of word patterns. And lastly, “Conventions” involves the mechanics of writing, including spelling, paragraph formatting, grammar and usage, punctuation, and capitalization.

Measuring writing quality. The two major approaches to measuring writing quality follow directly from the two approaches to defining good writing described above. One can evaluate the writing sample as a whole by determining the extent to which its communicative intent was achieved, or one can examine specific aspects of the writing sample (i.e., the extent to which the written product displays the particular characteristics, such as the six traits) that contribute to this whole. The first approach is termed "holistic" scoring; the second is termed "analytic" (Jentzsch & Tindal, 1991).

Both approaches to assessing the overall quality of a writing sample have been employed in the research literature and in the assessment of writing in schools and other settings. With both approaches, it is possible to achieve acceptable reliability across raters

and writing tasks. In terms of validity evidence, measures of written expression using both approaches have been shown to correlate with each other moderately (concurrent validity), and with expert ratings of writing products. However, problems have also been noted in that raters may be more likely to rate longer writing samples more positively than shorter samples, regardless of their quality; and poor appearance may influence raters, meaning that writing samples that are messy or difficult to read may be scored lower than writing samples that are neat and easy to read (Berninger, Yates, Cartwright, Rutberg, Remy, & Abbott 1992).

Performance sampling: A third approach. One difficulty with assessing student writing is that it can be quite time consuming, particularly if the writing sample is produced under typical classroom conditions where teachers emphasize a multi-stage, multi-draft approach to producing a writing product over several days of instruction, and a formal scoring system is reliably applied. Because of this difficulty, formal assessments of writing typically only happen between one and four times per year. The infrequent use of formal assessments makes it very difficult for teachers to assess students' writing progress or need for additional instruction.

To address the time consuming nature of formal writing assessments and allow assessment of writing in the lower elementary grades when students are not yet writing full sentences, an alternate form of writing assessment has been developed. The approach, termed "curriculum-based measurement" (CBM) is frequently used in classroom assessment of reading, writing, and mathematics because of its efficiency and ability to distinguish

between students who are performing on grade level versus students who are falling behind. CBM measures generally take one to five minutes to administer, are speeded tasks, and are scored based on frequencies of countable behaviors. Each individual test is called a "probe" and probe sets (generally 10 to 20 probes) sample the same content at the same difficulty level. These features generally make CBM probes quick to administer and sensitive to small changes in student skill. A classic example of CBM probes are a set of reading passages of the same difficulty level that students read for one minute and a count is taken of words read correctly.

Writing CBMs are short measures of writing skill (Rose, 2007). The assessment typically takes up to ten minutes, during which time the students are asked to write a story about an assigned story prompt. Students are given one minute to think about the prompt and between three and five minutes to write (Rose, 2007). Writing CBMs can be done in a group or individually, rendering them extremely quick and easy to administer.

Scores derived from writing CBM include total words written, a measure of productivity; words spelled correctly, a measure of spelling accuracy; correct writing sequences, a measure of sentence fluency; and total correct punctuation, a measure of accuracy of punctuation (Rose, 2007). Although all aspects of the 6-trait model are not reflected in the scoring options for CBM writing assessments, the correct writing sequences scoring overlaps with the 6-trait model in terms of sentence fluency and conventions. Thus, at least some of the CBM writing measures available assess aspects of writing quality.

Handwriting Fluency and Its Relationship to Different Aspects of Writing

With these definitions and measurement methods in mind, I now review studies that have found correlations between handwriting fluency and writing.

Handwriting Fluency and Compositional Fluency

Most of the studies that have investigated the relationship between handwriting fluency and any aspect of writing have used variations of a single measure, the Alphabet Task (Berninger, 1992), to assess handwriting fluency. For this task, students are asked to write as much of the alphabet as they can, in sequence, in one minute. However, the measures of written expression used for these studies differ from study to study. In this section, studies that found a relationship between handwriting fluency and compositional fluency are summarized.

Berninger, Yates, Cartwright, Rutberg, Remy and Abbott (1992) developed the Alphabet Task with children in grades one through three. The authors then collected two 5-minute writing samples, one narrative and one expository. They used number of words and clauses to reflect productivity and sentence fluency. Results indicated that handwriting fluency is positively correlated with number of words and clauses written in a five minute period for both narrative and expository writing samples, meaning that handwriting fluency is related to compositional fluency and sentence fluency.

In another study, Berninger, Vaughan, Abbott, Abbott, Woodruff-Rogan, Brooks, Reed and Graham (1997) implemented an intervention study in which they randomly assigned 144 first grade students to six handwriting treatment conditions. Interventions were

implemented twice a week for 20 minutes each. As pre and post measures of handwriting fluency and compositional fluency, the authors used the Alphabet Task, and the Writing Fluency subtest of the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; Woodcock-Johnson, 1990), which measures the ability to formulate and write simple sentences quickly. The authors found that handwriting interventions improved compositional fluency in first grade students who were at risk for handwriting problems (Berninger et al., 1997).

In a third study, Graham, Harris and Fink (2000) also implemented an intervention study. Their participants included 38 first grade students, randomly assigned to two groups, handwriting instruction or phonological awareness instruction. The intervention was implemented in 27, 15-minute sessions. For a pre and post intervention measure of handwriting fluency, like the two previous studies, the authors used the Alphabet Task. For writing, two pre and post intervention measures were used; the Writing Fluency subtest of the WJ-R and a story writing task, in which students were asked to write a story about a black and white picture. Rather than give the students a set amount of time to write the story, the authors recorded the amount of time it took each student to complete the assignment. The students' times ranged from 33 seconds to 15 minutes. The students' stories were assigned two scores, one for compositional fluency (number of words per minute) and another for compositional quality (using a 9-point holistic scale). Results from this study indicated a significant main effect of the handwriting instruction on compositional fluency; however,

they did not find a significant main effect of the handwriting instruction on compositional quality.

