International Peer Reviewed E Journal of English Language & Literature Studies
ISSN: 2583-5963
www.ell.iaar.co Page No. 167 To 235

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A Study on the Implementation of Automated Writing Evaluation

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Abstract:

The body of research demonstrating the significance of automated writing evaluation (AWE) systems in writing instruction and education continues to expand. However, not much research has been done to investigate how AWE may be implemented in different educational settings and what kind of effects it has on the students' ability to write. This article describes the MI Write AWE system and the conclusions of an inquiry that looked at the incorporation and use of AWE with middle school writing teaching utilizing a variety of research methodologies. During this investigation, AWE integration was investigated concerning a conventional process approach to writing education and a strategy teaching method based on the paradigm of self-regulated strategy development. Both of these pedagogical tenets were considered about one another. Both the effectiveness of these two instructional settings in fostering students' and teachers' experiences with and perspectives on teaching and learning through the use of AWE, as well as the effectiveness of these instructional settings in encouraging students to improve the quality of their writing from their first draft through subsequent essays, were both evaluated. The results of these evaluations can be found in the table below. Following an eight-week intervention, multilevel model analyses showed that students' first-draft writing skills increased at approximately the same rates independent of the instructional setting. This improvement occurred across the duration of the intervention. The findings of qualitative analyses of interview data demonstrated that AWE's effects on teaching were consistent across various

contexts. Both instructional environments featured qualities consistent with a framework for purposeful practice, and this was especially true when it came to the application of AWE.

Keywords: automated writing evaluation; writing instruction; writing assessment

1. Introduction and Theoretical Basis

Writing is a skill that requires a considerable lot of mental complexity and dexterity (Berninger & Swanson, 1994; Flower & Hayes, 1980; Hayes, 2012). As a consequence of this, the development of writing skills requires continual, purposeful practice in order to be possible (Kellogg & Whiteford, 2009). Constant changes in practice, an innate desire to remain focused on the current endeavor, and a conscious attempt to improve performance are all components of sustained intentional practice (Ericsson, 2006). Students must participate in the practice of this kind if they are to acquire and naturally apply lower-level writing skills such as handwriting, keyboarding, spelling, and the application of rules controlling written language. Students must also demonstrate that they understand and can apply these skills (Berninger & Swanson, 1994; Kellogg, 2008; McCutchen, 1988). In addition, students need to have plenty of practice with this mode of writing to develop their ability to think strategically and exercise metacognitive control over the primary cognitive processes that are engaged in the writing process. Some of these processes include planning, translating, assessing, and reworking the material (Bereiter & Scardamalia, 1987; Flower & Hayes, 1980; Graham, 2018; Graham et al., 2019; Harris, Graham, Brindle, & Sandmel, 2009; Hayes, 1996, 2012).

Putting these strategies into action, on the other hand, is not adequate on its own. It is essential, in order to keep one's level of competence consistent over time, to regularly get feedback that is timely, pertinent, and constructive from one or more feedback agents, such as a mentor, peers, or even one's self or a computer (Ericsson, 2006; Hattie & Timperley, 2007). Research done in the past (Patchan, Schunn, & Correnti, 2016; Patthey-Chavez, Matsumura, & Valdés; Hattie & Timperley, 2007; Nelson & Schunn, 2009; 2004; Shute, 2008) has demonstrated that students benefit the most from receiving criticism that addresses both the surface-level and content elements of writing and that is quick, precise,

localized, and thorough. This type of feedback has been shown to help students improve their writing.

It is unfortunate that students seldom ever engage in the type of continuous focused practice that I just described because the majority of curricula only allocate a very small amount of time to writing instruction (Brindle, Graham, Harris, & Hebert, 2015; Gilbert & Graham, 2010; Graham, Harris, Fink-Chorzempa, & MacArthur, 2003). In addition, to provide teachers with high-quality feedback, the instructors must put in much effort and knowledge in pedagogy (Dikli, 2010). Both Mr. Parr and Mr. Timperley In point of fact, research conducted by Clare, Valdés, and Patthey-Chavez (2000) and Matsumura, Patthey-Chavez, Valdés, and Garnier (2002) indicates that instructor evaluation does not typically result in an improvement in the academic performance of students because it emphasizes the students' inadequate writing abilities. Therefore, it is imperative to develop strategies for improving students' writing practice and the frequency and effectiveness of teacher feedback if one wishes to see an increase in the writing results of one's student body. This is the case if one wishes to see an increase in the writing results of one's student body. Utilizing automated writing evaluation (AWE) systems is one way to strengthen writing practice and reduce the amount of time spent on the practice-feedback cycle (Kellogg, Whiteford, & Quinlan, 2010). This can be done without increasing the time teachers are required to spend evaluating and commenting on their pupils' work. A wide variety of learning management capabilities and automated grading are typically utilized together with automated feedback elements incorporated into AWE platforms to assist in the teaching and learning of writing. A significant portion of the teaching staff now uses AWE technology (Palermo). However, research into how AWE might be successfully implemented into various teacher-led writing education programs and styles has lagged behind popularity in recent years (Thomson, 2018; Stevenson, 2016; Wilson & Czik, 2016).

In the current study, a mixed-techniques approach was utilized so that the researchers could investigate the application of AWE and its incorporation with the other two methods of teaching writing at the middle school level. [This phrase needs a reference] [This phrase needs a reference] Authentic writing opportunities and cycles of planning, drafting, and revising were provided in an instructional setting that followed the traditional process

approach to teaching writing, whereas authentic writing opportunities and cycles of planning, drafting, and revising were included in an instructional setting that utilized strategy instruction to include AWE. There were real opportunities to write, with cycles consisting of planning, drafting, and editing (i.e., explicit instruction on cognitive and metacognitive strategies for executing various writing processes like planning, drafting, and revising). We examined the two learning environments to see which would be more likely to inspire students to produce better first drafts of their papers in the future. We also looked at the students' and the instructors' experiences with and perceptions of the AWE system in order to get a better understanding of the pros and cons of the system as seen by its users, as well as how these views connected to and explained the students' writing performance trajectories in the two different instructional settings. This was done in order to get a better understanding of the pros and cons of the system as seen by its users. This provided us with a better understanding of the merits and drawbacks of AWE as viewed by its customers.

1.1 Automated Writing Evaluation

Writing is something that may be taught as well as learning with the use of AWE systems, which are educational aids that are based on various forms of technology. The automated feedback offered by AWE is an essential part of the platform. This feedback is designed to assist authors in improving their writing after they have revised their work (see, in this issue, Cotos, Huffman, & Link, 2020; Knight et al., 2020). The purpose of the Academic Writing Experience (AWE) is to reduce the number of grading teachers must undertake while simultaneously providing students with opportunities to practice writing and receive feedback on their work. AWE systems integrate automated qualitative input with automated quantitative feedback in scores or other assessment indications (e.g., Mayfield et al., 2018; Roscoe, Allen, Weston, Crossley, & McNamara, 2014; Roscoe & McNamara, 2013). One thing that usually makes AWE as a feedback system dependent on it is the development of automated essay scoring, generally known as AES. Another name for AES is an automated essay scoring system. Automated scoring algorithms, abbreviated as AES, are computer programs that are tried and true to faithfully reproduce the ratings given by human raters (Shermis & Hamner, 2013).

Studies conducted in the past have found that combining AWE with automated feedback provides a variety of benefits for both teaching and learning writing in a classroom setting. It has been demonstrated that the use of AWE can free up teachers' time in the classroom by reducing the amount of grading that they are required to complete, encouraging individualized instruction, boosting student autonomy and writing motivation, assisting with portfolio management, and enabling teachers to provide more feedback on higher-level writing abilities (Grimes & Warschauer, 2010; Warschauer & Grimes, 2008; Wilson & Czik, 2016; Wilson & Roscoe, 2020).

However, the implementation of AWE has not always been followed by an increase in the number of chances for pupils to write that they have been given (Warschauer & Grimes, 2008). This demonstrates that, at the middle school and secondary school levels, the requirements of adhering to an English Language Arts (ELA) curriculum that places less emphasis on writing may be more time demanding than the time-saving advantages of utilizing AWE (Wilson & Roscoe, 2020). Additionally, some students find the amount of information provided by automated feedback to be excessive and overwhelming (Grimes & Warschauer, 2010; Ranalli, 2018), which necessitates additional support and instruction from teachers in order for students to correctly interpret the data (even though automated feedback is effective in scaffolding writing quality improvements across subsequent revisions of an essay; Wilson & Czik, 2016; Wilson, Olinghouse, & Andrada, 2014). Even though it has been demonstrated that automated feedback is effective in scaffolding, this continues to be the case.

The implementation of AWE has been linked to positive effects on a variety of writing outcomes for students in grades K–12, including increases in the number of time students spend working on their writing, increases in the number of revisions they finish, and improvements in the quality of the writing they produce (Franzke, Kintsch, Caccamise, Johnson, & Dooley, 2005; Graham, Hebert, & Harris, 2015; Grimes & Warschauer, 2010; Morphy & Graham, 2012; Shermis, Garvan, & Diao, 2008; Wade-Stein & Kintsch, 2004). However, fewer studies have found a connection between automated feedback and improvements in writing attitudes (Roscoe, Allen, Johnson, & McNamara, 2018), motivation and self-efficacy (Grimes & Warschauer, 2010; Wilson & Czik, 2016; Wilson & Roscoe, 2020), and writing quality, particularly mechanical aspects of writing across

revisions (Kellogg et al., 2010; Morphy & Graham, 2012; Wilson, 2017; Wilson). These findings have been (Wilson & Roscoe, 2020).

Even though the outcomes of applying AWE are typically positive, not much research has been done to investigate how AWE might be utilized in conjunction with instructor-led writing instruction to produce the optimum outcomes (c.f., Knight et al., 2020). Writing-process practice, strategy-based practice, and game-based practice, for example, have all been proven to have equal benefits on students' advancements in work quality while revising their writing, according to earlier research by Roscoe and colleagues. [citation needed] (see Roscoe et al., 2018; Roscoe, Snow, & McNamara, 2013). However, these studies do not provide insight into how teachers incorporate AWE into their classes or adjust their instruction in response to the research outcomes. Comparing an AWE feedback condition to a teacher feedback condition is a common approach utilized in earlier research on AWE that has investigated differences at the teacher level (Stevenson & Phakiti, 2014). The construction of a false dichotomy between AWE feedback and instructor input is the defect that causes these comparisons to be erroneous from an ecological aspect, even though they can be beneficial in terms of the research design. The purpose of the automatic feedback made available by AWE systems is not to take the place of the input provided by teachers but rather to supplement it (Kellogg et al., 2010). Therefore, educators can provide students feedback that has been selected with greater care because of this (Wilson & Czik, 2016). As a consequence of this, additional research is required to teach teachers about the affordances of AWE that they can use, the limitations of AWE that they should be aware of and how to handle them, and the integration of AWE into various contexts for teacher-led instruction, such as instruction on the writing process or instruction on strategies. This is because more research is required to teach teachers about the affordances of AWE that they can use, the limitations of AWE that they should be aware of and how to handle them.

Consequently, the current research investigates how students can generalize and maintain improved writing quality across various essays after receiving the automated evaluation. The researchers also investigate how teachers and students see the usage of AWE concerning more traditional process-based methods of teaching writing strategy and teaching writing. In light of this, the current research expands upon the ground-breaking work done more than ten years ago by Warschauer and Grimes when they evaluated the

district's adoption of AWE (Grimes & Warschauer, 2010; Warschauer & Grimes, 2008). The current research considers the perspectives of individuals whose thoughts affect whether or not a strategy is successful, whether or not it is adopted, and whether or not it is used. The strategies for implementing AWE are the primary emphasis of the current study and the researchers' previous work. This study is unique in that it also uses longitudinal development models to determine the rate at which students' writing skills advance as they complete a number of essays in various educational contexts. This helps the researchers determine how students' writing abilities improve over time. This aims to determine how quickly children's writing skills grow over time. The bulk of research done in the past concentrated on determining how much of an improvement there was in the quality of writing either between different drafts of the same essay or between the pre-test and post-test versions of the same essay (see Stevenson & Phakiti, 2014). There is a lack of information on how AWE might be incorporated into teacher-led instruction, which makes it difficult to support generalized writing quality improvements, such as the transfer to improved performance on writing assignments completed independently without the support of automated feedback (i.e., improvements in the quality of students' first drafts). This is necessary to support generalized writing quality improvements. This is because there is a dearth of information regarding how AWE may be integrated into teacher-led instruction to improve overall writing quality.

2. MI Write

A well-known example of an AWE system is the Measurement Incorporated (MI) Write system, formerly PEG Writing. The capabilities of MI Write's formative assessment should help improve both the writing instruction students get and their own development. This online interactive learning environment enables a wide range of interactions between instructors and students and the AWE system itself. For example, teachers can provide students with prompts that can be modified, give them embedded (that is, in-text) or summary comments and feedback, and create reports that can be customized to track the development of their class or individual students, thanks to the learning management features provided by MI Write. These features can be accessed through the MI Write website. In addition, students can take advantage of MI Write's feedback and scoring features to increase the amount of revision work they do, calibrate their performance

against automated writing quality scores, and use automated feedback to improve the quality of their writing across multiple drafts of an essay, complete differentiated and interactive multimedia skill-building lessons, and give and receive anonymous or identifiable peer reviews. The website for MI Write gives users access to these many tools.

The MI Write system utilizes the Project Essay Grade (PEG) grading engine, which in turn enables the system to automatically offer students feedback on their writing. Our scoring engine performs statistical analysis on student writings, computes metrics that capture the underlying features of writing, and models the judgments of professional raters in order to provide scores. These steps are necessary in order to generate scores. First, PEG searches for and pulls out text characteristics from the essays used for training associated with human-scored writing quality indicators. Syntactic parsers and semantic analysis are two methods that fall within this category. Following that, the overall quality of the essays is evaluated based on these qualities. Two examples of such qualities are the average hypernym level of the lexicon and the percentage of mature terms in the language. Other examples include counting the number of n-grams found in letters, words, parts of speech, and phrases, calculating measures of semantic overlap and other substitutions for structure and elaboration. Finally, PEG provides helpful automated feedback in the form of suggestions for increasing the overall quality of an essay when it is edited based on the characteristics of the text. Likewise, this feedback is offered when an essay is revised based on the characteristics of the text.

MI Write uses the PEG scoring engine, which grades student work based on both prompt-general scoring models and purpose-specific scoring models, to scaffold revision and improve writing skills (such as informational, argumentative, and narrative). This refers to the quantitative automatic feedback that PEG is capable of providing. MI Write uses score models to do automated evaluations of the following six areas of writing quality: idea development, organization, style, sentence structure, word choice, and conventions. The final score, which can vary anywhere from 6 to 30, is determined by giving each of the characteristics that are being evaluated a number on a scale that goes from 1 to 5. Students are provided with not only their individual but also their overall results, as well as a score report. In addition, this report includes annotations for the draft's spelling and grammar, a comprehensive evaluation and comments for each quality, and recommendations for

interactive courses (see Figures 1-4). The reports sent to the teachers include the question, information on how it was used (for essays, drafts, peer assessments, and lessons), utilization data, and student and class-level performance (by characteristic, total score, and writing purpose).

