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## The Influence of Visually Rich Technology on the Writing Process of Elementary Students

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## Visually Rich Technology and the Writing Process of Elementary Students

**Abstract:** *This teacher inquiry project, conducted by an undergraduate teacher candidate with support from a faculty member, explored the use of visually rich technology and its influence on elementary school students' motivation and learning outcomes in writing. Students used visually rich technology as part of the writing process. We found that when students used technology to support the writing process they showed incremental gains in motivation as well as gains in student learning outcomes. Implications for practitioners highlight a need for teachers to consider how visually rich technology can support students' aspects of the writing process as well as development in other literacy areas. Further inquiry projects should examine how technology influences students with consideration of their grade level, academic background, and level of motivation in writing and literacy.*

### Introduction and Rationale for the Inquiry Project

As an undergraduate elementary education major, I (first author) became immediately aware of some students who were engaged in certain activities, but completely not interested, off task, and at times defiant during other activities. Fleming and Mills (1992) wrote about four primary modalities in elementary classrooms: visual, kinesthetic, linguistic, and auditory. I noted in all of my clinical settings certain students did not respond well to activities that were only linguistic. While there has been conversation and criticism about concepts such as learning styles, learning preferences and multiple intelligences, it is important for teachers to include a variety of those four modalities (Khazan, 2018). I designed this teacher inquiry project due to my personal interest to see if increasing the number of modalities in a writing activity could increase students' motivation in writing and the quality of their writing.

I conducted this inquiry project during the fall of my senior year in my undergraduate program. As an elementary education major, I spent 35 hours in elementary classrooms during each semester of my junior year in schools that qualified for federal Title I funding due to the high percentage of students who qualified for free and/or reduced lunch. As stated earlier, I saw students in every classroom that were not engaged and participating. This was especially the case in literacy, specifically reading and writing. At the same time, I noticed students' different levels of engagement, I also noticed that more and more teachers had access to and were depending on technology to support a lot of their students'

learning. This was especially the case in literacy when teachers would work with small groups of students while the rest of the students worked independently or in partners on various activities.

With a personal interest in writing and technology, I wondered about whether or not technology, specifically visually rich technology programs, could influence students' motivation in writing as well as the quality of their writing. Based on the literature, it seemed intuitive that technology could increase students' motivation in all subjects, especially writing. There seemed to be potential for technology to increase students' quality of writing, but that connection seemed less clear than the relationship between technology and motivation.

Specifically, in order to address the disparities between the access that visual learning students have to writing tools that aid their writing process as opposed to that of verbal-linguistic students, I (lead author) wanted to engage in teacher inquiry (Mills, 2002) to see if VRT helped students' writing skills and motivation when utilized as a tool in the writing process. I designed my inquiry around these questions: 1) "How do visually rich technology and word processing influence motivation in elementary students with a preferred visual learning modality?" and 2) "How do visually rich technology and word processing influence writing proficiency in elementary students with a preferred visual learning modality?"

### **Overview of Literature**

While criticism abounds related to students' specific learning preferences, it is still relevant and appropriate for educators to consider the types and number of modalities available during classroom activities (CAST, 2011; Fleming & Mills, 1992). The Universal Design for Learning framework (CAST, 2011) calls for learners to have access to all four of the modalities mentioned by Fleming and Mills (1992) at various points during instructional activities.

In elementary school writing, research indicates that the primary modality is linguistic (Vincent, 2001). Typical writing instruction and the texts produced by students to measure writing proficiency lend themselves to students who are high performing and have sophisticated verbal and linguistic skills. Students who are striving learners in literacy may write and speak more effectively if they have access to visuals (O'Bannon, Puckett, & Rakes, 2008). Researchers have coined the term "multimodal texts" to discuss texts, which include two of the following modalities: linguistic, visual, auditory, gestural, or spatial (Anstey & Bull, 2010). Multimodal texts provide learners with multiple ways to comprehend and develop

a deep understanding of the text (Barton, 2018). Examples of multimodal texts include picture books, books with an auditory read-aloud resource, and pictures with captions.

### **Visually Rich Technology**

**Overview of VRT.** Visually rich technologies (VRT) provides learners with opportunities to create multimodal texts due to the combination of the linguistic and visual modes. Common examples of VRT's are software programs that create graphic organizers, photographs with captions, concept maps, or digital books with both pictures and writing components. Research by Olson (1992) and Dixon (1983) showed that "for some children, writing complexity and volume could be increased by asking them to visualize concurrently with writing" (cited by Vincent, 2001, p. 242). By allowing students to create text and also be able to add pictures, video, or animation to the text) not only are they able to show their skill through visuals, but their writing may also be at a higher level (Vincent, 2001). The use of multimodal text to create a product provides appropriate support to learners.