In sum, each of these studies provides evidence that handwriting fluency and writing productivity are related. The results of the two intervention studies suggest that increasing how quickly students can write letters increases the number of words and sentences they produce. Thus, it appears that when young students fail to be productive writers, a major contributor to their difficulty is handwriting (versus deficits in language or difficulty responding to the prompt). These results, however, do not indicate that increasing an individual's handwriting fluency will improve the overall quality of his or her writing.

Handwriting Fluency and Writing Quality

In the Graham et al. intervention study (2000), described in the previous section, the authors failed to find that improving students' handwriting fluency had an impact on the quality of students' writing. A few studies, however, have found a significant relationship between handwriting fluency and overall quality of written expression.

Jones and Christensen (1999) conducted two studies, examining handwriting fluency and writing quality in first grade students. In both studies, handwriting fluency was measured using the Berninger's Alphabet Task (Berninger et al. 1992). Writing quality was measured using a 15-minute sample of independently generated text on the topic of "vacation" and scored on a 20-point analytic scale, which was divided into four categories (coherent ideas, spelling and grammar, syntax and sentence structure, and fluency). The first study was a correlational study, which found a significant correlation between handwriting fluency,

which they termed "orthographic-motor integration" and writing quality. The second study was an intervention study, used to determine if direct handwriting instruction can improve writing quality. The intervention involved explicit instruction in handwriting by teaching efficient letter formations and activities promoting the speed and accuracy of writing letters. Results indicated that explicit handwriting instruction improved writing quality for students struggling with handwriting.

Similarly, Steve Graham and Virginia Berninger, along with several associates, used the Alphabet Task and the Copying subtest from the Group Diagnostic Reading Aptitude and Achievements Tests as measures of handwriting fluency for students in grades 1 through 6 (Graham, Berninger, Abbott, Abbott, & Whitaker, 1997). Writing quality was measured using two 5-minute writing composition samples, one narrative and one expository. The authors found a significant correlation between handwriting fluency and writing quality in students in both the primary and intermediate grades.

Handwriting Fluency and Written Expression in Older Populations

With the exception of Graham et al. (1997), most research examining the relationship of handwriting fluency and writing quality has focused on elementary school children in the primary grades. It is likely that researchers' explanation for the relationship between handwriting fluency and written expression led them to assume the finding would not be observed in older children. Specifically, in one of the most widely used models of the cognitive processes involved in writing, the Hayes and Flower model (1980), attention and working memory are viewed as placing limits on writing proficiency. Because younger

children are still learning how the sounds of a language are represented in graphic form, they must devote considerable attention and working memory capacity to recalling and forming letters, allowing them to devote fewer cognitive resources to expressing their ideas (McCutchen, 1988). The assumption was that once handwriting was automatic, the relationship between handwriting fluency and written expression would no longer be observed.

However, since Graham et al.'s (1997) study, there have been four additional studies looking at the relationship between handwriting fluency and written expression for older populations of students (Aitken & Martinussen, 2013; Christensen, 2005; Connelly, Dockrell, and Barnett, 2005; Wagner et al., 2011). The findings in these studies have raised questions about this assumption.

In one study by Wagner et al. (2011), samples of handwriting and written expression were collected from 186 students in first and fourth grades. As in most other studies, handwriting fluency was again measured by the Alphabet Task, and writing was measured by short-time frame writing samples. Writing samples were scored based on macro-organization, complexity, productivity, and spelling and punctuation. Macro-organization was defined as higher-level organization in writing; which includes a topic sentence, logical ordering of ideas, and a main idea, body and conclusion. The authors were surprised to find a strong relationship between handwriting fluency and both macro-organization and productivity in the fourth grade. Given these results, the authors concluded that handwriting fluency places a strong constraint not only on young writers, but also older students despite

the fact that they should be well beyond the point where they have learned to form the graphemes for each letter.

In another study, Christensen (2005) implemented an orthographic-motor integration intervention with 50 students in grades 8 and 9, broken into an intervention group and a control group. Orthographic-motor integration was assessed, pre and post intervention, using the Alphabet Task. Quality of written language was also assessed pre and post intervention, from a writing sample in which students were given three minutes to think about the topic and twenty minutes to write. Writing samples were scored based on the following five categories; creativity and originality of ideas, organization and structuring of ideas, technical accuracy of spelling and grammar, comprehensiveness and elaboration of ideas, and pragmatic awareness and sensitivity to audience. At pre-test, there were no significant differences between groups. At post-test, however, the group of students that received the handwriting intervention had significantly higher scores than control for orthographic-motor integration, length, and quality of written text. These results support the claim that there is a causal relationship between handwriting fluency and written expression in older grades.

Similarly, Connelly, Dockrell, and Barnett (2005) compared the impact of handwriting fluency on pressurized versus unpressurized writing tasks. Participants included twenty-two psychology undergraduate students. Handwriting fluency was measured using the Alphabet Task; and writing was measured using two tasks, one unpressurized writing task in which students were allotted one hour to complete an in class essay, and one pressurized task in which students were allotted one hour to complete an exam in the form of an essay. The

authors found that when comparing a low pressure writing task to an exam writing task, handwriting fluency accounted for a significant amount of the variance in the exam writing task. Furthermore, they found that handwriting fluency had more of an effect on the conclusion of the writing task than the introductory paragraph.

In a recent student, Aitken and Martinussen (2013) examined predictors of performance on curriculum-based measures of written expression with 45 fourth and fifth grade students. Handwriting fluency was measured using the Alphabet Task. For writing quality, the authors administered a curriculum-based measure of written expression to all participants and scored the writing samples using two methods; a count of correct minus incorrect word sequences (CMIWS) and a holistic 7-point rating scale (1 = considerably below grade expectations; 7 = considerably above grade expectations). Results of the study revealed a moderate and positive correlation between handwriting fluency and both CMIWS and ratings of writing quality using the 7-point rating scale.