PEG's automated scoring technique is consistent and immune to typical human-rater mistakes, such as rater drift and halo effects. [Citation needed] (that is, entirely trustworthy). Similar functionality may be found in other AWE scoring systems that use automated scoring. PEG recently provided evidence that it can be relied upon by competing in the first two rounds of the Automated Student Assessment Prize (ASAP) competition. The Hewlett Foundation financed this competition. PEG exceeded all of its rivals in that field regarding human score agreement, and it was found to be usually more trustworthy than utilizing two expert raters. In addition, PEG outperformed all of its competitors in that field regarding human score agreement (Morgan, Shermis, Van Deventer, & Vander Ark, 2013; Shermis & Hamner, 2013).

In addition to the findings that Wilson and his colleagues came at, the findings of the most current study that MI conducted Write demand more elaboration (Wilson, 2017; Wilson & Czik, 2016; Wilson et al., 2014; Wilson & Roscoe, 2020). Palermo and Thomson (2018) researched how instructors' use of the AWE system NC Write led to improvements in the writing abilities of middle school pupils (a state-specific variation of MI Write).

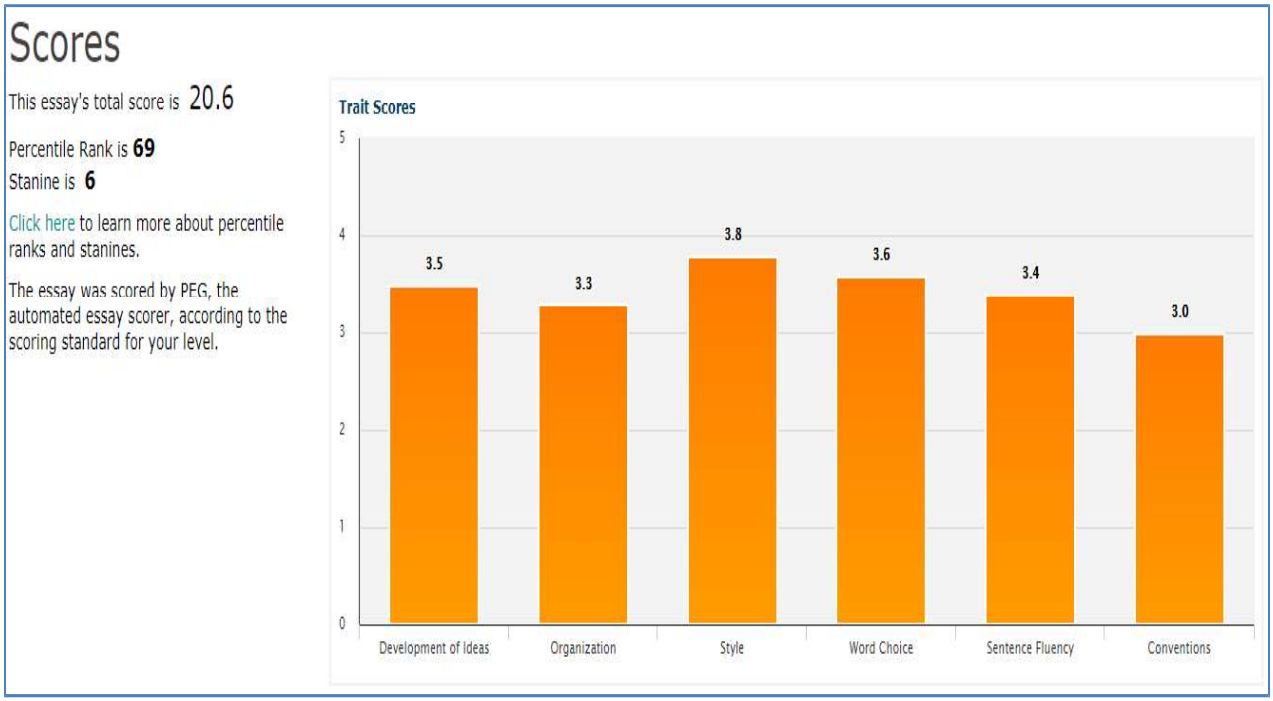
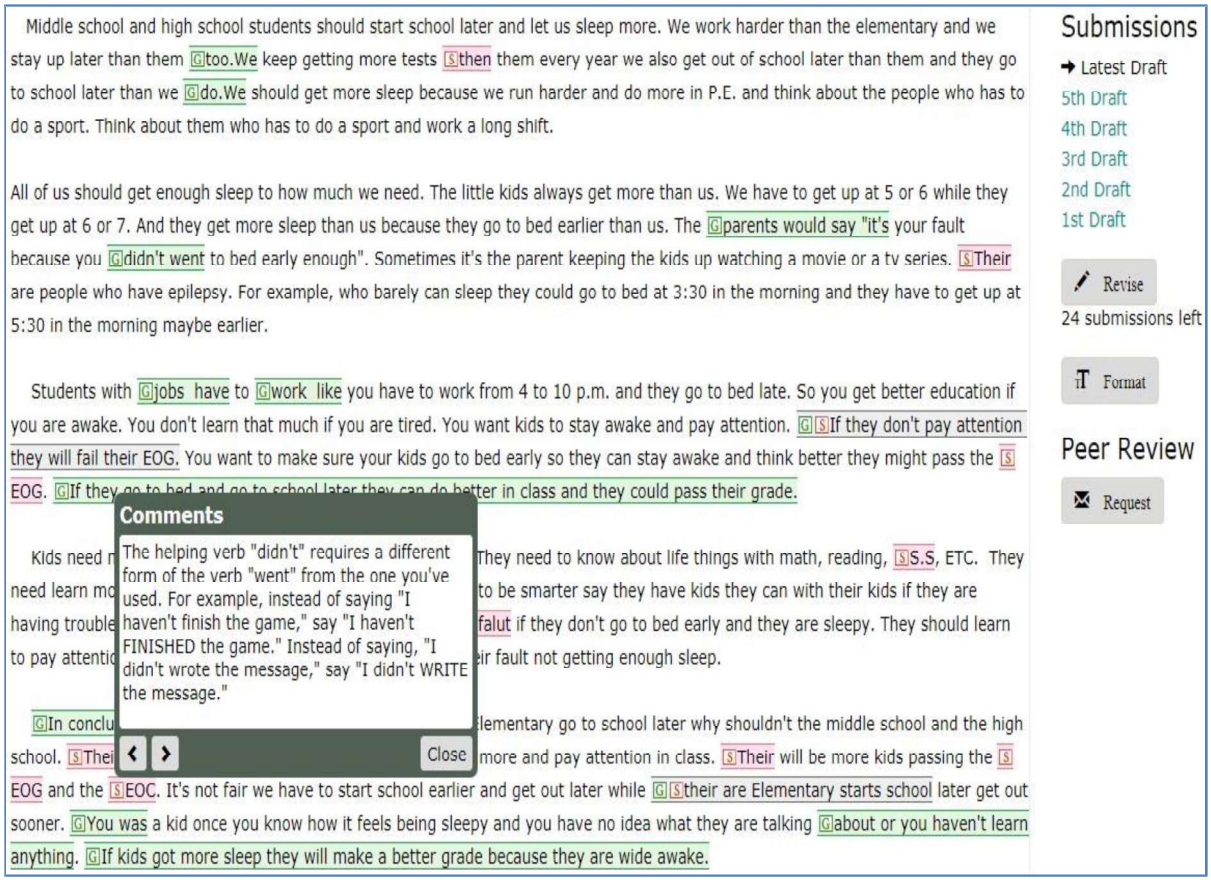


Figure 1. Essay total and trait-specific scores.



ISSN: 2583-5963

Figure 2. Student essay annotated with spelling and grammar feedback.

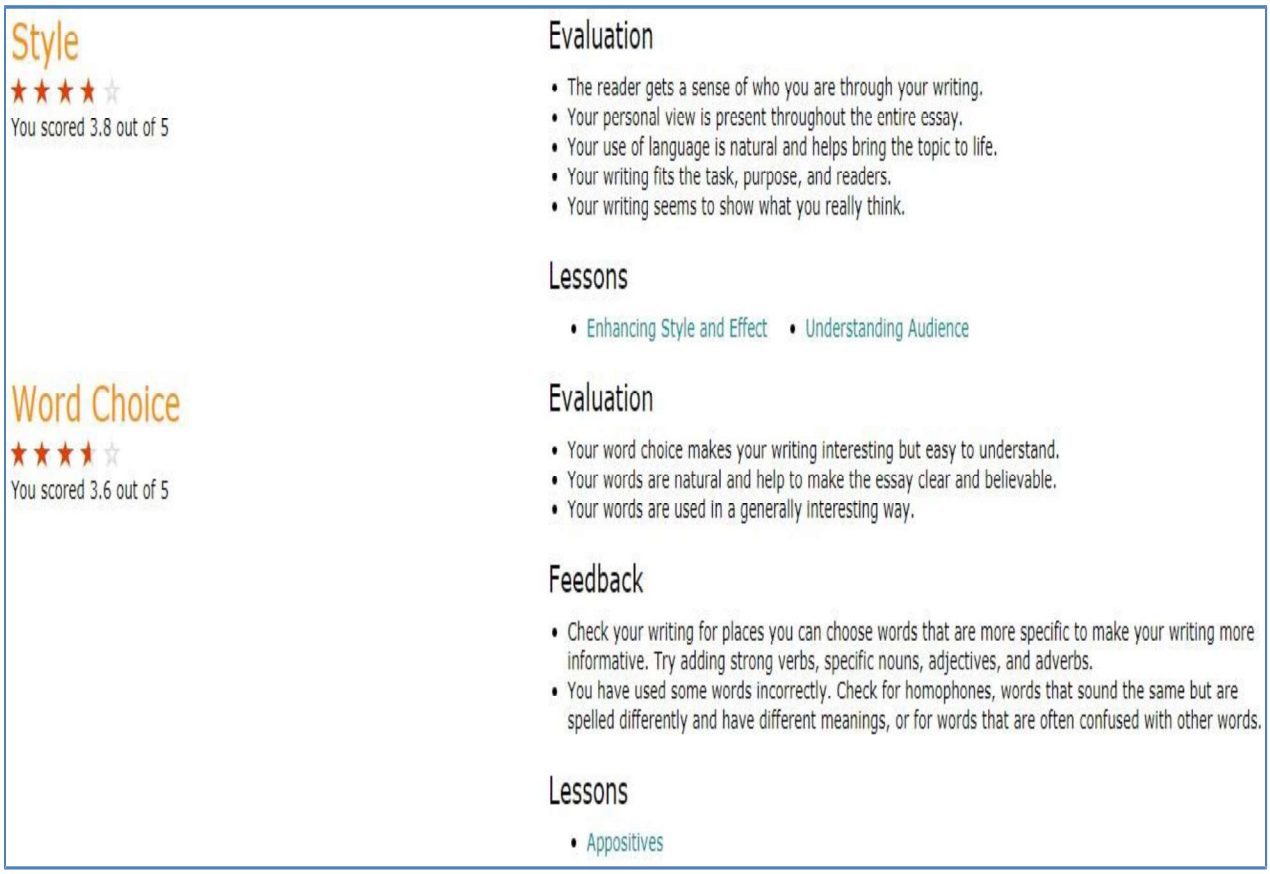


Figure 3. Writing analysis with evaluation and feedback for each trait.

ISSN: 2583-5963

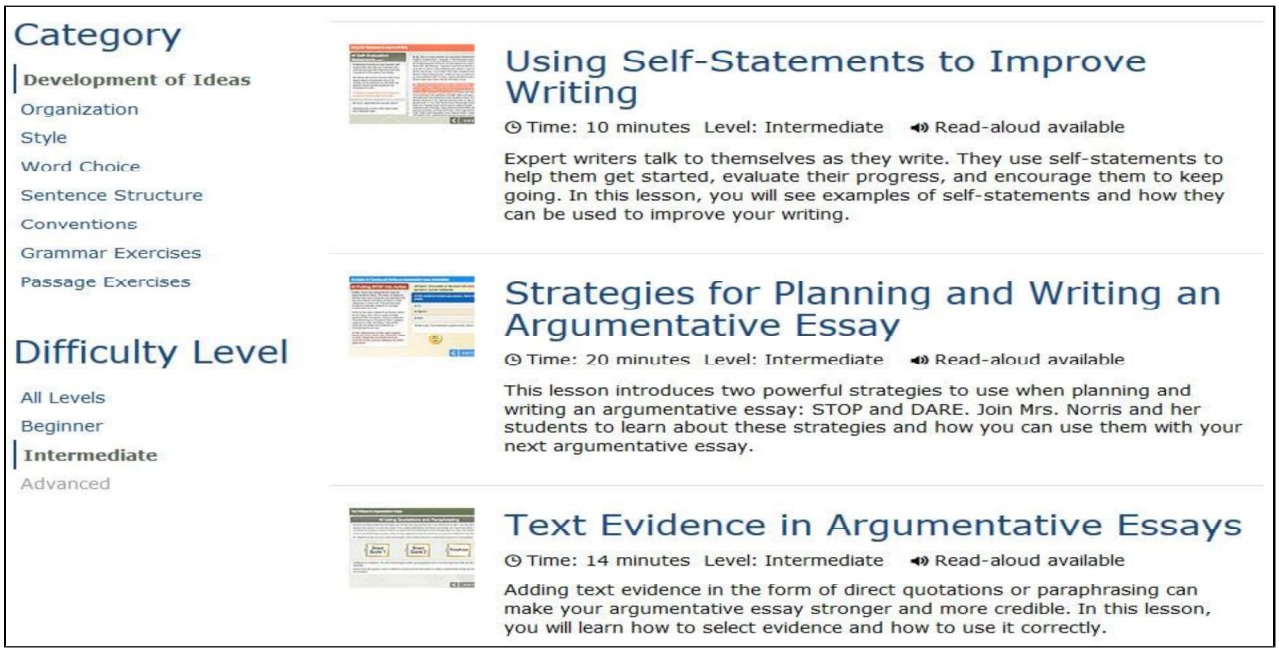


Figure 4. Interactive lessons.