Though many teachers believe in the use of computers and digital devices in the writing process, often students only use them as a tool for editing rough drafts in preparation for publication (Poole & Preciado, 2016). However, word processing and multimodal texts lend themselves well to all stages of the writing process, not just the revision and editing phases. In a recent research study, students were given the opportunity to create writing pieces using VRT and they "reported being able to keep the action moving throughout their story and make critical decisions regarding when to introduce characters or when to speed up action and when to slow it down to create tension" (Sessions, Kang, & Womack, 2016, p. 222). In this case, the students planned, wrote their first drafts on the computer, and were able to edit as they went along.

**VRT and motivation.** Many of the studies conducted on VRT examine its influence on motivation to participate in writing activities and improvement of writing skills. Beam and Williams (2015) conducted a case study in one kindergarten classroom highlighting the positive effects of VRT when used in the classroom. The researcher analyzed how technology rich instruction influenced student's writing samples. The teacher used digital and multimodal technology to show the students how a writer would use technology to aid their writing; however, due to IT problems, the students were not able to use the technology themselves (Beam & Williams, 2015). The results of the study showed that technology integrated into instruction made students more attentive and engaged during the lesson due to the attraction of the technology.

**VRT and writing skills.** Two studies highlight how a visual learner can improve in both writing skills and motivation to write when allowed to create multimodal texts utilizing both images and words. In one study, Vincent (2001) worked with five elementary children with a strongly preferred visual learning modality and one that preferred a verbal learning modality at an Australian independent suburban elementary school. The purpose of the study was to examine how VRT that allows students to create multimodal text affects the writing quality of students with a visual learning preference as opposed to a student with a verbal learning preference. The results of the study showed that when the students with a visual learning preference used the visually rich technology program to create visuals to accompany their writing, the language structures of their writing became more complex. Students using the technology to write also showed increased motivation to participate in writing activities.

In a second study, Sessions, Kang, and Womack (2016) studied a population of 30 fifth graders from a suburban school in the mountain west region of the United States. They sought to determine the impact of technology as a writing tool on the motivation of students to write and on the quality of their writing. This study emphasized how the integration of technology as a writing tool is a standard within the Common Core State Standards. The results found that the students that were using a computer application that allowed them to create visual scenes to accompany their writing pieces wrote using more sensory details. The results also showed that the students using the computer applications were better able to sequence their narratives as a result of visually mapping out the picture scenes that matched their plot.

### **Word Processing: A window into the possibilities of VRT**

While some researchers have examined the effects of VRT on students' writing performance and motivation, the majority of the research involving technology and the elementary writing process only addresses word processing. However, the effects of word processing do provide useful knowledge on how students react when given a technological tool to aid in their writing process. These studies also add to the body of information on how various aspects of the writing process (pre-writing, composition, revision, editing, and publication) are affected by the use of technology versus handwriting.

A study by Saulsburry, Kilpatrick, Wolbers, and Dostal (2015) called attention to the use of technology and word processing in creating meaningful publication opportunities and authentic writing experiences for specific audiences.

The study was done with two elementary classes, one class consisted of three deaf and hard of hearing students in an upper elementary while the other was made up of five ethnically diverse groups of third through fifth grade students. The purpose of the study was to examine how the integration of technology into writing workshop widens the opportunity for authentic writing as well as how it impacts students' writing choices. Testimony from the teacher involved in the study reflected a belief that the "writing project was successful in many ways: It included a topic of interest, multiple uses of digital tools, an authentic task, and a real audience, and the students were motivated to engage in their assignment from beginning to end" (Saulsburry, Kilpatrick, Wolbers, & Dostal, 2015, p. 32). The results suggest that if students are given a wider venue for writing and know that they have more options for authentic publication when using technology, they are likely to make different choices about their writing than when hand writing.