In summary, the research that has examined the relationship between handwriting fluency and written expression has found correlations between (a) handwriting fluency and number of words produced, or compositional fluency; (b) handwriting fluency and writing quality, using short-term writing samples; and (c) handwriting fluency and writing quality and productivity, in older populations. In discussing their results, most of these studies suggest that handwriting's use of attentional resources constrains attention available for higher level aspects of writing. If this explanation is correct, it implies that focusing on establishing automaticity in handwriting may be important for skilled writing, with slower

handwriting not only negatively affecting children just mastering handwriting, but also students in upper elementary grades and beyond.

The Mismatch between Writing Research Tasks and Classroom Instruction

Although the correlational and experimental research just summarized suggests that handwriting fluency may play an important role in skilled writing, a significant limitation in generalizing from this research to the classroom instruction is that the conditions under which students have been asked to produce writing samples in research is quite different than the conditions under which writing is typically taught and examined in the classroom.

Specifically, since the 1980s, the “process approach” to teaching writing (Troia et al., 2009) has predominated in classrooms. With this approach, teachers characterize writing as a multistep process, which entails prewriting, writing several drafts, seeking peer review, and revising and editing (Pritchard & Honeycutt, 2006). The emphasis in teaching students to write is on the process of writing, rather than focusing entirely on the final draft, or product of writing. Teachers stress to students that a first draft should not be the final draft and that they must go back and use the process, or steps, they have been taught to refine their product and make sure it achieves their intent (Pritchard & Honeycutt, 2006, 2007).

With a process approach, writing instruction is often done in the context of a content area so that students have a purpose for writing, summarizing, and communicating what they have learned in a writing assignment. For example, students might write about a science experiment. A writing assignment within the process approach typically requires several days and includes the production of multiple sub-products as the student works toward the

final product, such as research notes, first drafts, and edited drafts with comments from others.

The process approach to teaching writing is often paired with instruction about good writing using the 6-trait approach to identifying good writing (Spandel, 2009), discussed earlier. Students are encouraged to focus on different traits at different points in the writing process. For example, the trait of ideas might receive the most focus during prewriting, but the trait of conventions would receive the most attention in the editing step of the writing process, just before publication and sharing of the final writing product.

This multi-day, multi-step approach is quite different than the tasks used to produce writing samples in writing research. For example, the most generous time interval in the studies summarized in the previous section was one hour (Connelly et al., 2005). In the majority of studies (e.g., Aitken & Martinussen, 2013; Graham et al., 1997; Wagner et al., 2011), students were given 1 minute to plan and 5 to 10 minutes to write. It seems likely that handwriting fluency would play a much larger role in producing these brief samples than the tasks used in classrooms and the types of assessments used to evaluate student writing skill on high stakes assessments. In fact, students attempting to use the skills they have been taught in the classroom, such as brainstorming and outlining during the prewriting phase, would be disadvantaged when asked to produce a writing sample under these conditions. To date, there have been no studies which have examined how handwriting fluency is related to writing when the process approach to writing is used to produce untimed writing products.

Statement of the Problem and Hypotheses

Statement of the Problem

Written expression is a key literacy skill that presents multiple challenges in terms of accurate assessment and an understanding of the component skills that underlie its acquisition. Contemporary instruction in written expression focuses student and teacher attention on the communicative intent of writing and the multistep process that writers typically use to move from a set of ideas or points to a well-developed, organized written product.

Although handwriting is considered a lower level skill that receives relatively little instructional emphasis in schools, a consistent body of research has demonstrated that handwriting fluency is related not only to compositional fluency (i.e., the number of words written in a limited period of time), but to writing quality. Furthermore, a handful of intervention studies have demonstrated that improving children's handwriting fluency improves the quality of their written products. These findings suggest that handwriting fluency may be an important skill to develop in improving students' ability to express themselves in writing. If this is the case, it suggests that writing outcomes could be improved with more instructional emphasis on handwriting fluency in schools.

However, there is a fundamental shortcoming in the literature examining the relationship between handwriting fluency and quality of written expression. In almost all cases, the tasks used to assess written expression have required students to produce a writing sample in a single work session, typically of quite short duration (5 to 10 minutes). By

definition, those with poor handwriting fluency will write slower than those with better handwriting fluency. Therefore, it is no surprise that students with low handwriting fluency would be at a disadvantage when expressing their ideas in an extremely short time frame.

The existing research literature does not indicate whether handwriting fluency is related to writing quality in ecologically valid or “real world” settings in which students are allotted time for prewriting, drafts, peer review, and editing. If this relationship exists, then there is a stronger case for including instruction and practice in handwriting fluency in the language arts curriculum. However, if the relationship is merely an artifact of the conditions under which writing samples have been collected in studies of handwriting fluency, there is a less compelling case to spend instructional time on handwriting fluency.

The purpose of the present study is to examine the relationship between handwriting fluency and writing quality when the timeframe under which the writing sample is completed is varied, as well as the means of assessing writing quality. Specifically, the relationship between the most widely used measure of handwriting fluency, the Alphabet Task (Berninger, 1992), and writing quality will be examined with writing samples collected in brief (5 minute) and multi-day timeframes. For the brief writing sample, writing quality will be measured by counting the number of correct word sequences, as this is the most widely used measurement of quality used during formative assessment with curriculum-based measures of writing. The multi-day writing sample will be evaluated with the correct writing sequence measure and with a rubric-based system employed in the North Carolina public

schools. The rubric scoring system will provide a writing quality measure similar to the ones used in summative evaluations of students' writing in school.

It is predicted that a positive relationship between handwriting fluency and writing quality (with the correct word sequence measure) will be observed under both the brief and multi-day conditions. It is also predicted that there will be a positive relationship between the rubric-based measure of writing quality and handwriting fluency in the multi-day sample. However, the relationship between handwriting fluency and writing quality will be strongest when a brief timeframe is used and the writing quality metric includes a fluency component (correct word sequences).