Performance regarding the construction of arguments. During this eight-week intervention, students in two different treatment conditions used NC Compose to compose essays, receive automated grades and comments, change writings in response to feedback, and complete interactive courses. Teachers integrated NC Write into the traditional process of writing instruction of one treatment condition (NC + TRAD); they also integrated NC Write into the self-regulated strategy development (SRSD) instruction of a different treatment condition (NC + SRSD), which was changed to a lower-intensity format to support teacher implementation. Finally, teachers also integrated NC Write into the traditional process of writing instruction of a third treatment condition (NC + TRAD), which was the traditional writing instruction of a third treatment condition.

Students in the NC + TRAD condition get teaching that offers actual writing opportunities and includes cycles for planning, drafting, and revising their work. In addition, students in the NC + SRSD group had access to explicit training in cognitive and metacognitive capacities to construct and create persuasive language. Finally, students in a third condition analogous to the previous one were given traditional process writing training rather than NC Write. According to the findings of the multilevel model, the posttest essays written

by students who had been exposed to NC + SRSD were of the highest quality, had a greater word count, and contained a greater number of the fundamental components of argumentative essays than those written by students who had been exposed to the other two scenarios. In addition, the posttest revealed that students in the NC + TRAD group had generated essays at a more advanced level than students in the comparison group.

On the other hand, Palermo and Thomson (2018) also provide evidence of these impacts. Research has shown that MI Write helps teachers provide more feedback on higher-level writing skills (Wilson & Czik, 2016), supports increases in students' writing motivation and self-efficacy (Wilson & Roscoe, 2020), and scaffolds improvements in students' writing quality throughout multiple drafts of an essay. In addition, research has shown that MI Write helps teachers provide more feedback on lower-level writing skills (Wilson & Czik, 2016).

2.1 The Present Study

Using data from a previous study conducted by Palermo and Thomson, the purpose of this study is to provide a more in-depth analysis of how AWE can be incorporated in two distinct teacher-directed instructional contexts, the related effects on students' growth in first-draft writing quality across several essays over time, as well as teachers' and students' perceptions of AWE in those contexts. This study will also investigate the effects of AWE on students' growth in first-draft writing quality across several essays (2018). This analysis used the information obtained from Palermo and Thomson's research (2018). These particular facets of the subject under consideration are notable and relevant in and of themselves. Research on the two different ways to combine AWE with teacher-led teaching in ELA classrooms has not previously been conducted, but it is essential if educators are to comprehend how to fully utilize the affordances that AWE provides and get the most pedagogical benefit out of employing it. In addition, previous research on the efficacy of AWE has seldom concentrated on improving the quality of writing in the first drafts of several articles. Instead, the emphasis was placed on how one's writing has progressed throughout several drafts of the same essay or how one's writing has evolved from an initial exam to a subsequent test. It is conceivable to investigate if prolonged exposure to education paired with AWE feedback results in generalized advances in

autonomous writing ability if one looks at the improvement in the quality of first-draft writing. Last but not least, even though the viewpoints of both teachers and students have a crucial role in determining the effectiveness of active wilderness education (see Wilson, 2017), quite little is known about their roles in AWE research (c.f., Grimes & Warschauer, 2010; Warschauer & Grimes, 2008; Wilson & Roscoe, 2020).

The current study evaluated the use of AWE in writing teaching to better understand how it may contribute to improvements in writing instruction and learning. In order to research writing instruction, which was made possible by the AWE system NC Write, we utilized an embedded quasi-experimental mixed methods technique. Both of these study questions were answered as follows: When AWE is employed in two different instructional contexts—process writing instruction and strategy teaching—what are the students' first-draft writing performance development trajectories (i.e., writing quality, essay length, and essay elements)? In terms of their personal experiences and perspectives, what do teachers and students think the AWE system is all about? In light of these findings about the AWE affordances in the various educational contexts, what do these findings imply? (2b)

2. Evidence of Effectiveness: A Mixed-Methods Examination of Writing Instruction with AWE

2.1 Methods

In this study, a quasi-experimental approach was adopted, involving the use of various post-intervention tactics (Clark & Creswell, 2008). This approach sought to supplement the findings from quantitative research by including the collection of qualitative data in a predominately quantitative experiment (Creswell, 2015).

Participants and their settings

The sample developed by Palermo and Thomson is utilized in this investigation (2018). The new study incorporated up-to-date measurement and analysis methods and focused its attention on a wide range of research issues.

Within the sample, 14 teachers collectively represented five distinct school districts. They chose to adopt NC Write while also including strategy training into their SRSD instruction

(NC + SRSD) or introducing NC Write into their normal process writing instruction (NC + TRAD). Both options are shown below. They were provided with both choices as viable instructional methodologies for producing a process essay. The educator chose kids for each group and placed them in appropriate environments (within courses). In this manner, a quasi-experimental strategy was utilized in the research, in which the circumstances were established at the level of the teacher, and the outcomes were evaluated at the level of the student. The research activities were carried out with participation from all students enrolled in the classes taught by the participating instructors in the study; however, only the data collected from the students who provided their informed consent to participate in the study were analyzed. When the procedure for recruiting new instructors was initiated, there were a total of 1043 students registered in the classes that the participating teachers were teaching. 677 of these students, which is sixty-five percent of the total, provided parental approval to participate in the activity. Despite this, 118 willing students were not included in the sample because either their pre- and posttestsposttests were not completed, they only wrote three essays over the length of the intervention, or their class and instructor assignments changed throughout the therapy.

Nevertheless, because these students expressed an interest in participating in the study, we did not exclude them from consideration. Therefore, the final sample comprised 559 children in grades six through eight. The demographic information of the participant is presented in Table 1. In addition, we considered the implications of these characteristics in the study since the two sets of conditions were not similar in any way, including the fact that there was a disparity in the percentage of black children and pupils with impairments (SWDs).

In order to collect more qualitative information, we conducted interviews with additional student samples who volunteered to participate. The interview sample consisted of 30 students, with 15 randomly assigned to each of the three conditions. In addition, interviews with twelve academics were carried out, with six lecturers chosen to represent each of the three scenarios in the study.

When and under what conditions

It was in the spring of 2016 that the intervention took place. Before the spring of 2016,

neither the participating instructors nor the students had any prior knowledge of NC Write. Students were required to finish the pre-test essays during the first week of class. The next step was for teachers to use NC Write while simultaneously training their students in either the standard or the SRSD writing instruction for eight weeks.

Students in both groups utilized NC Produce to complete six interactive courses, write five unique essays (except the essays required for the pre-test and posttest), and receive feedback on each essay. In every scenario, students received training on writing throughout two weekly classes that lasted for forty-five minutes each. Unpredictable occurrences in two different school districts resulted in a two-week extension to the conclusion of the academic year. The total time spent on training for both scenarios was twelve hours. The posttest consisted of the students writing essays one week after they had completed the intervention.

Most participating schools ensured that each student had access to at least one digital learning device, despite the significant disparities in the technological resources available between districts and even within individual districts (see Table 1). In addition, a "bring your own device" policy is implemented at most schools nowadays. As a result, students have adequate access to technology to employ NC through a device of their choosing or a device provided by the school (such as a Chromebook). Write as a component of your writing lesson.

2.2Measures

Writing prompts

Writing tasks that required students to argue their points of view were used to evaluate the student's ability to express themselves in written form. Each of these prompts has been evaluated by specialists with expertise in the respective fields. The questions .Some search results include supplementary materials, such as short essays and videos. Using a method known as counterbalanced testing, the students were provided with prompts throughout the entirety of the pre-and posttestsposttests. Throughout the entirety of the intervention, students were provided with an option between two different essay questions to utilize for each of the assignments that were assigned to them. Since our primary objective was to

evaluate students' development in their general, autonomous writing ability, an outcome that had not been thoroughly investigated in any of the previous research, we decided to investigate how well students improved the quality of their early drafts for several different types of essays. This was because assessing the pupils' progress was our work's primary purpose. The research did not take into account any pieces of literature that were the product of collaboration between more than one author.

Table 1. Participant demographics

Variable	NC + TRAD	NC + SRSD	Difference test
Students (*n*)	272	287	
Districts (*n*)	3	4	
Schools (*n*)	3	5	
Teachers (*n*)	6	8	
Grade (*n*)			
6	41	113	
7	160	28	
8	71	146	
Male (%)	48.71	45.10	$\chi^2_{(1)} = 0.726$, $p = .394$
Race (%)			
White	78.71	50.74	$\chi^2_{(1)} = 54.530$, $p < .001$
Hispanic or Latino	12.93	12.59	$\chi^2_{(1)} = 0.013$, $p = .908$
Black or African American	4.18	32.96	$\chi^2_{(1)} = 72.403$, $p < .001$
Asian	1.14	0.37	$\chi^2_{(1)} = 1.061$, $p = .303$
American Indian or Alaska Native	0.38	0.37	$\chi^2_{(1)} = 0.000$, $p = .985$
Native Hawaiian or Pacific Islander	0.38	-	$\chi^2_{(1)} = 1.029$, $p = .311$
Two or More Races	2.28	2.96	$\chi^2_{(1)} = 0.242$, $p = .623$
Free or Reduced Price Lunch[a] (%)	60.33	59.96	
Limited English Proficiency (%)	3.06	5.71	$\chi^2_{(1)} = 2.062$, $p = .151$
Students with Disabilities (%)	5.68	14.12	$\chi^2_{(1)} = 9.529$, $p = .002$
Age[b] (*M, SD*)	155.51	156.42	$F(1,557) = 0.981$, $p = .322$
	(9.11)	(12.31)	
Previous ELA achievement[c] (*M, SD*)	455.67	454.53	$F(1,557) = 1.311$, $p = .253$
	(10.53)	(11.61)	
Students per digital learning device[a] (*M*)	0.73	1.01	

[a] Estimates based on school-level data.

[b] Age in months at time of pretest.

[c] Based on scale score (range: 423–484) from the previous year's end-of-grade assessment.

Writing quality

We used the PEG total essay score, which varied from 6 to 30 points, to evaluate the quality of each essay's writing and calculate its overall ranking. For various reasons, we decided to

evaluate the essay based on its overall score instead of the ratings it received for its characteristics. First, the objective of the PEG total essay score is to provide a numerical representation of a concept that is sometimes referred to as the quality of the student's writing. Consequently, the first quantitative study question we posed centered on the development paths taken by pupils with this specific topic area. Two, there is a significant correlation between people's weights to the many characteristics that make up their selves (Wilson et al., 2014).

Essay length

The number of words an essay needed to be considered complete was the measure used to determine its length. In order to perform this computation, every word written was taken into account, irrespective of how it was spelled. The article's length was calculated by using the software application known as Microsoft Excel.

essay components

Each essay was evaluated based on how well it used the key components of argumentative writing by applying the methods described by Scardamalia, Bereiter, and Goelman (1982). Before concluding, we gave careful consideration to the allegation, as well as its reasons, elaborations, and counterclaims. Essays were awarded points for each component they incorporated or for each unique and original example they used in their arguments, elaborations, and refutations. These scores were based on the total number of words in the essay. Alternately, one point was added to the total score of the essay for every argument refuted.

The essays were sent to the specialists to analyze them based on the essential components of argumentative writing. Throughout their instruction, the raters were provided with a scoring director, a team leader, and a collection of anchor essays. Afterward, the raters looked at two groups of 10 practice essays each and analyzed their content. In the last step of the process, raters were presented with a training set consisting of eight extra essays with difficult compositions for them to grade. After participating in an informational session that lasted one and a half days, raters evaluated the works by consulting the training materials, particularly the anchor pieces, which assisted them in basing their judgments on the scoring criteria. Throughout the scoring procedure, the scoring director and the team leader conducted random

checks of each rater's scores to evaluate accuracy and drift and to offer raters' comments. In addition, 15 percent of the essays were reevaluated by the person in charge of scoring or the head of the team to determine the extent to which each rater might be trusted. The reliability analysis concluded that there was a 96 percent agreement on the counterclaims (r =.874), a 96 percent agreement on the conclusions (r =.928), a 96 percent agreement on the elaborations (r =.917), a 96 percent agreement on the claims (r =.924), and a 96 percent agreement on the elaborations (r =.917). There was a correlation of 0.923% between the supporting reasons, representing 78% of the total.

Students and educators' perspectives and their own professional experiences with the AWE system. We conducted open-ended and semi-structured interviews with students and instructors to learn more about how students and instructors utilized and perceived the AWE system, as well as what these perceptions suggested about AWE's affordances in various educational situations. A few things piqued our interest: Before we began this study, we did not have any ideas or assumptions about how consumers would respond or interpret AWE after it was installed. This was largely because the previous research on user views and experiences with AWE was scant and outdated. Consequently, we posed a wide variety of questions on NC Write to the educators and pupils involved in both settings. Students were tested on their knowledge of a broad spectrum of topics, including their awareness of whether or not NC Write helped them improve their writing, whether or not the automatic feedback was helpful in this regard, what they had learned from using the program, and what aspects of NC Write they would change if they had the opportunity to do so. Teachers were asked a variety of other questions, some of which included the following:

whether or not NC Write had helped their students improve their writing

how it had done so

what they thought of the automatic feedback

which aspects of NC Write they would change if they had the opportunity to do so

The interviews that were digitally captured were afterward transcribed word for word.

When analyzing the information we obtained from the interviews, we relied on grounded theory-based qualitative data analysis methodologies (Strauss & Corbin, 1998). A tool called NVivo 10 developed by QSR International was utilized during the study. Two individuals with previous experience in qualitative data analysis were responsible for coding the data. The usage of both iterative and recursive coding was made. The coding steps were structured following the sequence suggested by Corbin and Strauss (2015). The findings from the interviews were first arranged into groups according to the conditions, and only then were they openly coded. This was done to make it simpler to come up with the first ideas. After that, we conducted a comparative analysis to determine each concept's interconnected dimensions and characteristics. After that, we categorized people's responses according to the context, the approach, and the category integration we used. Finally, we validated the coding scheme by comparing the completed coding scheme to the problematic situations found while we were coding. The completed coding system may be seen in Table 2. Standardized techniques for use in educational situations. Before the start of the study, each teacher participated in a walkthrough of NC Write, which introduced them to the software and demonstrated its major functions. This allowed the teachers to become familiar with NC Write. In addition, before the beginning of the semester, the teachers were allowed to test out the application after getting their account details.