Leeuwen and Gabriel (2007) examined a first grade class to study the impact of introducing a word processor as a writing tool. Findings showed that allowing students to use a word processor as a writing tool increased writing fluency in some while others actually wrote less. Also, technology questions outnumbered writing process questions by the students. MacArthur (2009) addresses the issue of technology outweighing the writing curriculum in some classrooms in his literature review of his past research studies. He concluded that teachers must instruct students on how to use the technology throughout the entire writing process instead of using it solely for publication. As highlighted by Session, Kang, and Womack (2016), the Common Core State Standards also state that the use of technology be integrated into the elementary writing process as a means of creating as well as publishing.

Another possible solution for this problem in technology integration is addressed by Mills (2014) in his mixed methods study involving a population of 85 fourth grade students and 3 teachers in 3 separate Australian, low-socioeconomic status classrooms to determine the effects that a new writing program that taught students how to write across different genres of online, multimodal texts. Mills' results suggest that students need ample time to learn how to use the technology before using it in their writing process.

MacArthur (2009) claims that while writing with a word processor, students revised more during their writing rather than waiting until after, they struggled with the technology if their typing skills were poor, and the writing process was more social and peer editing was easier with the ability to print copies of a draft. The negative claim in his review addresses another complication of technology integrated into the writing process, lack of typing skills. Results of a qualitative

research study found that though teachers' opinions differ on what grade touch-typing is a necessary skill. A significant portion of the teachers surveyed believed that the ability to fluently type influences the quality of student writing when students use technology in the writing process (Poole & Preciado, 2016).

## **Conclusion**

The literature review provides evidence that Visual Rich Technologies (VRT) can support the writing process by providing support for learners and by increasing motivation. There is a gap in the literature about how the creation of multimodal texts can support learners. Further, there is also a lack of published research about how VRT can help students in the planning/pre-writing process. Therefore, this teacher inquiry project sought to examine the influence of visually rich technology on quality of writing skills and student motivation, in visual learners. It also addresses the need for technology throughout the writing process, with an emphasis on pre-writing.

## **Methods**

Teacher inquiry provides opportunities for teachers and teacher candidates to examine their own practice (Currin, 2019) and make sense of their teaching (Cochran-Smith & Lytle, 1999). I (first author) developed this teacher inquiry project from my observations as an undergraduate teacher candidate in my elementary education program. Based on my clinical practice experiences I was curious about why some students did not appear engaged or interested in writing activities. I also was interested in how different activities may increase their motivation as well as their writing skills. Through the literature review, it seems as if Visual Rich Technologies (VRT) have potential to increase students' motivation, and the quality of their writing.

This teacher inquiry examined the following questions:

1. How can I integrate visually rich technology (VRT) and word processing to influence motivation in elementary students with a preferred visual learning modality?
2. How can I integrate visually rich technology (VRT) and word processing to influence writing proficiency in elementary students with a preferred visual learning modality?

## **The Context**

I chose a fifth-grade classroom in an elementary school in an urban setting in the southeastern United States. Over 80 percent of the students in the school qualify for the federal free and/or reduced lunch program and the school receives federal Title I funding, due to the large proportion of students identified as economically disadvantaged. The school serves a diverse range of learners. The classroom teacher of the fifth-grade class had looped with her students from the previous year, meaning that she had been their fourth grade teacher the year before and then moved up to fifth grade to continue teaching the same group of students. Within the classroom, the teacher used a writing workshop model. To begin their writing time each day, the students would gather in front of the smart board and the teacher would present and model a mini lesson. In these lessons, she would teach the students a new writing concept or skill and would then model it for the students by doing her own writing and thinking out loud. Afterward, she would release students to try the concept or skill in their own personal writing. Students were required to plan and compose their writing within “writing notebooks” and to write in pencil. During the weeks of the teacher inquiry, students within the class were receiving instruction from their classroom teacher on writing personal narratives and were practicing techniques relevant to narrative writing. In the classroom my role was to conduct classroom observations, teach a handful of lessons, and support the teacher as part of my clinical experience. This teacher inquiry was an additional set of activities outside of the expectations of the teacher education program.

## **Population and Selection Process**

I obtained parental consent for each child before the project began. There were 14 consent forms returned out of the 22 students in the class. Those 14 students spent 15 minutes and completed the VARK questionnaire--the younger version (Fleming & Mills, 1992). In order to select the two students that would be in the project, I asked the classroom teacher to select two students out of the students that were identified by the VARK Questionnaire as those who prefer visual activities. I asked the teacher to choose 1 student who was progressing towards grade level expectations and one who had not yet met grade level expectations from the previous year. The teacher made selections based on the students' End of Grade test scores from the previous year and current scores on the state-mandated reading comprehension assessment tool. This measure was taken to ensure that the inquiry project stayed true to its goal of examining if VRT may influence the writing proficiency of visual learners who are not excelling in a mainly linguistic writing workshop. Data from Student 1 indicates they have not yet met grade level



expectations for the previous grade and they receive English Learner (EL) services at the school. Data from Student 2 indicates they have met grade level expectations from the previous year and they were progressing towards meeting the expectations in their current grade level. Student 2's primary and only language is English.