Although this study only examines the relationship between handwriting fluency and writing quality within a correlational (versus causal) design, it advances our understanding of the role of handwriting fluency in writing quality. Evidence that handwriting fluency is related to writing quality, even when time constraints are not present and found with a writing quality measure that does not contain a fluency component will make stronger case for the need for intervention studies where handwriting fluency is improved to address problems with students' written expression.

Hypotheses

1. There will be a significant, positive correlation between handwriting fluency and writing quality when writing quality is assessed in a writing sample produced in a brief time period (5-minute writing sample) with a fluency-based measure of writing quality (Correct Word Sequences).

Description and Rationale: It is predicted that handwriting fluency, as measured by the number of letters of the alphabet written correctly in one minute (Alphabet Task), will be positively related to the number of correct word sequences (CWS) on a five-minute writing sample. This relationship has been observed in a previous study by Aitken and Martinussen (2013). It is tested here to provide the starting point for examining under what conditions a relationship between handwriting fluency and writing quality is observed.

2. There will be significant, positive correlation between handwriting fluency and writing quality when writing quality is assessed in a writing sample produced within an extended timeframe (Classroom Writing Project) and a fluency-based measure of writing quality is used.

Description and Rationale: It is predicted that handwriting fluency, as measured with the number of letters of the alphabet written correctly in one minute (Alphabet Task), will be positively related to the number of correct word sequences (CWS) produced on a multi-day writing sample. This hypothesis provides a test of whether handwriting fluency is related to writing quality when the timeframe for completing the writing task is extended beyond the timeframe that has been used in previous studies (e.g., Aitken & Martinussen, 2013; Christensen, 2005; Connelly, Dockrell, & Barnett, 2005; Graham et al., 1997; Jones & Christensen, 1999; Wagner et al., 2011).

3. There will be a significant, positive correlation between handwriting fluency and writing quality when writing quality is assessed in a writing sample produced within

an extended timeframe (Classroom Writing Project) and a measure of writing quality that does not incorporate fluency is used.

Description and Rationale: It is predicted that handwriting fluency, as measured by the number of letters of the alphabet written correctly in one minute (Alphabet Task), will be positively related to NC Writing Rubric scores on the multi-day writing sample. If handwriting fluency is a key aspect of skilled written expression then there should be a relationship between handwriting fluency and writing quality even when fluency plays no explicit role in the metric for assessing writing quality.

4. The correlation found between handwriting fluency and writing quality (Correct Word Sequences) will be significantly weaker when assessed in a writing sample produced in an extended rather than brief timeframe.

Description and Rationale: It is predicted that the correlation found in Hypothesis 2 will be significantly weaker than the correlation found in Hypothesis 1. When all scoring procedures are held constant, if the relationship between handwriting fluency is weaker when time constraints in producing a written product are removed, it suggests that part of the strength of the relationship between handwriting fluency and writing quality that has been observed in previous literature may be an artifact of the way writing quality has been assessed.

5. The correlation found between handwriting fluency and writing quality will be significantly weaker when assessed in a writing sample produced in an extended

rather than brief timeframe with a quality measure that does not include a fluency component (Correct Writing Sequences versus the NC Rubric).

Description and Rationale: It is predicted that the correlation found in Hypothesis 3 will be significantly weaker than the correlation found in Hypothesis 1. Similar to Hypothesis 4, if this hypothesis is confirmed, it suggests that the part of the strength of relationship between handwriting fluency and writing quality that has been observed in previous literature may be an artifact of the way writing quality has been assessed.

Method

Participants and Setting

After receiving district and principal permission to conduct the study at an Eastern North Carolina elementary school in a small suburban district, an email was sent to all fourth grade teachers in the school describing the study and requesting their participation. All four fourth grade teachers agreed to participate and sent home a description of the study and an informed consent form to parents of all students in their classrooms. Students who returned signed consent forms were allowed to participate in the study. Of the 95 students invited to participate, 48 students returned the required forms; however, on the day of data collection, only 40 of those 48 students were present at school. Minor assent forms were collected from those 40 students on the day of data collection. Of those 40 students, 45% were of European American ethnic background, 30% were African American, 11% were Hispanic American, and 2% were Asian American. For 13%, information on ethnicity was not available. At the time of data collection, participant mean age was 10 years 5 months, with a standard deviation of 3 months and a range from age 9 years 7 months to 10 years 8 months.

Information regarding socioeconomic status and aptitude was not available to the researcher.

Measures

Two constructs related to children's writing skill were the focus of the present study; handwriting fluency and writing quality. Handwriting fluency was assessed using The Alphabet Task, a one-minute task that requires students to write the alphabet quickly. Writing quality was assessed using two measures, the number of correct word sequences, and

the NC Writing Rubric. The available psychometric characteristics of each measure are summarized below.

Alphabet Task. The Alphabet Task (Berninger et al., 1997) requires students to write as much of the alphabet as they can from memory within a one-minute time frame. Students' scores are the number of letters written correctly within the allotted time frame. Although this task has been used in multiple research studies (Aitken & Martinussen, 2013; Berninger et al., 1997; Christensen, 2005; Connelly et al., 2005; Graham, et al., 2000; Wagner et al., 2011), information about its psychometric characteristics is limited. In terms of reliability, Berninger et al. (1997) reported a .97 inter-rater reliability when two raters scored children's protocols independently. Test-retest reliability for the Alphabet Task, as reported in the User Guide for the *Process Assessment of the Learner, Second Edition* (2007; a measure which includes the Alphabet Task), is .58 for students in grades K through 3, and .66 for students in grades 4 through 6. In these estimates of reliability, the time periods between Time 1 and Time 2 of assessment ranged from 2 to 34 days, with a mean of 15 days. In terms of validity, Berninger et al. (1992) found a .76 correlation between scores on the Alphabet Task and the copying subtest of the *Group Diagnostic Reading Aptitude and Achievement Tests*, suggesting both measures tap a similar construct, children's skill in reproducing letters or words, independent of the task of expressing thoughts in writing.