The educators were provided with all of the necessary teaching resources in order for them to successfully carry out the intervention. Every educator received comprehensive instructions that walked them through the objectives of the research as well as the many different treatment approaches in great detail. These instructions also contained all of the student materials necessary for the intervention, as well as directions for the pre-test and the post-test to be administered. In addition to receiving lesson plans for each of their classes, teachers were provided with an overview of the calendar that detailed the NC Write activities (such as interactive lessons, essay preparation and drafting, and essay revision) that would be taking place in each of the classrooms where their students would be enrolled. These activities included: Because there have been instances in the past in which students and teachers have depended excessively on AWE, teachers were provided with a script to follow to consistently offer students background information about PEG and automated essay scoring. This was done so that teachers could consistently offer students background information about PEG and

ISSN: 2583-5963

automated essay scoring. This was done because there were situations in which students and teachers placed excessive confidence in AWE (Grimes & Warschauer, 2010). PEG does not read and comprehends written material in the same way that people do; however, it has learned how to recognize the characteristics of effective writing through training that includes reading and grading a significant number of essays graded by humans. Even though PEG does not read and comprehend written material in the same way that people do, it has learned how to recognize the characteristics of effective writing. Students were taught this important information. This purpose was to teach PEG how to identify the characteristics of good writing. Therefore this was done. The students were informed that the PEG could only consistently evaluate essays that were prepared in "good faith" and that if they submitted duplicate work or attempted to deceive the PEG in any other way, the ratings they received on their essays might not accurately reflect the quality of their work.

Table 2. Coding Scheme

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Concept	Dimensions/Properties	Description
1. Benefits of NC Write	1.1 Efficiency 1.2 Evidence of growth 1.3 Provides a structure for writing 1.4 Relevance 1.5 Supports differentiation 1.6 Supports intrinsic motivation 1.7 Supports writing instruction	Perceptions of benefits of NC Write for learning and teaching
2. Change about NC Write	2.1 Opinions	Aspects of NC Write users felt should be improved, added, or removed
3. Writing quality feedback	3.1 How feedback supported improvement 3.2 How students used feedback 3.3 Teacher assistance with interpretation 3.4 Criticisms and other limitations of feedback	Perceptions, implementation, and use of automated feedback
4. NC Write Lessons	4.1 How supported improvement 4.2 Criticisms and limitations	Perceptions of interactive lessons
5. Prompts	5.1 Perceptions	Perceptions of intervention prompts
6. Graphic organizers	6.1 How supported improvement 6.2 Criticisms and limitations	Perceptions of graphic organizers in NC Write
7. Explanation for growth trajectories	7.1 Ceiling on improvement	Factors explaining growth trajectories
8. Implementation challenges	8.1 Practice 8.2 Intervention timing	Challenges associated with implementing NC Write and/or intervention

Putting NC's plan into motion Writing might be difficult, and developing ideas for interventions could also be difficult. Therefore, the teachers allocated to the SRSD condition received supplementary teaching on utilizing SRSD in the classroom to teach writing methods. This instruction was provided since the SRSD condition was one of the possible outcomes. The professional development program ran for a total of sixty minutes and was carried out onsite at the schools attended by the instructors. Additional reading material on the SRSD model was distributed to the instructors to get things started. Participants gained an understanding of the theoretical underpinnings of SRSD, its logic, and the steps involved in teaching SRSD writing during the program. During the training, teachers went through the SRSD lesson plans and the student resources related to those

lesson plans. It was underlined that lesson plans should be altered as necessary to differentiate instruction based on the needs of learners, and this point was driven home repeatedly. Because lesson plans provided a framework for instruction, they were designed to be adaptable enough to accommodate various changes.

Instructional strategies for NC + TRAD

When both the NC and TRAD conditions are satisfied, teachers in classrooms often employ the standard approach to instructing students in the art of writing. A writing environment that is participatory and supportive, cycles of planning, writing, and revising, individualized instruction, student ownership of their work, as well as self-reflection and evaluation are all characteristics of process writing education. Several factors characterize process writing education. These factors include: (Graham, McKeown, Kiuhara, & Harris, 2012; Graham & Perin, 2007). This class will cover several core writing skills, strategies for planning and organizing, and the basic framework of argumentative essay writing. Students in the NC + TRAD condition utilized NC Produce to write argumentative essays, access interactive lessons on concept development, organization, word choice, sentence structure, and conventions, and improve their writing using the program's feedback. This condition was compared to the control condition, which did not utilize NC Produce. The NC condition was combined with the TRAD condition to create a new condition known as the NC + TRAD condition.

In their article, "Process Writing Strategies That NC + TRAD Educators Use in Their Classrooms," Palermo and Thomson provide an in-depth overview of the many methods that NC + TRAD teachers implement in their lessons (2018). In a nutshell, the findings of a study on writing instruction methods (Gilbert & Graham, 2010) supported the adoption of a process approach to writing education by instructors, which included the teaching of writing skills. The study was conducted by Gilbert & Graham. This was because learning to write well was integral to the procedure. Direct skill training, summary instruction, writing as a learning tool, and paragraph writing were the evidence-based strategies that NC + TRAD instructors used the most frequently in their classrooms. [Further citation is required] [Further citation is required] Spelling, phrase combination, inquiry or research, and other similar tactics were among the methods that were commonly suggested but less

frequently put into practice.

As a consequence of the interactions that we had with the instructors of NC + TRAD, we now have a more in-depth understanding of the activities they participate in. Since the North Carolina General Writing Assessments were eliminated, there appears to have been a change away from prioritizing writing education, as indicated by the responses of five of the six instructors who were questioned regarding this topic. The lecturers talked about using different strategies, such as strengthening the connection between reading and writing, including argumentative writing components in research papers, and reducing the time spent writing as a direct result of these activities. The five-paragraph essay format was maintained by some of the professors, despite the fact that these individuals were aware of the repetitious nature of the procedure. Writing skills were offered to students engaging in process writing education by NC + TRAD educators in the form of mini-lessons several times each week. The students were given regular exposure to these writing abilities.

The following pieces of guidance were included in the NC + TRAD lessons, which provided teachers with a fundamental foundation to aid in incorporating NC Write into their more traditional approach to teaching the writing process. These lessons were designed to provide teachers with a foundation to help them teach NC Write. First, using the script provided, instruct the students on the principles of the Performance Evaluation Guide (PEG) and the automated essay scoring system. Two, offer students the chance to create a one-of-a-kind essay in NC. Write roughly every other week (that would make a total of five, excluding the pre-and post-tests), and provide a variety of themes for students to pick from. 3. Guide the students through the process of selecting the most suitable graphic organizers for prewriting and preparation from the several alternatives shown in NC Write. In the fourth step, each student should be given the option to use the automated feedback to make changes to the essays written by the other students. It would help if you underlined how crucial it is to incorporate the criticism into key adjustments that enrich the organization of the essay in this paragraph. These changes should be brought about as a result of the critique. 5. At a frequency of about once every two weeks, each student should participate in an NC Write lesson (i.e., six total). Students enrolled in NC + TRAD were recommended to participate in additional coursework that included issues such as audience comprehension, essay elaboration, and sentence diversity.

In conclusion, the teachers at NC + TRAD instructed students in various writing skills in addition to the actual construction of argumentative essays by utilizing a process writing technique incorporating AWE. This was done to teach the students the essential components of argumentative essay construction. There were three important differences between teaching writing using SRSD and writing using the process writing method, even though the two approaches had certain commonalities in teaching writing. (3) The instruction provided by NC + TRAD was not as criterion based or instructional responsive as the instruction provided by NC + SRSD was to the same degree. (1) NC + TRAD teachers did not explicitly teach techniques for self-regulation. (2) NC + TRAD teachers did not explicitly teach strategies for planning, writing, and revising argumentative essays.

Instructional approaches applicable to NC + SRSD Writing instruction based on the SRSD pedagogical method was administered in classrooms randomly assigned to the NC + SRSD condition. Composing classes at SRSD focused on teaching students techniques for organizing and writing argumentative essays and the background information, skills, and self-discipline required to successfully implement such strategies in their writing. Throughout this unit, students were also taught how to organize and compose argumentative essays. Students in the NC + SRSD condition utilized NC Compose to obtain access to interactive courses highlighting automated methods, composing argumentative essays, and revising works utilizing feedback supplied by the application. This was done in the context of the NC + SRSD condition.

The SRSD writing curriculum was applied by the teachers of NC + SRSD in a total of six iterations, making it a recursive curriculum. This lesson will provide students with general and genre-specific writing procedures, the knowledge to employ strategies, and the self-regulatory knowledge and abilities necessary to properly use strategies and manage the writing task. This lesson aims to provide students with general and genre-specific writing procedures (Graham, Harris, & McKeown, 2013; Harris & Graham, 2016). This was discovered by Graham, Harris, and McKeown (2013) and Harris and Graham (2016). In addition, a short mnemonic that will aid the student in recalling the mental processes linked with each approach is provided to the student (Graham & Harris, 2018). (Graham & Harris, 2018). The phases of education promote a gradual discharge of responsibility for various strategies and the preservation and generalization of such strategies, as students enhance

their skills in applying various methods.

Numerous meta-analyses have unequivocally proved that SRSD has a positive influence, on average, on the writing abilities of students, which supports the hypothesis that this impact is favorable (i.e., Graham, 2006, Graham & Harris, 2003; Graham et al., 2012; Graham & Perin, 2007). On the other hand, the vast majority of SRSD treatments that have been described in the published research have been led by researchers or tutors, have been carried out in small groups or one-on-one settings, and have featured high-intensity therapy (that is, courses that are provided for 20–45 minutes three to five times a week). After a significant amount of practice-based professional development, only a select few studies conducted in more recent times have examined the use of SRSD by instructors across the entirety of the classroom (e.g., Festas et al., 2015; McKeown et al., 2016, 2018). As a part of the current study project, we decided to lessen the amount of emphasis placed on the SRSD model's presentation to lessen the amount of time spent on professional development and make it easier for instructors to accept the SRSD model.

As a direct consequence of the inclusion of argumentative writing in the current research, the students were instructed in a planning process that is commonly referred to as STOP (which stands for "Suspend judgment," "Take a stance," "Organize thoughts," and "Plan more as you write"). One of the goals of this method is to persuade students to choose the side of an argument that they are most likely to be able to defend while assessing allegations and potential counterclaims. This should be done so that students can demonstrate their understanding of both sides of the debate. In order to develop a compelling argument, students are expected to think about how to arrange the material they have obtained, and they must continue to prepare, change, and rewrite their work throughout the writing process. In addition to this, students received training in the DARE method, which is tailored to a particular genre (which stands for "D" for "develop your argument," "A" for "include supporting reasoning and evidence," "R" for "reject counterclaims," and "E" for "end with a conclusion"). With the assistance of this method, students will be led step-by-step through the process of merging all of the fundamental components of argumentative essays into their writing in their unique way.

The specific processes teachers used to guide students through the six phases of SRSD

writing instruction and to coach them in the necessary planning, and writing abilities are documented in great detail in Palermo and Thomson. These two books also contain much supporting evidence (2018). (2018). In a nutshell, the first stage of the process was titled "Develop background knowledge," Its purpose was to provide students with the basic information and terminology they needed to begin utilizing the strategies. This process phase was intended to provide students with the information and terminology needed to begin using the strategies. Next, the teachers imparted planning and writing skills to the students, who were tasked with learning them by heart and putting them into practice. This scaffolded approach was carried over into the other components of the program and continued throughout its whole. Finally, teachers and students continued their research of the tactics during the second stage, dubbed "Discuss it." During this stage, the primary focus was on how the essential components of argumentative essays contribute to the strengthening and persuading of an essay.

In the third step, titled "Model it," the teachers demonstrated how to use the STOP and DARE acronyms to the pupils. They accomplished this by demonstrating how to write an argumentative essay. During the time that students spent writing, teachers conducted demonstrations of self-regulation tactics such as goal planning, self-education, and self-evaluation. These were some of the activities that were covered. Students were given various tasks in the fourth part of the process, labeled "Memorize it," to aid them in remembering both approaches and putting them into practice. The instructors made periodic assessments of the student's levels of comprehension of the processes, and they adapted the students' respective practice and Support activities accordingly until all of the students had acquired the target level of competence. During the fifth phase, which was referred to as Support, both the students' teachers and their classmates encouraged the students to use their strengths in planning and writing and self-regulation methods. This was accomplished through collaborative efforts on the assigned essays (via small-group revision activities). Most of the time that students spent working on this phase was spent preparing and revising the essays they had previously written. The amount of coaching that instructors gave students as they increased their capacity to apply tactics like STOP, DARE, and self-regulation led to a decrease in the total amount of coaching that teachers provided. Students were considered to have completed the final level, called Independent performance, when

they demonstrated that they could organize and produce a powerful, persuasive essay without the assistance of professors or PEG assessment. This was one of the requirements for moving on to the next level.

The instructors of the courses offered by NC + SRSD were given direction on integrating NC Write with the various types of strategy training presented to them. This counsel consisted of the identical recommendations that were presented to the instructors of NC + TRAD, and those recommendations were as follows:

Please make sure students select the right graphic organizers for prewriting, give them time to rewrite each essay, and assign six separate NC Produce lessons.

Provide background information about PEG and automated scoring.

Have students write a total of five different essays in NC Write.

Because NC Write lessons, composing, and editing activities are aligned with the phases and content of teacher-led SRSD writing instruction, the integration of NC Write with strategy instruction is differentiated from other approaches to writing education. This is because other approaches to writing education do not have this alignment. As an illustration, teachers who instruct NC + SRSD have their students complete specific NC Write lessons at varying learning levels to reinforce the strategies for planning and writing as well as the methods for self-regulation that were initially presented to the students during teacher-led instruction. These strategies and methods were initially presented to the students during teacher-led instruction. The students from NC + SRSD were given assignments from the NC Compose curriculum. These lessons covered various topics, including how to plan and write an argumentative essay, improve writing by using self-statements, and improve essay writing by using transitions. The fifth stage of education, named Support it, and needed the most writing practice, was when students' composition and revision activity in NC Write reached its maximum point. This stage was also the instruction stage with the most writing practice requirements. This transpired when educators started cutting back on their assistance to pupils as the latter developed their writing abilities.

AWE publicity

Because we could not carry out detailed inspections of classroom teaching in each condition, we decided to go through the log files of the NC Write a program to assess the frequency with which each student was presented with AWE while they were learning how to write. We constructed a metric that represented each student's AWE exposure based on the core therapeutic activities by using those log data as our source of information. This evaluation had a maximum limit of 17 points, based on the maximum number of treatment activities each student successfully performed during the intervention. These activities included attending NC Write sessions, writing first drafts, and making revisions. This figure does not include coursework finished in less than two minutes or essays containing a significant amount of copied language. The average number of treatment activities was completed by more students in the NC + SRSD group than by students in the NC + TRAD group (M = 13.73, SD = 2.73; t(557) = 3.93, p0.01). Later studies used the grand mean centering technique to integrate the AWE exposure parameter.

3.4 Analyses

The quantitative examination was carried out using a modeling approach that included many levels. This system managed the whole dataset, which included skewed data and observations that were not independent of one another. MLwiN version 3.02 was utilized throughout every investigation (Charlton, Rasbash, Browne, Healy, & Cameron, 2017).