### **Data Sources**

The data sources used in this teacher inquiry project include a pre- and post-project questionnaire about motivation and students' performance on the writing activity. These are described in more detail in this section.

**Motivation Questionnaire (Pre- and Post-).** To measure the influence that VRT has on student motivation to write, students completed a 10-item motivation questionnaire before and after the project. Items on the questionnaire included questions concerning if students enjoyed writing (in varied situations), if they believed they write as well as other students, and if they enjoyed drawing pictures when they plan their writing.

**Procedures for Student Writing and Scoring of Writing Samples.** Students also planned/pre-wrote and then composed a piece of narrative writing using handwriting and then using VRT. Both phases of writing, handwritten and VRT, were done using an open-ended prompt and the time offered to students to plan and write for each phase were equivalent. The narrative writing prompts were similar enough to be comparable but were not the same prompt, in order to ensure that the students actually wrote in both phases, rather than copying what they had written in the first phase to write their narrative piece in the second phase. First, the students pre-wrote using a paper graphic organizer and a pencil. They then composed their narrative pieces using paper and pencil. In the second phase, the students pre-wrote using the VRT program, Storyjumper, an online website that allowed the students to create scenes and images as well as text and combine them to compose a storybook. The students then composed their narratives within the Storyjumper online program. To assess pre-writing, I (first author) used a checklist to compare if the quality of each student's planning changed between the use of paper/pencil and VRT. The checklist aligns to grade appropriate expectations of the CCSS. I created it and the second author provided feedback. In order to assess composition of both the handwritten and VRT phases, I created a rubric with support from the second author. I also refined it after further feedback from a literacy education professor. I used the rubric to evaluate each narrative writing piece based on focus/setting, organization/plot, narrative techniques, and language. Each student had the opportunity to score from below grade level to above grade level (on a 4-point scale) on each of these sections. I then compared the overall

score and the score for each section between both the handwritten narrative and the narrative written using VRT.

### **Data Analysis**

I (first author) analyzed each data source by the research questions separately with assistance from the second author. Below we describe the analysis.

**Question One.** Motivational data for research question one were collected using the motivation questionnaire, consisting of ten questions that the students each self-assessed on using a scale of 0-3 to indicate their agreement or disagreement with the statement. Students completed the motivation questionnaire twice, once at the beginning of the project and again at the very end of the project. We calculated the difference between the numerical responses for each item on the pre- and post-motivation questionnaires. Negative numerical values indicate a decline from pre- to post administrations, while positive values indicate an increase in numerical response from pre- to post administrations.

**Question Two.** The writing proficiency data for research question two consisted of data from a checklist that measured pre-writing proficiency for each student as well as data from a rubric that measured composition proficiency for each student. I (first author) examined the 13 statements on the checklist based on students' handwritten pre-writing and visual rich technology pre-writing work samples. For each criteria statement, the work samples received a score of a check (✓) or an (X) to indicate that the student either did or did not meet the requirements of the checklist criteria. To analyze the data, the research entered the check (✓) or (X) scores for each students' handwritten pre-writing and visual rich technology pre-writing work samples, indicating the score for each individual criteria statement. The response scores of a check (✓) or (X) were compared between students' handwritten pre-writing and visual rich technology pre-writing samples. This comparison was made by entering either increase (with a green box), decrease (with a red box), or none in the change row to indicate the change, if any, that happened in the student's pre-writing between the handwritten pre-writing (completed first) and the visually rich technology pre-writing (completed second).

The lead author used a 3-level rubric to score the student work samples. Using the rubric descriptors to measure the two students' composition proficiency for both the handwritten personal narrative and the visually rich technology. The rubric was made up of 4 larger topics: Focus/setting, organization, narrative, and language. Each topic included subtopics (Table 1). During data analysis, I

organized the numerical rubric data into a spreadsheet that records the points given to each criteria descriptor within each of the four sections of the rubric for both students, and for both the handwritten work sample and the visually rich technology work sample. The spreadsheet also records the total composite score for the large section overall, as well as the average composite score of the descriptors in that section. The authors then determined the change between the numerical score on each descriptor for the handwritten pieces and the visually rich technology pieces. The formula subtracted the numerical score of the handwritten (completed first) from the numerical score of the visually rich technology work sample (completed second), to determine if the student scored higher or lower in composition proficiency using the visually rich technology than they did handwriting.