Correct word sequences. Correct word sequences (CWS) is a count of the number of "two adjacent, correctly spelled words that are acceptable within the context of the [written] phrase to a native speaker of the English language" (Videen et al., 1982, p. 7). It is thought to

be a measure of at least some aspects of writing quality because CWS takes into account punctuation, syntax, semantics, spelling, and capitalization (Videen et al., 1982). Typically, CWS is assessed in a writing sample obtained in a response to a story starter (e.g., “It was a dark and stormy night...”) within a short time frame (typically 5 minutes). In the present study, CWS was assessed in this brief format, and also in a multi-day writing assignment.

To determine CWS, scorers counted the total number of correct writing sequences (Hosp et. al, 2007) in each of two writing samples (to be described later). Inter-rater reliability for CWS is reported to be .86 (Maleki & Jewell, 2003; Videen, Deno, & Marston, 1982), and alternate-form reliability, .80 (Videen, Deno, & Marston, 1982). CWS scores from a 5-minute writing sample have been found to be highly correlated with holistic ratings of writing quality (Videen, Deno, & Marston, 1982), but lower correlations (.49-.69) have been reported for the relationship between CWS and other measures of writing skill (McMaster & Espin, 2007).

NC Writing Rubric. To provide a measure of student writing skill under conditions that more closely paralleled those under which students are typically asked to express themselves in writing, and are then evaluated by their teachers, the writing assessment scoring rubrics (see Appendices A and B) developed by the North Carolina Department of Public Instruction (NCDPI, 2007-2008) were applied to a student writing sample produced as part of a multi-day classroom assignment. These conditions are described in detail in the Procedure section; however, the NC Writing Rubric and its psychometric characteristics are described below.

The NC Writing Rubric has been used as part of the general education large scale assessment system in North Carolina, and was designed to be applied to writing samples produced in authentic writing contexts where students have multiple days to proceed through the stages of written product development in the process approach to teaching writing. Using the rubric, two raters independently evaluate the quality of the content of a written product (e.g., an essay) on a scale of 1 to 4, and then evaluate the author's use of writing conventions in the product on a scale of 0 to 2 points. The content component score reflects the evaluator's overall judgment concerning the writing sample's focus, organization, support and elaboration, and style. The conventions component score reflects an evaluation of the writer's skills in sentence formation, usage, and mechanics. The scores from each of the raters on both components are summed using an equation that gives double weight to the content score ($Raw\ Score = 2(Content1 + Content2) + 1(Conventions1 + Conventions2)$). The inter-rater reliability reported for this scoring system was 71% agreement for content and 74% agreement for conventions.

To provide evidence of the measure's validity, scores derived from this scoring system have been correlated with ratings of the same written products by experts, yielding correlations of .81 for content and .79 for conventions between the experts' holistic judgments and scores derived from the scoring system (NCDPI, 2007-2008).

Procedures

The present study made use of extant data in the form of a classroom writing project assigned by teachers (but independently scored by the investigator) and two additional

measures administered and scored by the investigator. The following section describes the procedures used by the teachers in conducting the classroom writing project, and the procedures that were implemented by the university investigator.

Classroom writing project. Prior to collection of the study-related measures, students completed a research project that was to culminate in the production of a persuasive essay. Each student was to research a North Carolina lighthouse and then incorporate information from the research into a letter written to the principal, persuading him to visit that lighthouse. This project was a regular part of the fourth grade writing instruction across multiple years in the elementary school where the study was conducted. Students were provided approximately two weeks to write their letters, during which time the writing assignment was integrated into class time and instruction for both language arts and social studies. Prior to writing their essays, students were provided a detailed prompt containing specifications regarding information to be included and an overall structure to follow (for prompt, see Appendix C). They were also provided an outline to follow, numbered 1 through 7, organizing the essay (see Appendix D). The students were then instructed to work on each part of the outline in order. The teacher provided modeling and coaching for each step of the outline. The project followed the stages of the writing process model in that, as students completed each step of the outline, they were instructed to self-edit, seek peer review, and meet with the teacher for additional edits and feedback.

CWP extant data collection. The CWP was assigned and completed prior to initiation of the consent procedures for conducting the study. Once consent was received,

participating teachers supplied CWP originals to the researchers, who then copied the samples and returned them to the teachers.

Collection of remaining study measures by the investigator. A brief writing sample in response to a story prompt and the Alphabet Task were administered by the researchers to participating students in their classrooms. Administration took approximately 15 minutes. Students were asked to clear their desks of everything except two pieces of lined paper and a pencil and were given one minute to write as many letters of the alphabet as they could (for scripted directions, see Appendix E). Students were instructed that if they got to the end of the alphabet before the time limit, to start again at the beginning of the alphabet and use all time allotted. At the end of one minute, the students were told to stop and turn in their handwriting samples. Students were then asked to take one minute to think about a story prompt that was read aloud (see Appendix F) by the investigator and then given five minutes to write about the topic on the prompt. At the end of five minutes, the students were told to stop and turn in their writing samples (for scripted directions, see Appendix F).

Results

There were four main variables in this study: (a) the number of letters written per minute (handwriting fluency; HWF); (b) the number of correct word sequences produced on a brief writing sample (CWS Brief); (c) the number of correct word sequences produced on an extended/multi-day writing sample (CWS Extended); and (d) the total raw score from the analytic scoring rubric applied to the extended writing sample (Analytic Extended).