A series of models consisting of three levels were developed to include all of the students' first-draft essays that they had written while operating under either the NC + TRAD or the NC + SRSD conditions to investigate the development pathways of students' writing abilities. During the intervention, students typically completed six essays (the mean number was 6.31, and the standard deviation was.92). According to a preliminary analysis of each student's writing performance outcomes (i.e., essay length, essay components, and writing quality), both the findings from the pre-test (i.e., the first essay) and the change over time was erratic. This was determined by each student's essay length, components, and writing quality. In addition, there was a difference in the outcomes of the pre-test and the initial essay. The results demonstrated a non-linear evolution over time, particularly for many students. This was evidenced by the highly rapid improvements in performance that

occurred at the outset of therapy but the slower development that occurred as the intervention progressed. In light of previous research that investigated the growth trajectories of writing performance in connection to AWE, a variety of growth models were evaluated and put through their paces for this study (Wilson, 2017; Wilson et al., 2014). There were three models: a linear model, a logarithmic model that used the natural log of the time variable, and a polynomial, quadratic development model that used the variables. The linear model was the simplest of the three. Time2 and primetime (a count of all the first draft articles written and used to describe the instantaneous speed of change) were taken (a variable representing the amount of time that had elapsed since the beginning of the study). Both variables' centers were set to 0, representing the student's performance on the pre-test writing exercise, and both variables had the same meaning.

In order to determine intra-class correlations and ensure sufficient variation across all levels to support the implementation of a three-level model, the first step in each study was to specify an unconditional model. This was done to determine intra-class correlations (Model 1). According to the findings of each unconditional model, there was sufficient variability at each level to warrant the use of a three-level model. This was determined by analyzing the outcomes of the models. In order to evaluate the development patterns of the pupils' writing abilities, the quadratic equation presented below was utilized. Growth model (Model 2):

Rijk yijk = β0ijk + β1Timeijk + β2Time2 + v0k + v1k Timeijk + v2k Time2 + ijk Dijk u0jk + u1kTimeijk + u2kTime2 + eijk

The expected level of the student's writing performance is represented by the variable link in this model for a student I who is collaborating with a teacher j for a specific period k. (i.e., writing quality, essay length, and essay components). During the practice round, it was discovered that the link between student I and instructor j was in the initial condition of 0ijk. The instantaneous growth rate of the student is represented by the variable time Dijk, measured at time k. Time 2 illustrates the curvature, sometimes referred to as the gradual slowing down of the growth rate. The variation inside a student is represented as Dijk, a variation between students is represented as u0jk, and differences between instructors and students are represented as v0k. It is generally accepted that random effects follow a normal

distribution consisting of constant variances and zero-mean means. A conditional quadratic growth model, also known as Model 3, was constructed in the last development phase. form: yijk = 0ijk + 1Timeijk + 2Time2 + SRSD + SRSD*Time + 6SRSD* Time2 + v + v ijk+ time v 3 jk Time2 + u 4 k 5+ u Time + u e ijk+ time2 ijk 0k 1k ijk 2k ijk 0jk 1k ijk Kijiji 2k This model is superior to the earlier quadratic growth model because it includes a control for AWE exposure (3Exposurejk) and predictors to look for between-condition differences in initial status (4SRSDk), growth rate (5SRSD*Timeijk), and deceleration (6SRSD*Time2) for each writing performance outcome. Additionally, this model includes predictors to look for between-condition differences in initial status (4SRSDk), growth rate (5SRSD*Timeijk), and deceleration (6SR (i.e., Model 2).

In order to evaluate how well each model fits the data, we employed a metric known as negative log-likelihood (-2LL). When a significant chi-square difference test is done based on the number of estimated parameters, smaller results indicate a better match than those larger.

3.5 Results

What are the first-draft writing performance growth trajectories of students (i.e., writing quality, essay length, and essay elements) when AWE is used in two different instructional settings, namely process writing instruction and strategy teaching? Specifically, process writing instruction and strategy teaching. The instruction given to children in writing in any of these two scenarios is a different writing format.

The results of developing more advanced models are outlined in Table 3, which may be seen here. The random effects of the unconditional model show that differences in teachers account for 24 percent of the variance in writing quality, differences between students within teachers account for 27 percent, and differences between students themselves account for 49 percent of the variance in writing quality. The quadratic growth model (Model 2) was significantly more fitted to the data as compared to the unconditional model [(12)=1095.52, p.001]. After taking into account the clustered data structure, the findings of the quadratic model showed that students improved the quality of their first drafts of each subsequent essay by 1.6 points, with a deceleration rate of 0.2 points. This was the case even though the students' overall quality increased over time. This was the circumstance

even though, over time, there was an improvement in the overall quality of the students. According to analyses of demographic x condition interactions, the initial status and rate of change of Black students were not statistically significant (p =.47 and.09, respectively). This was the conclusion reached by the researchers. However, Black children in the NC + SRSD group decelerated at a significantly slower speed than that non-Black pupils in the NC + SRSD group (p =.01). This was a significant difference between the two groups.

Because the initial status, rate of change, and deceleration of SWDs did not show any statistically significant differences (p = 0.38, 0.56, and 0.90, respectively), these variables were omitted from the final model in the interest of maintaining as much simplicity as possible. According to the concluding conditional model (Model 3), which took into consideration students' levels of AWE exposure, the quality of the students' first drafts was initially worse for those in the NC + SRSD group than it was for those in the NC + TRAD group. This was the case for both categories of students (by 2.4 points). Students diagnosed with NC and SRSD did not exhibit any signs of improvement over time.

When compared to students from NC + TRAD, the student's overall writing quality advancement rose by 0.68 points while decreasing by 0.07 points. Figure 5 displays in a split-screen style the expected development trajectories for Black and non-Black students, indicating how the two distinct student groupings will alter over time.

The length of the article

Table 4 displays the results of numerous models used to make predictions regarding the length of essays. According to the random effects of the unconditional model (Model 1), out of the total variance in essay length, 47% was attributable to individual students, 27% was attributable to differences in student performance within instructors, and 26% was attributable to differences in instructor performance. According to these statistics, there was a decline of 47 percent among students, 27 percent among students and instructors, and 26 percent among professors, respectively. Approximately speaking, the reduction occurred across students, students and instructors, and professors. The quadratic growth model (Model 2) could predict the data with greater accuracy [2 =1061.69, p.001]. After taking into account the clustered data structure, the model results showed that students increased the length of the initial drafts of each subsequent essay by approximately 45 words, with a

deceleration rate of approximately 6 words. This was the case even though students slowed down their rate of word growth slightly. This was the case even if the students' word addition rate reduced by around 6 words over the year. The analyses of demographic condition interactions for beginning status, rate of change, and deceleration did not provide statistically significant outcomes for Black students or SWDs (p =.15,.16, and.22, respectively) or deceleration (p =.89,.97, and.60, respectively). Because of this, these variables were excluded from the final model. According to the final conditional model (Model 3), which considered the students' prior exposure to AWE, students in the NC + SRSD group initially generated shorter first drafts than students in the NC + TRAD group. This finding was based on comparing the two groups' initial draft lengths (102 words). Students who completed NC + SRSD demonstrated variations in the growth rate (by 19 words) and slowing (by 2 words) of the length of their essays across successive initial drafts; however, these differences were not statistically significant when compared to students who completed NC + TRAD. The students who completed NC + SRSD also demonstrated variations in the growth rate (by 19 words) and slowing (by 2 words) of the length of their essays across successive initial drafts. These forecasted shifts in the direction of economic development are depicted in figure 6.

Essay components

Table 5 displays the results of the models employed to analyze the essay's component components. The unconditional model's random effects (Model 1) revealed that of the overall variability in the number of essential elements of argumentative essays, 49 percent fell among students, 27 percent fell among students within instructors, and 24 percent fell among teachers. The remaining 24 percent fell between students and between instructors. The remaining twenty-four percent was distributed fairly evenly between the teaching staff and the pupils. The quadratic growth model (Model 2) was significantly more fitted to the data as compared to the unconditional model [(12)=649.59, p.001]. After considering the clustered data structure, the model's findings showed that students gradually increased the number of components in their initial drafts by approximately 1.6 for each subsequent essay, with a deceleration rate of 0.2. This was the case even though the number of components increased over time. This was discovered after the model had been utilized to analyze the data. The studies of demographic condition interactions for starting status, rate

ISSN: 2583-5963

of change, and deceleration produced non-significant findings for Black students (p =.49,.96, and.64 respectively) and SWDs (p =.35,.32, and.24 respectively). Because of this, these variables were excluded from the final model.

Table 3. Unstandardized Coefficients (and Standard Errors) of Multilevel Growth Models of Essay Quality

Parameter	Model 1: Unconditional model			Model 2: Quadratic growth model			Model 3: Conditional model		
	Est.	SE	*p*	Est.	SE	*p*	Est.	SE	*p*
Fixed Effects									
Writing quality									
Initial status, β_0	14.11	0.57	<.001	12.05	0.68	<.001	13.54	0.84	<.001
AWE exposure, β_3							0.37	0.06	<.001
NC + SRSD, β_4							−2.43	1.12	.03
Rate of change									
Intercept, β_1				1.55	0.33	<.001	1.18	0.47	.01
NC + SRSD, β_5							0.68	0.63	.28
Deceleration									
Intercept, β_2				−0.21	0.05	<.001	−0.17	0.07	.01
NC + SRSD, β_6							−0.07	0.09	.43
Random Effects									
Level 1 (time, σ^2_{e0})	8.68	0.25		5.12	0.17		5.12	0.17	
Level 2 (students)									
Initial status (σ^2_{u0})	4.86	0.40		4.33	0.56		4.04	0.54	
Rate of change (σ^2_{u1})				0.22	0.14		0.21	0.14	
Deceleration (σ^2_{u2})				0.00	0.00		0.00	0.00	
Level 3 (teachers)									
Initial status (σ^2_{v0})	4.26	1.70		6.12	2.44		3.99	1.63	
Rate of change (σ^2_{v1})				1.40	0.57		1.28	0.52	
Deceleration (σ^2_{v2})				0.03	0.01		0.03	0.01	
Goodness of Fit									
Deviance (-2LL)	15877.16			14781.64			14738.73		
Difference Test				χ^2_{12}=1095.52		<.001	χ^2_4=42.91		<.001

Note. Est. = Unstandardized parameter estimate, SE = standard error, *p* = *p*-value. *P*-values are not provided for random effects as the Wald test for these parameters is only approximate.

ISSN: 2583-5963

Table 4. Unstandardized Coefficients (and Standard Errors) of Multilevel Growth Models of Essay Length

Parameter	Model 1: Unconditional model			Model 2: Quadratic growth model			Model 3: Conditional model		
	Est.	SE	*p*	Est.	SE	*p*	Est.	SE	*p*
Fixed Effects									
Essay length									
Initial status, β_0	267.09	22.30	<.001	204.42	26.46	<.001	265.35	32.70	<.001
AWE exposure, β_3							8.84	2.05	<.001
NC + SRSD, β_4							−102.48	43.63	.03
Rate of change									
Intercept, β_1				45.46	10.99	<.001	35.44	15.99	.03
NC + SRSD, β_5							18.73	21.44	.38
Deceleration									
Intercept, β_2				−5.96	1.63	<.001	−4.99	2.40	.04
NC + SRSD, β_6							−1.95	3.22	.54
Random Effects									
Level 1 (time, σ^2_{e0})	11998.11	342.60		7037.84	245.10		7036.77	245.32	
Level 2 (students)									
Initial status (σ^2_{u0})	6749.61	549.91		3646.38	649.10		3498.87	640.83	
Rate of change (σ^2_{u1})				786.87	254.44		788.31	255.42	
Deceleration (σ^2_{u2})				19.01	6.31		19.04	6.35	
Level 3 (teachers)									
Initial status (σ^2_{v0})	6609.15	2627.67		9397.93	3700.49		6175.28	2476.43	
Rate of change (σ^2_{v1})				1522.54	636.77		1420.26	597.81	
Deceleration (σ^2_{v2})				32.07	13.90		30.84	13.43	
Goodness of Fit									
Deviance (-2LL)	37646.10			36584.41			36562.13		
Difference Test				χ^2_{12}=1061.69		<.001	χ^2_4=22.28		<.001

Note. Est. = Unstandardized parameter estimate, SE = standard error, *p* = *p*-value. *P*-values are not provided for random effects as the Wald test for these parameters is only approximate.

ISSN: 2583-5963

Table 5. Unstandardized Coefficients (and Standard Errors) of Multilevel Growth Models of Essay Elements

Parameter	Model 1: Unconditional model			Model 2: Quadratic growth model			Model 3: Conditional model		
	Est.	SE	*p*	Est.	SE	*p*	Est.	SE	*p*
Fixed Effects									
Essay elements									
Initial status, β_0	9.28	0.58	<.001	7.28	0.72	<.001	8.90	0.89	<.001
AWE exposure, β_3							0.25	0.07	<.001
NC + SRSD, β_4							−2.71	1.20	.02
Rate of change									
Intercept, β_1				1.63	0.34	<.001	1.33	0.50	<.01
NC + SRSD, β_5							0.55	0.67	.41
Deceleration									
Intercept, β_2				−0.24	0.05	<.001	−0.20	0.08	.01
NC + SRSD, β_6							−0.06	0.11	.59
Random Effects									
Level 1 (time, $\sigma^2_{\varepsilon 0}$)	11.83	0.34		8.81	0.25		8.81	0.25	
Level 2 (students)									
Initial status (σ^2_{u0})	6.29	0.52		6.85	0.52		6.73	0.51	
Rate of change (σ^2_{u1})				0.00	0.00		0.00	0.00	
Deceleration (σ^2_{u2})				0.00	0.00		0.00	0.00	
Level 3 (teachers)									
Initial status (σ^2_{v0})	4.36	1.76		6.67	2.73		4.44	1.88	
Rate of change (σ^2_{v1})				1.46	0.61		1.40	0.59	
Deceleration (σ^2_{v2})				0.03	0.01		0.03	0.01	
Goodness of Fit									
Deviance (-2LL)	16775.71			16126.12			16109.57		
Difference Test				χ^2_{12}=649.59		<.001	χ^2_4=16.55		<.01

Note. Est. = Unstandardized parameter estimate, SE = standard error, *p* = *p*-value. *P*-values are not provided for random effects as the Wald test for these parameters is only approximate.