Table 1: Process for Evaluating Writing

<b>Category</b>	<b>Points</b>
	<b>3= Meets Expectations</b>
	<b>2= Partially Meets Expectations</b>
	<b>1= Does Not Yet Meet Expectations</b>
<b>Focus/setting- Prompt</b>	
<b>Focus/setting- Situation/characters</b>	
<b>Organization- Sequence</b>	
<b>Organization- Transitional Words</b>	
<b>Organization- Conclusion</b>	
<b>Narrative- Descriptive</b>	
<b>Narrative- Dialogue</b>	
<b>Narrative- Concrete/Sensory</b>	
<b>Language- Sentences</b>	
<b>Language- Conventions</b>	
<b>Language- Word Choice</b>	

### **Findings**

As a result of this teacher inquiry project, students demonstrated gains in their motivation using the VARK instrument. Also, based on the rubric students' writing samples showed growth from the beginning of the project to the end of the project. Using visual technology increased both motivation and student performance.

### Research Question One: Motivation Questionnaire

Data from the motivation questionnaire indicates that there were changes in students' self-rated scores on several items from the pre- to post questionnaire. In analyzing the data, the researcher found that Student 1 self-rated with exactly the same numerical scores on each question from pre- to post except on one statement, question 2: "I complete a writing assignment even when it is hard." On the pre-questionnaire, student 1 self-rated with a numerical score of 3 (strongly agree), while on the post questionnaire student 1 self-rated with a numerical score of 2 (agree), therefore there was a numerical change of -1 between pre- and post-questionnaire.

Student 2's self-rated pre- and post-motivation questionnaires showed a difference in numerical scores on four statements. On question statement number 3, student 2 self-scored on the pre- questionnaire as a 2 (agree) to a 3 (strongly agree) on the post questionnaire, yielding a change in numerical score of +1. Question number 3 states, "I write as well as other students." The next statement that showed a change in score for student 2 was question 4: "I like to plan before I start a writing assignment." On the pre-questionnaire, the student self-rated as a 3 (strongly agree), while on the post questionnaire the student self-rated at a 2 (agree), yielding a change in score of -1. On question number 5, "I am able to clearly express my ideas in writing," student 2 showed a change of +1 between pre- and post-questionnaires. On the pre- questionnaire, the student self-rated at a 2 (agree) and on the post questionnaire the student self-rated at a 3 (strongly agree).

The last statement that student 2 showed a difference in score on was question number 9, "I enjoy using a computer to complete a writing assignment." On the pre- questionnaire, student 2 self-rated as a 2 (agree) and on the post questionnaire the student self-rated as a 3 (strongly agree), yielding a change in numerical score of +1 from pre- to post. Overall, student 1's self-rated scores yielded differences on just one question from pre- to post and the numerical change in score was a -1. Student 2's total result differences from pre- to post questionnaire yielding one decrease (-1) and three increases (+1).

### Research Question Two: Writing Proficiency: Pre-writing

**Pre-Writing Checklist Data.** The next set of data analyzed in this inquiry project, was the handwritten pre- writing graphic organizer and the VRT pre-writing completed using Storyjumper. Data for the checklist is in Table 2. Each pre-writing sample was assessed with a checklist aligned to the grade appropriate expectations of the CCSS. After the data was analyzed, the data showed that there

were both increases and decreases in the pre-writing proficiency from handwriting to using visually rich technology. A checklist assessment for pre-writing was used to assess whether or not the student's work sample met the grade level expectations. In comparing Student 1's handwritten pre-writing to the visually rich technology pre-writing, the researcher noticed that Student 1's pre-writing showed a decrease in score from handwritten to visually rich technology and three increases. The one decrease in score resulted on criteria statement 2 which states, "Student describes the narrator and/or characters." Therefore, the student was able to meet this criteria on the handwritten pre-writing however was not able to meet the criteria on the VRT pre-writing. The three increases that happened in pre-writing from handwritten to visually Rich technology wear on statements 1, 10, 13 which state respectively, "student planned or imagined at least two different scenes or events," "student planned their characters responses to the situations and events," and "student use the full-time provided for planning this narrative or story." Student 1 was not able to meet these three criteria statements during the handwritten pre-writing; however, the student was able to meet the expectations during the visually rich technology pre-writing.