Preliminary Analyses

Following data collection, all measures were scored independently by two different raters. High interrater reliability correlations were obtained for three of the four variables, HWF (1.00), CWS Brief (.99), and CWS Extended (.98). Because both raters' scores were entered into the previously stated formula to derive the Analytic Extended scores, an accurate estimate of interrater reliability is unavailable for this variable, as this would have required a second pair of raters. However, as an estimate of the lower limit of interrater reliability for this measure, the correlation between the two raters' total weighted scores, was calculated and fell within the moderate range at .68. In addition, percent agreement and Kappa were calculated for raters' separate scores on content and conventions. Raters reached exact agreement 67% of the time for content, and 71% of the time for conventions. The Kappa values of .448 for content and .431 for conventions were statistically significant and indicative of moderate agreement between raters.

Analysis of descriptive statistics revealed that HWF, CWS Brief and CWS Extended were normally distributed; however, Analytic Extended was slightly negatively skewed. This

negative skew could be due to a ceiling effect produced by the amount of scaffolding provided by teachers for the CWP. Means, standard deviations, variances, skew and kurtosis are summarized in Table 1.

Table 1

Descriptive Statistics

Variable	M	SD	σ^2	Skew	Kurtosis
HWF	41.19	15.58	242.74	.47	-.41
CWS Brief	54.79	24.37	593.78	.57	.30
CWS Extended	286.43	87.37	7633.52	.78	.09
Analytic Extended	16.57	2.90	8.40	-.85*	.72

Note. HWF = Handwriting Fluency; CWS = Correct Word Sequences.

*Skew is significant.

Tests of Hypotheses

Hypothesis 1 predicted that there would be a significant, positive correlation between handwriting fluency and correct word sequences on the brief writing sample. As predicted, a significant and positive relationship was observed, $r(39) = .66, p \leq .01$. Students who wrote more letters per minute on the Alphabet Task (HWF) also tended to write more correct word sequences on the short, timed writing task (CWS Brief).

Hypothesis 2 predicted that there would be a positive correlation between HWF and the CWS Extended. This hypothesis was also confirmed ($r(39) = .58, p \leq .05$). Students who

wrote more letters per minute also tended to write more correct word sequences on an extended/multi-day writing task.

Hypothesis 3 predicted that there would be a positive correlation between HWF and the Analytic Extended. Again, as predicted, there was a significant and positive relationship between handwriting fluency and analytic scoring rubric scores on an extended time frame writing task, $r(39) = .37, p = .02$. Students who wrote more letters per minute also tended to have higher ratings on an analytic scoring rubric.

Hypothesis 4 predicted that the correlation found between HWF and CWS Extended would be significantly weaker than the correlation found between HWF and CWS Brief. To find the difference between two dependent correlations the following equation, which takes into account the correlation between the CBM writing samples and the Classroom Writing Project writing samples, was used (Field, 2009):

$$t_{Difference} = (r_{xy} - r_{xz}) \sqrt{\frac{(N-3)(1+r_{xz})}{(1-r_{xy}^2 - r_{xz}^2 - r_{zy}^2) + (2r_{xy}r_{xz}r_{zy})}}$$

where $x = \text{HWF}$, $y = \text{CWS Brief}$, and $z = \text{CWS Extended}$. Contrary to the prediction, there was no significant difference between the correlation between HWF and CWS Brief and the correlation between HWF and CWS Extended, $t(39) = 1.04, p > .05$.

Hypothesis 5 predicted that the correlation found between HWF and Analytic Extended would be significantly weaker than the correlation found between HWF and CWS Brief. Field's (2009) formula was again applied. This time, $x = \text{HWF}$, $y = \text{CWS Brief}$, and $z = \text{Analytic Extended}$. Hypothesis 5 was confirmed; there was a stronger relationship between

HWF and CWS when a brief rather than extended writing sample was used, $t(39) = 3.00$, $p < .05$.

Table 2 provides an opportunity to examine additional correlations between variables that were not part of the proposed hypotheses. The table reveals significant correlations between CWS Brief and CWS Extended, CWS Brief and Analytic Extended, and CWS Extended and Analytic Extended. These correlations suggest that the writing quality measures used in the present study were related to one another across different types of assignments and scoring approaches.

Table 2

Between Study Measures

Measure	1	2	3
1. CWS Brief	1	--	--
2. CWS Extended	.59**	1	--
3. Analytic Extended	.37*	.68**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Discussion

Several research studies have documented a positive relationship between handwriting fluency and the quality of written expression. However, these studies used short, timed writing samples as measures of writing quality. This methodological characteristic of the existing literature raises the possibility that the relationship between handwriting fluency and quality of written expression found in the research literature may be an artifact of the conditions under which writing samples have been collected and the measures of writing quality used. This possibility is problematic because speeded tasks do not represent the typical conditions under which student writing is produced or evaluated.

The purpose of the current study was to examine the conditions under which a relationship between handwriting fluency and writing quality would be observed. The relationship between handwriting fluency and writing quality when a speeded task and count-based quality measure were used was compared to the relationship when conditions for producing and judging writing were more similar to those that occur in typical classroom writing assignments.

As predicted, when a speeded task and count-based measure of writing quality was used, a significant and moderately strong relationship between handwriting fluency and writing quality was observed (Hypothesis One). Thus, this study replicated previous research where handwriting fluency was related to writing quality when students were given only a short time to write (Aitken & Martinussen, 2013; Connelly et al., 2005; Jones & Christensen, 1999; Wagner et al., 2011). In the present study, handwriting fluency accounted for

approximately 43% of the variance in handwriting quality; this figure is within the range reported across these three previous studies (3 to 67%), but somewhat higher than the shared variance between handwriting and writing (18 to 37%) reported in the studies that examined this age group (Aitken & Martinussen, 2013; Wagner et al., 2011).

The present study also found handwriting fluency to be a predictor of writing quality when the writing project was completed across multiple days, both with a count-based quality measure (Hypothesis Two) and with a writing quality rubric that had no overt speed component (Hypothesis Three). In the one previous study that contrasted a highly speeded and less speeded tasks (Connelly et al., 2005), no relationship between handwriting fluency and writing quality was found in the less speeded task. Possible reasons for this difference in findings across the two studies will be discussed later.