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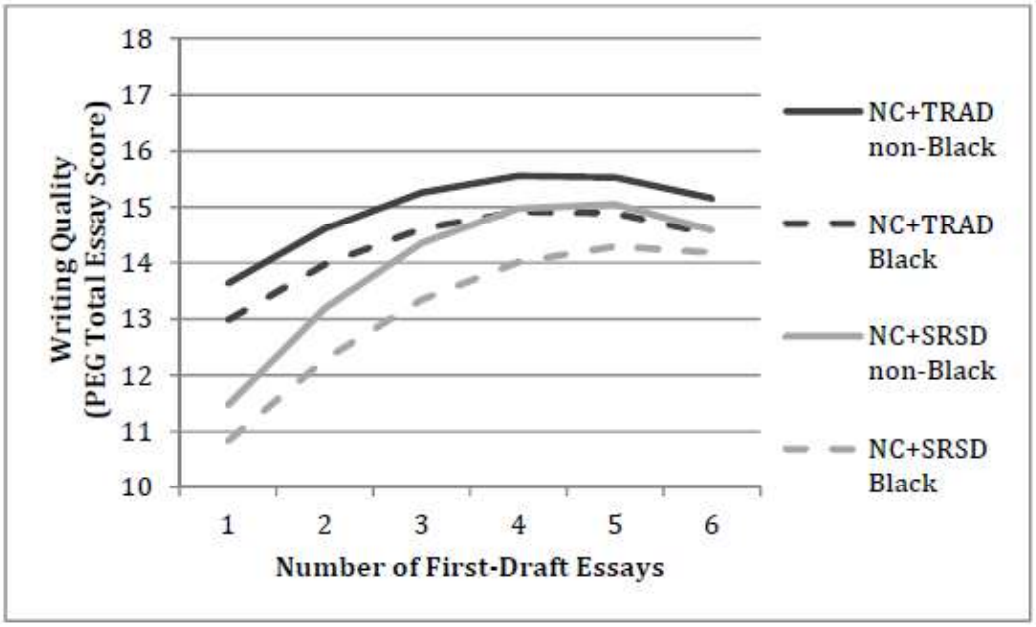

Figure 5. Growth in writing quality by treatment condition using restricted y-axis for illustration purposes (PEG total essay score range 6–30).

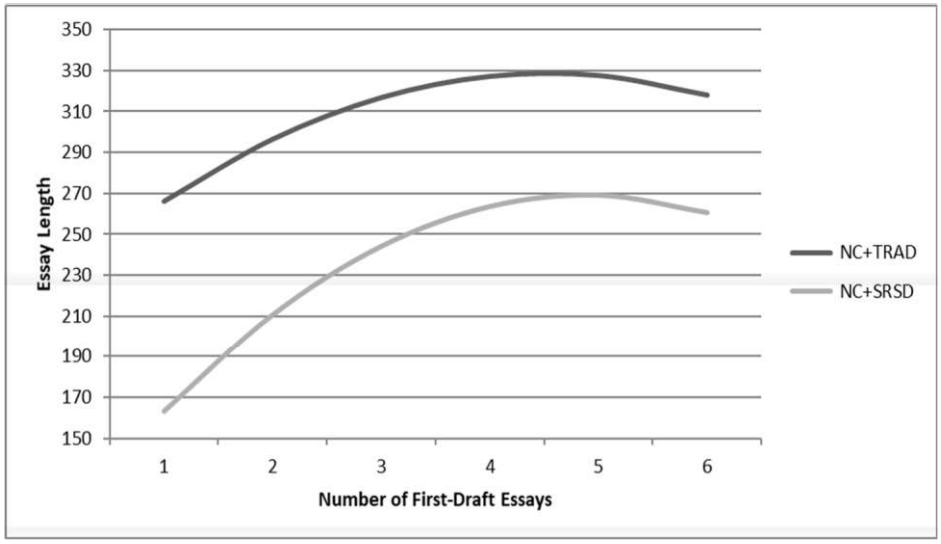

Figure 6 displays, along a constrained y-axis, how the length of each essay increased as a function of the treatment condition. lengthy essays

According to the final conditional model (Model 3), which considered the students' exposure to AWE, students in the NC + SRSD group started with 2.7 less fundamental components in their first drafts than students in the NC + TRAD group. In addition, students in NC + SRSD experienced non-significant changes in their essay element growth rate (by 0.6 elements) and

a decrease in growth over time, in contrast to students in NC + TRAD (by 0.06 elements). Figure 7 displays the expected development patterns for both groups of students over the next few years...

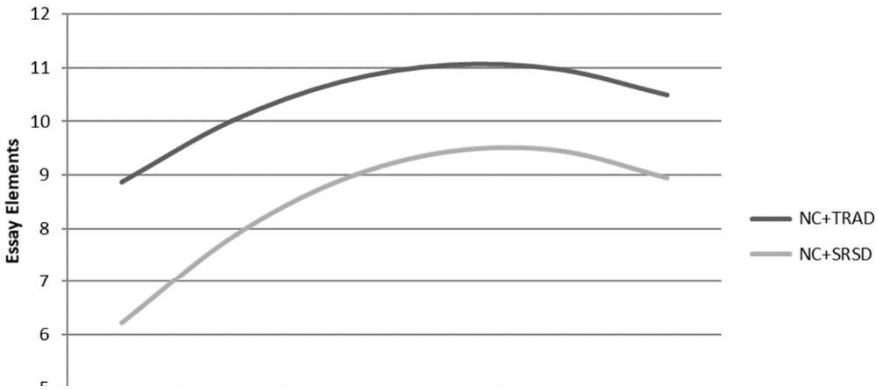

Figure 7. Growth in essay elements by treatment condition using restricted y-axis for illustration purposes.

What are students' and teachers' experiences with and perceptions of the AWE system and what do these perceptions indicate regarding the affordances of AWE in the different instructional contexts?

The students' writing abilities in both treatment groups greatly improved during their first draft essays. The students' writing performance development trajectories demonstrated a substantial initial gain, followed by a decrease when consecutive first-draft essays were produced, and then a plateau at the end of the process. This pattern was followed by all outcomes, including improving the student's writing ability (i.e., writing quality, essay length, and elements). Even though students in the NC + SRSD treatment group showed poorer writing abilities at the outset of the experiment, students in both treatment groups made equal growth throughout the first draft of their essays. After the students had been exposed to teacher-led teaching paired with AWE feedback for a longer period, the results indicate an overall improvement in the student's capacity to write independently.

Qualitative data were gathered from students and instructors' experiences with and impressions of the AWE system to supplement the quantitative findings and explore potential aspects of instruction and AWE feedback that may have contributed to the increase in the quantitative findings. This was done to investigate potential factors that may have contributed to the increase in the quantitative findings. The purpose of this was

to investigate potential explanations that might have had a role in helping to explain the rise in the quantitative findings. In addition, we used qualitative data analysis techniques from grounded theory to determine the dimensions and characteristics of the concepts that frequently emerged in the interview data and identify ideas that frequently appeared in the data. This was done in order to accomplish both of these goals.

The qualitative research revealed, among other things, that teachers and students who used NC Write in contexts for strategy instruction and process writing had comparable views of the AWE system and experiences with it. This was shown by the findings that both groups used NC Write in these contexts. Furthermore, it was discovered that this was the case when teachers and students used NC Write in various situations to teach writing strategies and writing processes. This overarching conclusion, in line with the quantitative data, showed that NC Write presented constant affordances and limits regardless of the educational setting in which the students were put. The findings of the study supported this conclusion. When we present qualitative results. As a result, we categorize the data according to the important concepts discovered throughout the research rather than the conditions that were looked at. This is because we find that this approach yields more accurate results.

A structure that facilitates writing with intent. In conclusion, the qualitative research demonstrated that NC Write offered a writing structure geared toward achieving a certain objective. The concepts that emerged from the interview data were used to describe how NC Write was utilized to supplement writing instruction in two different instructional environments and how students' improvement in writing performance was similarly aided. The interview data were used to generate these concepts. Both of these settings provided a one-of-a-kind approach to the process of teaching writing. The format of the concentrated writing exercise is outlined in Figure 8, which may be found here. Writing, in the context of this paradigm, is a process that entails both getting feedback on one's performance and learning by completing the actual act of writing itself. The interactions between each component are shown to be cyclical and non-sequential by using arrows that point in both directions when moving from one component to the next. According to the findings of the interviews, NC Write provided a writing framework that supported numerous crucial aspects of purposeful practice in both of the schools' environments. (Ericsson, 2006)

ISSN: 2583-5963

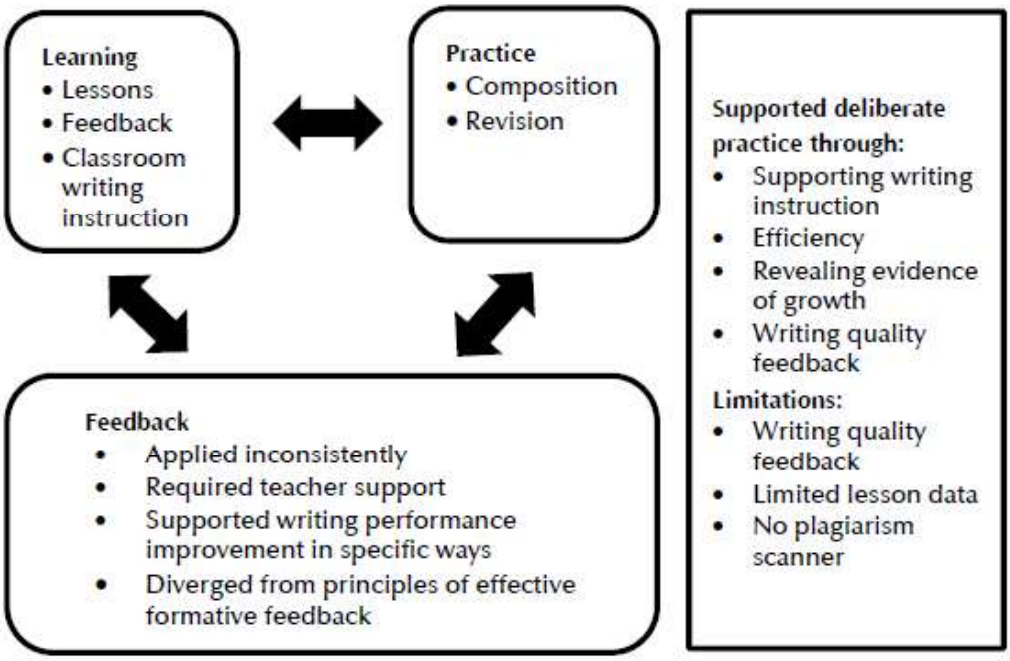

Figure 8. Framework for deliberate writing practice.

The most important takeaway from the qualitative research is an explanation for why the quantitative research did not demonstrate any clear effects of the instructional environment on the development trajectories of children: The process writing instruction setting and the strategy teaching setting is no longer as compared to one another as they previously were since NC Write is not helping with intentional practice. Students received numerous opportunities for relevant practice and task-level performance feedback that assessed the quality of their writing thanks to the learning, practice, and feedback components that were a part of NC Write specifically. This feedback was used to evaluate the students' writing. The links the components had with one another served as a source of support, which helped the students enhance the quality of their writing. The next step is for us to go over the thoughts that emerged from the interview data and that assist us in comprehending how students' writing abilities have improved throughout the course of the study that supports the teaching of writing.

One of the ideas that emerged from the analysis of the interview data was the concept that the use of NC Write served as a valuable supplement to the writing instruction and strategy training teachers delivered. Students were able to practice newly learned educational concepts via the usage of NC Write, while teachers were able to reinforce recently taught

themes in the classroom using NC Write. For instance, students from NC + SRSD took part in a presentation conducted by a teacher in which they learned about the STOP and DARE strategies. In addition, students were allowed to use the skills they had gained in the interactive NC Write session in a future class by completing a graphic organizer and writing an essay using NC Write. This allowed the students to apply what they had learned. When asked if NC Produce benefited her SRSD class, one teacher responded, "The software supplied us with examples that kids were able to... truly appreciate how that structure worked together; it was incredibly beneficial, and it was something that I did not have to, myself, go and write." When asked if NC Produce benefited her SRSD class, she said that it was something that she did not have to go and write.

Another component of NC Write's capacity to assist in the facilitation of writing education was the program's compatibility with the writing instruction teachers provides for their students. The instructors addressed how well the curriculum linked with the writing standards and how well it suited their unique process-oriented methods of teaching writing. They also discussed how well the curriculum matched how they teach writing. According to the viewpoint of one educator responsible for teaching both the Common Core and the NC + TRAD curriculum, the NC Write program "just feels like it complements my Common Core and what I am currently teaching." It is another tool that I use in my classroom to help my students improve their writing, and in my view, it is one of the most helpful tools. The educators discussed the best ways to adapt their lesson plans to realize this alignment. A conversation was had by one of the lecturers at NC+TRAD.

My students would benefit from merely taking the time to explain things to them and ensuring that I use the same terminology when I teach if I want them to grow accustomed to it. This is since I considered the phrase they used in the comments helpful, and as a result, I would not want to modify it. On the other hand, it gave off the impression of being highly potent. Incorporating a framework for process writing education and practice into the NC Write program was the third element contributing to the program's overall success in improving writing teaching. Several NC + TRAD teachers who did not believe they were well suited to teach writing found that the program's instructional framework, opportunities for composition and revision, and feedback provided by the program were useful. One of the instructors recalled saying:

It was helpful to have a framework of what to talk about and what to teach them, given that I am not the finest writing instructor. Nevertheless, there are important life lessons to be learned here, and you may say, "OK, everybody, here is the challenge posed to us. Here it is. Let us have a conversation about these issues." "All right, here is the question that has been posed to us," she said. Because of NC Write's assistance, I was able to dramatically improve the quality of my class.

The software's capacity to direct students' attention toward writing while they were in a classroom setting was the program's last addition to NC Write's support for writing education. The majority of the lecturers who took part in the study were in agreement with the premise that the elimination of the North Carolina General Writing Assessments was one of the contributing factors that led to the recent shift away from placing as much of an emphasis on writing instruction in the state of North Carolina. The following is an explanation given by one of the professors for NC + TRAD:

Because of the proliferation of texting and other forms of electronic communication, in addition to technological advances, it has become increasingly challenging for today's youth to regularly express themselves via the medium of writing. Therefore, on a day-to-day basis, it assisted me in better focusing, and I considered that to be a valuable component.

Efficiency

Another topic that was brought up rather frequently in the interviews was the efficiency of the North Carolina Write program. One aspect of efficiency that teachers thought would benefit their students' efforts to enhance the quality of their writing was the availability of chances for writing practice. According to one teacher for NC + TRAD, the more you write, the better writer you will become. This instructor also stated that the program "just affords them the opportunity they require." Teachers reported that students were able to complete more writing tasks when using the program than they were able to do when they were not using the application. This was true in both scenarios. This aspect was present in both cases. This degree of efficiency was made possible by the fact that all of the information in NC Write was typed, which made it possible to write text far more quickly than it would have been feasible to create it by hand. According to the words of one of the

students in the NC + TRAD program, "I have more time while I am on the computer since I can type faster than I can write." Students' growing familiarity with writing production strategies was found to be the cause of the increasing amount of writing practice that was given to students, according to the findings of an NC + SRSD study. This was especially true when those strategies were used across various subject areas in the curriculum.