Next, the data for Student 2 were analyzed to determine the differences between handwriting and VRT pre-writing. The researcher found that the checklist assessments of Student 2's work showed a decrease in 5 areas and an increase in 5 areas when comparing scores from handwriting to VRT. See Table 2.

Table 2: Checklist Data

	S1-Hand	S1-VRT	S1-Change	S2-Hand	S2-VRT	S2-Change
Q1	X	✓	Increase	✓	✓	None
Q2	✓	X	Decrease	X	✓	Increase
Q3	✓	✓	None	✓	X	Decrease
Q4	✓	✓	None	✓	X	Decrease
Q5	✓	✓	None	X	X	None
Q6	X	X	None	X	✓	Increase
Q7	X	X	None	X	✓	Increase
Q8	X	X	None	✓	X	Decrease
Q9	X	X	None	✓	✓	None
Q10	X	✓	Increase	X	✓	Increase
Q11	X	X	None	✓	X	Decrease
Q12	X	X	None	✓	X	Decrease
Q13	X	✓	Increase	X	✓	Increase

### Research Question Two: Writing Proficiency Composition

**Composition Scores.** The two students' composition proficiency for both the handwritten narrative and the VRT narrative was determined using a rubric composed of 4 larger sections: Focus/setting, organization, narrative, and language. The students could score from a 1 (below grade level) up to a 4 (above grade level) on each of the 2-3 descriptors in each of the large sections and then the scores were totaled to create a total composite score for that section as well as an average composite score. The scores were then analyzed to determine if there had been an increase or decrease in score from handwritten narrative to visually rich technology narrative on each descriptor. Table 3 shows the results for this research question.

Table 3: Rubric Data

	<b>S1- hand</b>	<b>S1- vrt</b>	<b>S1- change</b>	<b>S2- hand</b>	<b>S2- vrt</b>	<b>S2- change</b>
focus/setting-prompt	3	3	0	3	3	0
focus/setting-situation/characters	2	3	1	3	3	0
focus/setting-composite (total)	5	6	1	6	6	0
percent composite (total)	<b>83.33%</b>	<b>100.00%</b>	<b>16.67%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>0.00%</b>
focus/setting-composite (avg)	2.5	3	0.5	3	3	0
org- sequence	2	3	1	2	3	1
org- transitional words	2	2	0	2	2	0
org- conclusion	3	1	-2	2	1	-1
org- composite (total)	7	6	-1	6	6	0
percent composite (total)	<b>77.78%</b>	<b>66.67%</b>	<b>-11.11%</b>	<b>66.67%</b>	<b>66.67%</b>	<b>0.00%</b>
org- composite (avg)	2.33	2	-0.33	2	2	0
narrative-describes	3	3	0	2	3	1
narrative-dialogue	2	1	-1	3	3	0
narrative-concrete/sensory	2	2	0	2	2	0
narrative composite (total)	7	6	-1	7	8	1
percent composite (total)	<b>77.78%</b>	<b>66.67%</b>	<b>-11.11%</b>	<b>77.78%</b>	<b>88.89%</b>	<b>11.11%</b>
narrative- composite (avg)	2.33	2	-0.33	2.33	2.67	0.34
language-sentences	1	2	1	1	2	1
language-conventions	1	2	1	2	3	1
language-word choice	1	2	1	2	2	0
language-composite	3	6	3	5	7	2

(total)							
percent (total)	composite	<b>33.33%</b>	<b>66.67%</b>	<b>33.33%</b>	<b>55.56%</b>	<b>77.78%</b>	<b>22.22%</b>
language- (avg)	composite	1	2	1	1.67	2.33	0.66

Figures 1 and 2 provide samples of the handwritten and the VRT produced writing samples for Student 1. Student 1's results showed a decrease in total and average composite score on two of the 4 sections and an increase in total and average composite score on the other two sections. The decreases in scores from handwritten narrative to visually rich technology narrative were in the sections, Organization and Narrative. In the Organization section, Student 1's change in total composite score was a 16.0% increase while the difference between the average composite scores was a -0.33. The Narrative section showed similar results with the total composite score showing a decrease of -11.11%, while the difference between the average composite scores was -0.33. The increase in score from handwritten to VRT occurred in the Focus/Setting and Language sections. In the Focus/Setting Section, the change in total composite score was a 16.67% increase while the difference between the average composite scores was a +0.5. The Language section showed the most significant increase between handwritten and VRT narrative with an increase in total composite score of 33.33% and a difference in average composite scores of +1.