Hypotheses Four and Five were aimed at estimating the extent to which a speeded task and a count-based measure of writing quality contributed to the relationship between handwriting fluency and writing quality. Drops in the correlation between handwriting fluency and writing quality were examined when students had more time and a quality measure was used that was not dependent on amount written. When the use of a count-based measure of writing quality was held constant and a speeded versus non-speeded writing task contrasted, the correlation between handwriting fluency and writing quality dropped, but the difference was not significant (Hypothesis Four). However, the difference between correlations was significant when the correlation of handwriting fluency and writing quality was assessed with a speeded task and count-based quality measure was compared with the

correlation obtained when a multi-day task and a more holistic writing quality measure was used (Hypothesis Five).

In sum, the results from the present study provide evidence that at least some of the relationship found between handwriting fluency and writing quality is an artifact of the time-limited writing tasks which students are typically given in experimental studies. However, a significant (but weaker) relationship between handwriting and writing quality remained even when the writing task was untimed, and the quality metric was an analytic scoring rubric. As noted earlier, only one other study, Connolly et al. (2005) has examined the impact of writing fluency when time constraints were varied, and in that study the relationship between handwriting fluency and writing quality was only observed in the speeded task. However, this study was conducted with college students. There may be a developmental explanation for the difference between the two studies; as students gain years of experience writing, the impact of fluency is only apparent in timed tasks. Another possible explanation is that the range of handwriting fluency is more restricted in college, as students who have fluency issues in writing are less likely to attend college. It may also be that differences in the writing tasks or scoring systems between the two studies explain the different outcomes, or some other methodological difference between the studies, such as lower power in the Connolly study or a less reliable outcome measure.

Although the correlation was weaker, the present study demonstrated that, for fourth grade students, handwriting fluency was related to writing quality even when students were given multiple days to complete the writing task. One explanation put forth in the literature

is that if handwriting is slow and effortful, students do not have the attentional resources to focus on the content of their writing (Berninger, 1992; Berninger & Graham, 1998; McCutchen, 1988) and therefore the quality of the writing suffers. Placing the writer's attention on handwriting may reduce the attention placed on planning, therefore having detrimental effects on the organization and ideas in the writing sample. Similarly, slow handwriting may also affect the writer's ability to keep up with the rate at which his or her mind creates ideas, therefore causing the writer to forget some or many of those ideas by the time he or she is able to write them down (Graham & Weintraub, 1996); however, this difficulty would occur regardless of the amount of writing time, but could be alleviated if handwriting speed was increased. It also may be that students who find handwriting difficult grow to dislike writing, so that even when they have time to devote to content, they choose not to do so. This avoidance of writing may therefore hinder the development of their ability to write (McCutchen, 1996).

This interpretation might also explain why, when students receive practice in handwriting fluency, their writing improves (Jones & Christensen, 1999). Increasing handwriting fluency may make a significant difference in how easily and quickly students can compose. As a result, the time and attention they spend on writing is focus on the ideas and organization, rather than the physical act of creating text.

Limitations

The results of this study must be interpreted with the understanding of the following limitations. First, as previously stated, the goal of this study was to examine written

expression in an ecologically valid setting. However, because the writing project was collected in such a setting (i.e., by teachers in a public school), there was little control over the integrity with which the data were collected. For example, throughout the writing process, students were to seek peer and teacher feedback on their writing samples via “conferences.” Because the data were collected by teachers prior to their knowledge of the research study, the number of conferences may not have been held constant for all participants. Similarly, if participants were absent, they may have missed conferences or instruction time that was beneficial to other participants. Also, students were allowed to choose what peers to work with when seeking peer feedback. Because peer feedback sessions were not held constant for all participants, it could be that some students chose students who were better writers and therefore received beneficial peer feedback, while others could have chosen students who were poorer writers and therefore received less beneficial peer feedback. These limitations could have been minimized by collecting the students’ first drafts, rather than final drafts; however, this change could have also reduced the ecological validity by placing an artificial requirement of writing a complete and linear first draft, rather than writing the samples in pieces.

Second, interpretation of data is limited because it is based on a limited number and age range of participants and because data were collected from only one school. A larger number of participants from multiple schools and a broader age range, possibly first through sixth grade, could have provided more statistical power and information regarding the correlations found. Examination of the correlation between handwriting fluency and written

expression within a broader age range would allow for comparisons between grade levels and to investigate whether this correlation changes with age.

Implications of Findings for Practice

Although there are still questions that need to be answered regarding whether or not handwriting fluency places constraints on the writer's attentional resources, what we do know is that, if we provide ample time for students to use the writing process, those constraints may be reduced. This finding provides argument that state writing tests should continue to move toward untimed or extended time writing projects, rather than timed, on-demand writing tests that usually only allow for minimal brainstorming and do not allow for multiple drafts, if these tests are to be representative of the writing skills taught in the classroom.

Recently, handwriting instruction has been phased out of the curriculum in most elementary schools (Berninger, 1999; Graham & Weintraub, 1996). If it is the case that handwriting fluency places constraints on the writer's attentional resources, direct instruction and practice in handwriting should be included in the writing curriculum in order to increase fluency and alleviate some of handwriting's demand on the writer's attention.

Implications of Findings for Research

Because this study confirms the presence of a relationship between handwriting fluency and written expression, even when students are provided extended time to write, questions are raised regarding the nature of that relationship. Previous studies have discussed attentional resources as being an underlying process affecting written expression. Although

findings from this study may support this explanation, more research is necessary to develop a deeper understanding of the relationship between attention, writing fluency, and quality of written expression.