Additionally, research was conducted to determine whether or not automated feedback may assist teachers in saving time. "I suppose it is the number one selling aspect for me," a teacher at NC + TRAD was quoted as saying, "because I did not have to sit there and read every single [essay] to discover all the grammar issues, the spelling mistakes, and everything like that." [citation needed] "I did not have to sit there and read every single [essay] to discover all the grammar issues, the spelling mistakes, and everything like that." Through its courses, prompts, visual organizers, and portfolios, the program could facilitate an increase in the organization's operational efficiency. One of the professors at NC + TRAD expressed their appreciation that they did not need to spend an hour preparing an essay for their students to write or instructing them on the appropriate way to form sentences because it was already there for them. The instructors discussed how the grading and feedback-giving techniques they used in their classes were far more successful than those used in other teachers' courses. One teacher from NC + TRAD gave the following information on her utilization of NC Write as a formative evaluation tool within the context of the writing class that she was teaching:

Because I teach by example, and even though I like assisting my students in writing their papers together with them, doing so does not provide me a clear picture of where each student is with their writing, I continue to do it nevertheless. After we have finished working on the problem together, I will have them do some activities on the computer by themselves so that I can evaluate their progress. This gives me a much better understanding of how much knowledge they have gained over the last week. Students are held responsible for their writing as a direct consequence of this.

Because of the implementation of NC Write, several efficiencies have been brought about. These efficiencies include an enhanced chance for kids to improve their writing talents and time savings for teachers who can now notice signs of improvement. When asked whether

NC Write has improved their writing abilities, students in both groups replied yes, citing the program's presentation of quantitative improvement markers as evidence. Most students felt a high self-awareness regarding the quality of their writing and how much it had progressed since they began using NC Write. This was especially true for those students who had previously struggled with writing. One student who participated in the NC and TRAD seminars remarked that his writing had improved "far more" due to his participation. When I first attempted it, I got a 12, but after that, I altered it to a 23. Considering this, it is clear that practice makes perfect. My score was the lowest on the bar graph for the question that was categorized as "Sentence Structure." This question evaluates aspects such as how well I use commas and how effective my sentences are overall. Following is what was expressed by a student at NC + SRSD who built on similar ideas:

I started with a score of 18, which represented my current standing at the moment. Because of the feedback and review process, which includes informing you what you need to do and what others can do to support you, I have improved my score to a maximum of 24. It describes what actions you should take and what information will be helpful to you. Students discussed how they kept track of their progress by utilizing their portfolios and expressed their contentment with having precise assessments of both their writing quality and their progress. The following information was provided by a student attending NC + TRAD: being able to monitor my progress as opposed to being told meaningless platitudes like "Oh, you did good,"

Your writing allowed you to visualize yourself ascending the mountain, so you did not have to rely on others to shed light on the situation. The interviews also revealed that the students had a better understanding of the relationships between the components of an essay and the quality of their writing. This was supported by the fact that there was obvious evidence that the student's writing had improved. For instance, the students had a very good understanding, thanks to the automated grading and comments, that higher-quality works often featured either a greater number of essay parts or fewer faults. The following is how one student from NC + TRAD characterized his overall experience: When I saw the directions that said to "select more upper-grade words," "make your sentence longer," and "add some extra paragraphs," I quickly realized what I was supposed to be doing. I

exited the page, went back in, made the necessary modifications, added new material, and clicked the "submit" button. The second time around, I received a higher grade.

Providing insightful feedback

The automated feedback that NC Write offers were the subject that was often brought up in interviews. When questioned about their behavior after receiving feedback, students almost universally stated that they first looked at their PEG's total essay score before looking into their characteristic evaluations. This was their response to the question, "What did you do after you got feedback?" However, in addition to these aspects of the instruction, the kids took it and utilized it in various ways. Some students neglected to look at any of the other aspects of the examination, concentrating their attention on the overall essay and the characteristic evaluations. These students occasionally used their attribute scores to concentrate their growth efforts more targeted manner. A student from NC + TRAD illustrated how he used the bar graph that was provided with the assignment to compare various characteristic scores. I make it a point to move the number with the lowest value up at least one line; for instance, if it were a 3, I would make it a point to move it up to a 4 on the line that follows it.

After reading their overall essay and characteristic scores, most students went back to study the grammar and spelling comments and integrated them into their work. This was done after seeing their results for both the overall essay and the characteristics. Then, after realizing that my sentences were too long when I reached the grammatical portions, I would go back and evaluate the entire article, and on occasion, I would revise it. This process was summed up as follows by one of my classmates at NC + SRSD: After examining the words that I misspelled in the first place, I think about how poorly I spelled the other words.

The students believed that the criticism of their spelling and grammar was appropriate and helpful since it tied to a particular subject in the essays that they had written. This was the consensus among the students.

Their reports indicate that students did not regularly engage in activities that required them to write, such as analysis, evaluation, or feedback. It seems that the reason for this was the

large number of comments that were made, as well as the excellent quality of those remarks, which presented a choice of solutions for each characteristic. The students displayed a wide variety of levels of involvement as they read this information. According to the comments of one student who was enrolled in NC + TRAD, "they would go through the subject, but they would not study it in depth."

The vast majority of students who utilized the writing analysis tended to understand the comments more generally. This was the case rather than doing an in-depth analysis or systematically using the strategy. One student from NC + SRSD advised his other classmates to keep this in mind, saying, "So that the next time I write it, I know that I need to include more detail or more supporting evidence." Even if you do not take notes, you will still be able to look at it and tell yourself, "OK, remember that so that the next time I write it, I know that I need to include more information or more supporting evidence." This will happen regardless of whether or not you make notes. According to the students' reflections, everything was documented in their portfolios made it possible for them to receive feedback from prior iterations of their work whenever necessary.

Instructors in both types of classrooms who took part in interviews acknowledged that students seldom used the writing analysis assessment and feedback but instead concentrated on the total essay scores. This was established through the teachers' participation in the interviews. On the other hand, the instructors saw that as the students' score comparisons advanced, they began to compare the content of their work and explore the links between textual aspects and their ratings. This was something that the teachers had not seen before. Although it was the role of the instructors to direct the student's attention to the extra remarks, the professors could not prevent the students from comparing and contrasting the outcomes of their essays.

The second criterion of high-quality written feedback is the requirement that instructors provide students with a significant amount of assistance in order for the students to correctly grasp and execute the feedback that is provided. "I do not think they can get it if you do not sit down with your students and explain [the remarks] to them," said one teacher for NC + TRAD. A handful of the pupils mentioned that they needed help to fully understand what was being conveyed. One of the students from NC + SRSD who

recounted their experience stated that when they initially heard the material, they had no idea what half of it meant. The children's poor command of the language was one of the primary factors contributing to the situation's urgency. In the interviews, teachers from both sets of circumstances characterized offering this help more as a duty to their students than as a direct result of the feedback, particularly failing. In this activity, the instructors were tasked with comparing and contrasting the two types of feedback. The students struggled with the intricacy of the terminology, which was necessary according to an NC + TRAD instructor, even though it was tough. Teachers discussed the use of task and topic scaffolding as a means of assisting students in comprehending and applying feedback, and many of them pointed out that writing-related challenges are the areas in which students require the greatest assistance.

It enabled instructors to shift the focus of their help from assessment to coaching, even though students require a great deal of aid to put the comments into practice.

Because of the feedback, I could have one-on-one conversations with [students] at various intervals and explain why certain things were causing them concern. For example, one of the teachers at NC + TRAD used statements such as "This is why they wanted you to do this" and other terms that were quite close to that. The feedback provided by an independent third-party facilitated improved communication and cooperation between students and their respective professors, regardless of the context in which it was presented.

In conclusion, but certainly not least, the comments made on the kids' work shed light on several general concerns, which spurred the teachers to give educational assistance. The educators who took part in the interviews underlined the need to routinely review the automated feedback provided to the students to provide direction for the decisions made about the educational system. A teacher for NC + TRAD provided the following explanation:

Because most of your students struggle with the same issues, the feedback you give them will be quite consistent. In every one of your classes, you will see this particular phenomenon taking place. Since they are all receiving the same information, you can teach a class and say things like, "OK, here is the feedback that everyone is getting, so let us see

what we can do to make it better," among other things.

In conclusion, even though feedback required a great deal of assistance from instructors, it enabled them to take on more of a coaching role and zero in on the most important learning goals.

The fact that it assisted students in improving their writing talents in certain ways was the third feature of the remarks on the quality of the writing. During the interviews, the students consistently mentioned that the criticism they had gotten helped them become better at self-regulating and self-evaluating their writing. In addition, they said that they had improved their writing in terms of the content and specialized terminology they used, as well as their spelling, grammar, word choice, and sentence structure. According to the comments given by the students, increasing the quantity and quality of their critiques helped them become better writers. Another student from NC + SRSD elaborated and said that what it is is merely more knowledge than you would receive from a typical lecturer. Another student from NC + SRSD adds that Things is more exhaustive and comprehensively covers the topic than the professors can do on their own. During the interviews, a handful of the students expressed their opinion that the criticism's focus assisted them in developing their writing skills. One of the students from NC + SRSD remarked that it is quite clear what you did well and where you need to improve in the future.

in addition, many educators concluded that encouraging students to monitor their work by offering consistent and timely feedback on each essay draft benefited the student's academic performance. One NC + TRAD teacher described how consistently providing her students with feedback helped them improve during the course at identifying and correcting their errors. Simply having the ability to go back and change a few things... when I instruct people to edit, they seek for [errors] or notice them, which is how the information became public. I had the impression that my children were starting to get it and that they were able to make the necessary modifications as we continued to practice it. In addition, I saw that they were making fewer errors as we continued, which was another evidence that our technique was successful.

Constraints of the structure

The NC Write elements that enable writing teaching, effectiveness, feedback on writing quality, and proof of change appeared to increase learning settings that focused on this framework for purposeful writing practice in two independent instructional contexts. These learning settings included: The findings from the interviews also revealed that NC Write had components that diminished the efficiency of the same framework. The findings illustrated how limiting each of these characteristics might be. These concerns relate to NC Write's inability to detect plagiarism instances and the platform's limitations on the provision of interactive courses and automated feedback.

A significant number of the criteria for delivering constructive formative feedback were disregarded in the remarks on the writing quality (e.g., Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Parr & Timperley, 2010; Shute, 2008). This distinction posed a challenge to the usefulness of the provided feedback and its relevance. For example, many students voiced their dissatisfaction with the difficulty and amount of time required for the writing analysis evaluation and feedback. One of the students at NC + TRAD stated that due to the advanced vocabulary that was utilized, there were certain aspects of the critique that she did not fully get. Both types of teachers had similar concerns, and some of them described the effectiveness of the feedback as ranging from being incredibly useful to be completely ineffective. One of the instructors at NC + SRSD provided the following example as an illustration: The more advanced students that I had were able to comprehend this lesson on a deeper level, which led to their gaining a greater amount of knowledge from it. My pupils who read at a lower level need to develop in several areas, but one of those areas is their capacity to fully comprehend the information presented to them. They also need to concentrate on the things they accomplished well and the areas in which they may improve.

The level of clarity that was there in the remarks was another aspect that diverged from the standards of providing constructive feedback effectively. Several students were dissatisfied with the writing analysis because they believed it was too vague to be helpful. If there were one thing I could change, it would be to provide a little bit more specific information on how I may make things better. One of the students at NC + TRAD mentioned that it might shed light on what issues need to be addressed and how things can be improved. A couple of students all had the same remark: there was not enough variety

in the writing analysis. The educators all had the same point of view: they believed the input was reasonable and usually useful but lacked enough specifics to allow for constant revisions as the document moved from draft to final. In every instance, the teachers and the students recalled a period when the children had achieved a writing quality ceiling and found it difficult to continue to advance. This was consistent with the quantitative research findings, and both sets of individuals recalled it. "When I did the one before that, I fired a 24... " When questioned about their experience, one student from NC + TRAD responded, "I have even rewrote a whole paragraph to see if it would help or anything else, but I feel like I cannot reach that point where I am above a 24," when asked about their performance. At NC + SRSD, one of the instructors recommended that the feedback format be reorganized to place a greater emphasis on the revision strategy. As a response, she said, "OK, here is your score," as though the information needed to be presented in a manner that was engaging to the pupils. Why is it vital to consider this? What course of action should I follow after this?

Last but not least, some clues that suggested how the formative feedback was delivered may not have adhered to the basics of effective formative feedback, which resulted in a reduction in the usefulness of the input. Because the feedback was presented in a visual style, some students made minor adjustments to their work to correct their spelling and grammatical errors. These students were under the notion that by making these adjustments, they would be able to significantly improve the quality of their work. Students in both types of classrooms discussed their experiences of trying to make improvements and felt disheartened when their scores or the remarks that followed did not change. The reading analysis was more illustrative than the writing analysis, but the writing analysis allowed for more individual interpretation. The students appeared to have the most difficulty applying critique to concept development, structural style, and stylistic choice in the writing analysis. If one of my students responded, "Well, I went through, and I did everything they asked me to do, and I still got an 18," and another of my children replied the same way, she could feel slightly annoyed. One educator from NC and SRSD had to say about it in their evaluations. After going back and reading the comments for a second time, they concluded that, for the most part, they were still making the same mistake. You are reviewing the feedback, but are you taking any action in response to it, or are you

merely making adjustments and crossing your fingers that the outcome will be positive?

The feedback on the writing quality was less valuable and effective than it might have been because it did not adhere to the principles of effective formative feedback regarding complexity, specificity, and presentation (Shute, 2008).

Throughout the interviews, the professors and the students expressed a variety of perspectives on their experiences with the NC Write classes. Only a few students could think of specific classes that they believed had contributed to their development as writers. The students voiced a general satisfaction with the interactive teaching approach that was being utilized in the classroom. The majority of the instructors commented that the classes met their requirements and were successful on the whole. According to one of the NC + SRSD instructors, the mini-lessons "helped out considerably," the explanations were succinct, got right to the point, and were written in a way children could readily comprehend. This was true regardless of the topic being discussed. Despite this, more instructors and students than any other NC Write component voiced dissatisfaction with the courses. The most common concerns from students were that the lecture might have been made easier to understand and that there should have been far less information presented than there was. According to the instructors, the most significant problem with the courses was a deficiency in providing good feedback on the pupils' progress. The following is an explanation that an instructor offered for NC + TRAD as an example:

I am interested in learning more about the students' progression while working through the lessons and after completing a particular session.