Student 2's results for total and average composite scores all showed either no change or an increase from handwritten narrative to VRT narrative. In the Focus/Setting section there was no increase or decrease neither in the total composite nor in the average composite scores. The Organization section of the rubric also showed no change in the total composite or average composite scores. However, the Narrative and Language sections both saw an increase in total composite and average composite scores between the two versions of the narrative. The Narrative section results showed an increase of 11.11% total composite score between handwritten and VRT as well as a +0.34 increase in average composite score. Lastly, the Language section scores showed an increase in total composite score of 22.22%, and an average composite score difference of +0.66 between the handwritten and VRT narrative versions.



## Discussion

### Question One: Motivation

In this inquiry project, data analysis of the pre- and post-motivation questionnaire indicated that student 1's motivation remained the same on all except one of the motivation questionnaire statements: "I complete a writing assignment even when it is hard." The student self-scored her ability to complete a hard assignment as lower after the project than she did before the project started. This is different from past research in which students were "motivated to engage in their assignment from beginning to end." (Saulsbury, Kilpatrick, Wolbers, & Dostal, 2015, p32).

Student 2's self-rated motivation questionnaire scores indicated that her motivation changed from pre- to post in three positive aspects and one negative aspect. The only statement that she scored herself lower on was, "I like to plan before I start a writing assignment." She therefore indicated that she had less motivation to plan her writing after she had participated in the inquiry project. However, the three positive aspects that she self-rated higher on during the post questions were more like the results seen in previous research studies. The first of the three positive aspects that the student self-rated higher on was, "I write as well as other students." In this statement, the student is showing positive growth in her self-efficacy and belief that she now can write as well as other students that she may compare herself to. The next positive change happened with the statement, "I am able to clearly express my ideas in writing." The student rating herself higher on expressing her ideas in writing after experiencing the visually rich technology. This change is vital to the inquiry project because it highlights improvement in motivation that may also have positive effects on her writing proficiency. The last statement student 2 rated herself higher on was, "I enjoy using a computer to complete a writing assignment." The student's motivation to participate in computer centered writing activities increased after she was given opportunities to interact with the visually rich technology computer program. Through analysis of the data, student 2's overall motivation to compose increased, over the course of the inquiry project while she showed decreased motivation to pre-write.

### Question Two-Part 1: Pre-writing

During analysis of the pre-writing data, which included data from the handwritten and VRT writing samples, as well as the pre-writing checklist used to assess the samples, the results showed more positive outcomes for student 1, as compared to her negative outcomes, than student 2. The pre-writing checklist for

student 1 indicated that during the VRT pre-writing she scored worse only on criteria 2, “student describes the narrator and/or characters.” In the VRT writing sample, the student’s pre-writing showed less skill in introducing the narrator (herself because it is a personal narrative writing task) or the characters using describing words.

However, she showed positive growth using the VRT pre-writing on three other criteria. The first being, “student planned or imagined at least two different scenes or events.” Therefore, the student was better able to plan more than one event in her pre-writing. Though there is little past research to compare the pre-writing results to, the effects on the student’s writing as a result of being able to plan more than one event will be shown in the composition discussion. The second pre-writing criteria that she showed positive results on, as compared to handwriting, was “student planned their character’s responses to the situations and events.” In the VRT pre-writing the student was able to use dialogue in the planning of her story, such as “if we can go ice skating,” and did so using the appropriate quotation marks. The VRT shows her ability to plan what her characters will say and how they will interact to the situations and events in the story. Lastly, Student 1 scored positively on criteria 13 of the pre-writing checklist, which was “student used the full time provided for planning this narrative or story.” This criteria speaks to past research that highlights the high engagement level of students engaged in writing tasks done using VRT. Increased motivation for this student resulted in the student taking the full time allowed to her to continue to interact with the technology and to remain fully dedicated to the task the full time.