Additional research is also needed to compare the relationship between handwriting fluency and the current on-demand writing assessment with the relationship between handwriting fluency and a writing assessment that utilizes the writing process (prewriting, writing, revising) over multiple days. Conditions could be included in which some students handwrite their responses, some type, and others have a scribe. These conditions could help to parse out the magnitude of the effect of handwriting fluency on written expression.

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Resources.

APPENDICES

Appendix A: Rubric for Content Areas

Comprehensive Guide

North Carolina Writing Instruction

Published July 2009
System Pilot**Rubric for Content Areas**

This scoring rubric applies to the content-specific writing assignments in content areas such as Mathematics, Sciences, Social Sciences, Humanities, Arts, Technology, etc. and will be used in conjunction with the writing features and convention rubrics below.

Content Area Rubric

Points	Descriptions
3	<p>The student response meets the following criteria:</p> <ul style="list-style-type: none"> • demonstrates all aspects of the writing assignment • follows all directions, steps, and/or procedures • cites and explains appropriate content-specific examples accurately • employs sound reasoning, arguments, and/or support • demonstrates the use of evaluating, analyzing, and applying skills
2	<p>The student response meets the following criteria:</p> <ul style="list-style-type: none"> • demonstrates most aspects of the writing assignment • follows most directions, steps, and/or procedures • cites and explains appropriate content-specific examples, however, some inaccurate information is included • employs inferential reasoning, arguments, and/or support • demonstrates the use of analyzing and applying skills
1	<p>The student response meets the following criteria:</p> <ul style="list-style-type: none"> • demonstrates some aspects of the writing assignment • follows some directions, steps, and/or procedures • may attempt to cite and explain some content-specific examples, and/or inaccurate information is included • employs concrete reasoning, arguments, and/or support • demonstrates the use of analyzing skills in a literal manner
0	<p>The student response meets the following criteria:</p> <ul style="list-style-type: none"> • does not demonstrate any aspect of the writing assignment • follows few directions, steps, and/or procedures or none at all

	<ul style="list-style-type: none">• cites inaccurate or inappropriate examples• employs little or no evidence of reasoning, argument, and/or support• demonstrates little or no evidence of any apparent reasoning skills
Note	<ul style="list-style-type: none">• Those scoring content-specific tasks for Second Language courses should note that a student response may be composed in the foreign language that is being taught and score them accordingly.

Appendix B: Conventions Rubric

NC Writing Instruction System 2009-2010

Conventions Rubric

Points	Description
2	<p>Exhibits reasonable control of grammatical conventions appropriate to the writing task</p> <ul style="list-style-type: none"> • Exhibits reasonable control of sentence formation • Exhibits reasonable control of standard usage including agreement, tense, and case • Exhibits reasonable control of mechanics including use of capitalization, punctuation, and spelling
1	<p>Exhibits minimal control of grammatical conventions appropriate to the writing task</p> <ul style="list-style-type: none"> • Exhibits minimal control of sentence formation • Exhibits minimal control of standard usage including agreement, tense, and case • Exhibits minimal control of mechanics including use of capitalization, punctuation, and spelling
0	<p>Lacks control of grammatical conventions appropriate to the writing task</p> <ul style="list-style-type: none"> • Lacks control of sentence formation • Lacks control of standard usage including agreement, tense, and case • Lacks control of mechanics including use of capitalization, punctuation, and spelling

Appendix C: Directions for Classroom Writing Project

School Address

February 10, 2012

Dear Fourth Grade Panda,

Your teacher has shared that you are learning about lighthouses of North Carolina. How exciting! I am planning to sail my boat to a NC lighthouse. I would like to learn more about each of them before I make my decision. I was wondering what information you could share with me about the lighthouse you researched.

Here are some **specific facts** I would like to know about your lighthouse:

- Height
- Location
- Operational (Is it working?)
- Number of Steps
- Year Finished

I would like to know some interesting and historical facts about your lighthouse. I know they are very important to North Carolina's history, but am not sure of all the reasons why. What can you share with me about the history?

I am interested in your opinions and questions. I may get the opportunity to talk with the caretaker of the lighthouse. If I do, what would you be interested in learning more about? Would you like to visit your lighthouse? Explain why or why not.

I need your completed letters by **March 10, 2012**. As you write your response letter, be sure to include:

- All 5 parts of a friendly letter
 - Heading (address and date)
 - Salutation
 - Body (several indented paragraphs)
 - Closing
 - Signature
- Specific facts about the NC lighthouse
- More than 1 page long
- Correct grammar, spelling, punctuation, and capitalization.

Sincerely,

Your Principal

Appendix D: Required Outline of Classroom Writing Project

School Address

March 10, 2012

Dear Mr. Minge,

1. Introduction
2. Specific facts (Height, Location, Operational?, # of Steps, Year Finished)
3. Interesting and Historical Facts
4. **Why** your lighthouse is important to NC's history.
5. Questions for the caretaker. (What you want to know more about.)
6. Visit? – Why or Why not?
7. Conclusion

Sincerely,

4th grade Panda

Appendix E: Directions for Alphabet Task Data Collection

The following scripted directions were used to obtain handwriting samples:

When I say, “ready, begin,” you are going to write the small letters of the alphabet as fast and as carefully as you can. Keep writing until I say stop. If you make a mistake, draw a line through the letter and keep going. If you get to the end of the alphabet, start over again. Ready, begin.

Appendix F: Directions for Brief Writing Task

The following scripted directions were used to obtain writing samples:

You are going to write a story. First, I will read a sentence, and then you will write a story about what happens next. You will have 1 minute to think about what you will write, and 5 minutes to write your story. Remember to do your best work. If you don't know how to spell a word, you should guess. Are there any questions?

Put your pencils down and listen.

For the next minute, think about "Yesterday, a monkey climbed through the window at school and..."

(After 1 minute), Now begin writing.

(After 90 seconds). You should be thinking about "Yesterday, a monkey climbed through the window at school and..."

(After the full 5 minutes). Stop. Put your pencils down.