During the interviews, we questioned teachers and students about NC Write's aspects that they believed may use some tweaking or improvement. The students offered several suggestions that were connected to the characteristics that were already present in NC Write. One of these suggestions was the peer review system. However, throughout the investigation, this particular function was never utilized. According to the opinions of the instructors and the students, it would have been good to receive further feedback in the form of sample essays. At the time of the intervention, NC Write only had a limited number of annotated example essays, but the results of the intervention showed that there was no clear association between the grades received on those essays and the total grades received

on the essay assignments. Many educators believe that NC Write should be able to differentiate between information that has been taken straight from the prompts and source materials and work that has been stolen from other writers when judging whether or not a piece of writing has been plagiarized (i.e., copied from essays that have been published online). Even though there was evidence that some students in the sixth grade had duplicated the prompts, the teachers observed that plagiarism was more of a problem in the upper grades. According to one of the teachers working at NC and SRSD, all required to get a score of 12 was to copy and paste the question. Because of this, it was a poor decision on their part not to even write anything on their initiative.

Even though they had informed the students that essays were to be sent in with "good faith" to receive an appropriate grade on the PEG, the instances of plagiarism continued to annoy the teachers. Students were given fewer chances to practice their writing and were more likely to receive criticism that was not entirely accurate because it was assumed that plagiarism had occurred even in situations where it was not disclosed. This was because it was assumed that plagiarism had occurred. The degree to which feedback differed from the cornerstones of successful feedback, the dearth of lesson data, and the absence of a plagiarism detector were all shortcomings that limited the use of the framework for deliberate writing practice in process writing and strategy training. These shortcomings included: the lack of a plagiarism detector, the dearth of lesson data, and the extent to which feedback varied from the cornerstones of successful feedback. The problems with the purposeful writing practice paradigm rendered it less useful.

3.6 Discussion

This study aimed to investigate the feasibility of incorporating AWE into two separate pedagogies for teacher-led writing instruction at the middle school level. In order to accomplish this goal, we used a strategy based on mixed techniques, which incorporated both qualitative and quantitative research. The integration of AWE with a traditional process approach to writing education was carried out differently when compared to the integration of AWE with teaching strategies in one instructional scenario. Both of these approaches were used to instruct writing classes. We examined the two learning environments to see which would be more likely to inspire students to produce better first

drafts of their papers in the future. We looked at students' and teachers' experiences with and perceptions of the AWE system in order to get a better understanding of the quantitative findings, the advantages and disadvantages of AWE as perceived by users, as well as what these perceptions indicated regarding the affordances of AWE in the various instructional contexts. This was done to better understand what these perceptions indicated regarding the affordances of AWE in the various instructional contexts. This was done in order to have a better understanding of what these perceptions about the affordances of AWE showed when used in a variety of educational settings. In this part, we will discuss each component of the research independently.

What are the growth trajectories of students' first-draft writing performance (i.e., writing quality, essay length, and essay elements) when AWE is used in two different instructional contexts, namely process writing instruction and strategy teaching? These contexts are processed writing instruction and strategy teaching.

Previous research has very infrequently explored the growth of first-draft writing skills throughout successive essays and discovered evidence of transfer. The current study is an extension of earlier research on AWE because it demonstrates that students who took part in different instructional contexts supported by AWE increased the quality of their writing, the length of their essays, and the number of fundamental components they included in their first drafts for a variety of writing performance outcomes. This study also shows that students who took part in different instructional contexts supported by AWE increased the length of their essays. The students in NC + TRAD and NC + SRSD showed an immediate increase in their writing skills that declined over time and reached their peak after the intervention's fourth first-draft essay. This growth occurred in both groups of students. This finding is noteworthy because it reveals that students' development rates in their ability to write were comparable across both educational settings. This finding illustrates why this finding is relevant. The research also showed that the student's reading competency growth rates were comparable in the different contexts in which reading was taught. The findings of this experiment, which focused on different teacher-directed instructional models, are similar to the findings of Roscoe and his colleagues' investigation of the efficacy of various student-directed practice models for the implementation of AWE. Students saw improvements in the quality of their writing after revising their essays using

AWE, regardless of the kind of process writing practice forms they used to complete the assignments (standard process writing practice formats, strategy-based practice, or game-based practice) (Roscoe et al., 2013, 2018, 2019).

There are some reasons why the two groups of students who used AWE in different instructional contexts showed similar growth trajectories. Even though strategy instruction is linked to large effect sizes (Graham et al., 2012; Graham & Perin, 2007), and even though SRSD-based interventions have, on average, produced the largest effect sizes for writing quality of all writing interventions (Graham & Harris, 2018), there are several reasons why the two groups of students who used AWE in Both courses made use of AWE in order to improve the quality of their writing; however, only one class employed The first issue is that the overall efficacy of the strategy has decreased as a consequence of its alteration to a structure that is less strict to increase the number of teachers who accept it and minimize the amount of time spent on professional development. However, Palermo and Thomson found that NC + SRSD had a significant, positive influence on students' essay length (Cohen's DZ = 1.36), essay components (DZ =.97), and writing quality (Cohen's DZ = 1.18) at the post-test. These findings were based on the multivariate analysis of variance (MANOVA) (2018). These impact sizes are all comparable to those determined by previous SRSD studies (e.g., Graham & Harris, 2003; Graham, 2006; Graham & Perin, 2007; Graham et al., 2012). The second line of reasoning proposes that differences in the average quantities of AWE exposure brought on by the various situations would go some way toward helping to explain the findings.

On the other hand, a control for AWE exposure at the student level was included in every one of the final conditional models. This control took into account the fact that there were differences in the amount of time spent writing in NC Write both within and between the various conditions. The third point of contention is the regularity with which measurements are taken. In the current study, it is possible that the standard errors were too large or that the mean gains in writing competence over first-draft essays were too low to identify any changes between the conditions. This finding is comparable to what Palermo and Thomson (2018) discovered. They discovered that NC + SRSD students improved their writing performance more from the pre-test to the post-test than NC + TRAD students did. As a result of NC Write's consistent affordances (and limits)

throughout different learning situations, the effect of students' exposure to writing instruction was mitigated, which improved students' overall writing ability. The facts from the interview provide credence to this interpretation of what transpired. This last concept will be investigated in further detail further down.

What are the experiences that students and teachers have had with the AWE system and their views of it, and what do these perceptions imply about the affordances that AWE provides in the various instructional contexts?

Although NC Write was deployed in both contexts—process writing instruction and strategy teaching—students and instructors engaged with and felt the same way about NC Write. As a result, NC Write was implemented in the fields of teaching writing skills and teaching the writing process. This discovery led to the idea that NC Write presented continuous affordances and restrictions independent of the educational situation.

A study of qualitative data demonstrated that NC Write provides a framework for purposeful writing practice independent of the instructional context. Through the application of this system, which included a cycle of learning, practice, and feedback, students' writing talents were encouraged to improve. It provided efficiencies that could not have been achieved in any other way, provided feedback on the caliber of students' writing, showed that students had improved, and encouraged ongoing, iterative engagement with cycles of practice and feedback. In addition, NC Write specifically helped teachers in writing instruction. As a result, the deliberate practice was made feasible.

The SRSD model was chosen as the best type of strategy teaching to apply in the current study because it is an evidence-based practice (Harris & Graham, 2016) and a particularly successful type of strategy training since it integrates self-regulation instruction. In addition, given that the study's goal is to examine the effectiveness of various types of strategy education, this choice was selected (Graham et al., 2012). (Graham et al., 2012). However, while process writing teaching and SRSD instruction had certain commonalities, they differed significantly in many important ways. The focus on teaching self-regulation skills and whether or not the training was criteria-based or instructional responsive were two examples of these disparities. The results of the interviews, on the other hand, revealed

that the little variations in writing performance between the two training methods might be due to NC Write's affordances, which were comparable to both the process writing and strategy training conditions.

An essential part of SRSD education, for instance, is teaching planning and writing processes (Graham & Harris, 2018). Students may use the DARE technique discussed in the previous section to help them recall and put all of the fundamental elements of argumentative essay writing into practice. This can be done by giving students a set of standards for excellent argumentative writing and asking them to assess their work in light of those standards. The interviews revealed that, although process writing instruction placed less emphasis on planning, writing, and revising strategies, AWE encouraged students in both conditions to consider the connections between essay components and the writing quality scores given by PEG. This discovery is quite intriguing. As a consequence of the practice of comparing essays and grades, students were better able to understand the relationships between textual qualities and writing quality, as well as the elements of good argumentative writing. The routine of comparing essays and marks helped achieve this.

Promoting writing beliefs and training in self-regulation techniques are also part of SRSD instruction. This is crucial to SRSD education because it helps students practice self-control, control the writing process, and compile verifiable evidence of their growth (Harris, Graham, & Mason, 2006). (Harris, Graham, & Mason, 2006). There was some evidence from the interview results that AWE gave students in both conditions the tools they needed to manage their use of writing strategies and the writing task, as well as the opportunity to compile evidence of their writing progress, even though self-regulation strategies and beliefs that are supportive of writing were not explicitly taught to students in the NC + TRAD condition. This was the case as AWE provided students in both settings with the chance to gather proof of their writing development. When students have the chance to practice frequently and receive feedback on their performance, their capacity to self-monitor, self-control, and self-evaluate their performance may grow (Ericsson, 2006). (Ericsson, 2006). The cycles of practice and feedback within the AWE framework were thought to enhance students' self-monitoring and self-evaluation. Students were able to employ new teaching techniques immediately and observe how they influenced the caliber of their writing when they learned them, whether from a lesson in NC Write or their

classroom teacher. This was made feasible because students had access to NC Write and their teachers in the classroom. The ease of access to automated results and comments and their broad acceptance as genuine and meaningful may have boosted the students' ability to self-evaluate. Each student received automatic feedback that provided them with tangible proof of their development, which they could easily follow over time through their writing portfolios and was very clear to them as they progressed from one draft of their work to the next. Students can access this information about their efficacy because of practice and feedback cycles, mastery experiences, and proof of progress. The results showed that some of the same levers for the development of self-regulatory skills and capacities and positive writing beliefs were provided by both SRSD training and AWE.

In conclusion, the degree to which SRSD training is founded on criteria and is sensitive to instruction is one of the most significant contrasts between SRSD training and process writing teaching. The results of the interviews suggested that the interconnected nature of the learning, practice and feedback cycles offered by AWE explained both current performances as well as the components necessary for improved performance for all students, even though process writing instruction is not typically as customized to the needs of students as SRSD instruction. For example, even though the present performance had been discussed, this was the situation. With this knowledge, the students could focus on particular areas of their writing performance and make efforts to enhance them. In addition, the cycles of learning, applying, and receiving feedback from their teachers may have helped students develop a better grasp of what makes outstanding writing.

As a result, it is quite encouraging to notice the advantages of using AWE to support writing instruction and acquisition. AWE can be successfully applied in various educational contexts, as evidenced by the fact that kids in the two treatment groups showed similar growth trajectories. When this is done, it seems that the kids' writing gets better, and the teachers and students can see AWE's benefits. Our findings suggest that using AWE modifies teaching in ways consistent with a framework for meaningful writing practice. These results suggest that typical process approaches to writing or strategy training differ substantially from effective writing education utilizing AWE.

Limitations of the Present Study

While interpreting the study's conclusions, keeping a few crucial caveats in mind is crucial. Professors did not randomly choose students; rather, they allocated them to conditions. Several undesirable consequences are produced by this quasi-experimental strategy, including between-condition variances in the proportion of students of color and students with disabilities, as well as the caliber of kids' initial writing. Due to a lack of resources, it was not possible to film or observe instructors' writing classes. This made it impossible to confirm the details provided by NC + TRAD teachers on how they conduct their writing lessons. Additionally, as evidenced by the NC Write log files, AWE exposure was constrained to a part of the completed actions. Lesson activity logs, for instance, showed which courses students attended and for how long, but they did not record any data on how well the students performed during that specific session. Although the lack of prior NC Write exposure did factor into the selection process, the interviews revealed that students and teachers needed some time to become used to the program. This implies that the software might have influenced the results. The timing of the intervention, which was close to the conclusion of the school year, which is frequently a period when student effort tends to diminish, may have contributed to the fact that students' writing ability deteriorated at the end of the intervention and on the post-test. We cannot distinguish between effects brought on by NC Write or the intervention and those that developed gradually. Further study will be necessary to examine the effects of maintenance and the issue of whether results alter if therapy is initiated earlier in the school year

1. Indications for Future Developments

Our investigation discovered that while the downsides of AWE were likewise not sensitive to the setting in which they were implemented, their advantages were not reliant on it either. This was shown by the fact that educators in NC + TRAD and NC + SRSD reported experiencing the same difficulties and annoyances. This finding shows that teachers could not modify their lesson plans to accommodate AWE's limitations. In order to help students navigate AWE's boundaries, instructors must be aware that adopting AWE may need them to expend additional effort. As a result, effective professional development and coaching will be necessary that go above and beyond the degree of technical expertise needed to use AWE.

The findings of this investigation offer proof that supports some theories about potential future developments. Future research will be required to determine how writing instruction should grow and alter in response to using AWE. Future studies should concentrate on instructional components that are more difficult when using AWE because the current focus of AWE research is on those teaching areas that instructors may ignore or lessen when using AWE (i.e., the time-saving elements of AWE) (i.e., the time-saving elements of AWE). Teachers should devote more time teaching students the fundamentals of effective writing, giving them feedback in the form of examples and counterexamples, and helping them connect general criticism with specific steps they can take to enhance their writing. In other words, they need to provide their students with more research-based writing instruction (e.g., Graham & Perin, 2007). The need to change and adapt lesson plans when AWE is a component of teachers' writing toolkits should also be emphasized when it comes to professional development for AWE (see also Knight et al., 2020).

The results showed that students who used AWE in contexts for process writing education and strategy training both improved their writing talents at comparable rates. This was determined by looking at the students' first draft ratings for each essay. Based on the results of the current investigation, these conclusions were reached. However, there were likely variations in the subsequent modifications that students made to their papers in the two sets of scenarios and the methods they used in each scenario. In order to better understand the potential disparities that may be attributed to various educational contexts, more studies should be conducted to examine writing performance concerning both first drafts and final manuscripts. By utilizing the information offered by keyboard recording software, which illustrates the writing and editing procedures that students go through, it is feasible to achieve this aim (see Vandermeulen, Leijten, & Van Waes, 2020).

In conclusion, children need practice opportunities that have been intelligently designed and can be mastered sequentially to encourage intentional writing practice (Ericsson, 2006). (Ericsson, 2006). While taking part in these practice opportunities, students should be able to apply specific writing strategies and techniques within the parameters of AWE; nevertheless, they should not be expected to write an essay to receive feedback on their work. For instance, one practice session may focus on developing a claim, while the other might focus on refuting that claim (or on developing introductions, elaborations, and

ISSN: 2583-5963

conclusions with a specific objective in mind). When taken as a whole, these exercises aim to support students in maintaining and even improving their writing skills throughout their academic careers. In an additional study, examining the goal of such practice opportunities in writing instruction that uses AWE is important. Creating these practice activities and the AES models that go with them should receive special attention.

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