Student 2’s pre-writing data showed more variation in score from handwritten pre-writing score to VRT pre-writing score than student 1’s data. During analysis of student 2’s data, the researcher found that the student’s pre-writing scores from handwritten to VRT showed variation on 10 of the 13 criteria on the pre-writing checklist. Though the student struggled on the VRT pre-writing to establish story structure and event details, she improved in describing and providing details about the characters and their responses to situations, including their dialogue. Examples of her characters’ dialogue were “my mom said my cousin could spend the night” and “ouch”. She also provided more in-depth detail about her setting in the VRT pre-writing than in the handwritten pre-writing. This detail could be seen in the picture scenes that the student created as well as in her writing. Her actions are similar that of previous research in which students were “visually mapping out the picture scenes that matched their plot” (Sessions, Kang, and Womack, 2016). Lastly, the student was engaged in the writing task for the full length of time provided to her. This is similar to previous research in which students were “motivated to engage in their assignment from beginning to end” (Saulsburry,

Kilpatrick, Wolbers, & Dostal, 2015, p.32) and showed “increased motivation to participate in writing activities” (Vincent, 2001).

**Qualitative Handwritten Pre-writing.** Student 1 asked the researcher about the “hook” section on the graphic organizer. The researcher said that the hook is “an interesting opening sentence.” However, the student did not show an understanding as her “hook” did not set up her beginning. The student also did not finish her pre-writing graphic organizer during the given time, leaving two middle detail sections and the conclusion section blank. Student 2 asked the researcher what the sensory details section was and what she was supposed to do. The researcher explained to the student that “the sensory details section is where you write words that tell what you saw, heard, touched, smelled, or tasted.” The student then shows in her graphic organizer that she understood the section as she lists sensory details such as “wolfs, tigers” for sight and “clapping” for sound.

**Qualitative VRT Pre-writing.** Observation notes taken of student actions and behaviors exhibited while completing the VRT pre-writing were also collected. Student 1 and student 2 were both allowed to look at the scenes and props in the Storyjumper program before beginning the VRT pre-writing. As seen in previous research, students need time to learn how to use the technology before being expected to use it in their writing process (Mills, 2014). Student 1 took much time at the beginning to pick the images as she looked for images with a higher level of personalization (picking the hair, face, and clothes for the characters) instead of picking pre-made figures. The student created a detailed beginning scene, then deleted it, and began typing her text. Next the student deleted the new text she had typed and began with typing a new story. The student also asked a few questions about the technology (how to delete and image and how to increase the size of a text box. On her own, the student used the method of selecting a word and deleting it all at once for quicker editing. Student 2 took little time to quickly create a beginning scene with images. She managed the functions of the Storyjumper program on her own without asking questions about the technology. The student also positioned the characters and objects in space in specific ways to show action. However, she did ask if she could write a fiction story, and was redirected by the researcher to write a personal narrative. The researcher also reread the prompt to the student.

## **Question Two-Part 2: Composition**

During analysis of the composition data, each of the two students showed very different results from one another in each of the 4 sections that the composition rubric scored. Student 1’s decreases in scores from handwritten narrative to

visually rich technology narrative were in the sections Organization and Narrative. In the Organization section, the student's total composite score decreased by -11.11% and making up that score are the descriptors "sequencing events," "using transitional words," and "providing a conclusion". A lower score on her "sequencing of events" means that the student was less able to, in her VRT narrative, to sequence her events in order, which is contrary to the previous research in which students were more skilled at sequencing their narratives (Sessions, Kang, & Womack, 2016). The other section on the rubric in which student 1's score decreased was the Narrative section, by -11.11% on the total composite score. Within this section are the descriptors "describes actions, thoughts, and feelings," "uses dialogue", and "describes with both concrete and sensory words." Her results in this section are also contrary to past research in which it was found that students using computer technology to create scenes and images to accompany their writing wrote using more sensory details (Sessions, Kang, and Womack, 2016). On the other two sections of the rubric, Focus/Setting and Language, student 1's scores increased. In the Focus/Setting section the student's score increased 16.67 % and the descriptors in the section included "fully responding to the prompt" and "establish a situation and introduce characters." The beginning of the student's story was shown to be more developed, as her middle was missing the necessary sensory details and her ending was not finished. This reflects in her rubric score as the Focus/Setting section is tailored to assess a story's introduction/beginning. The Language section for student 1 showed the highest increase in score on the entire rubric, at 33.33% increase in total composite score. Descriptors for the language section include "correct and varied sentence structures," "appropriate conventions," and "strong, grade level word choice." This is a notable accomplishment for this student as she receives ESL (English as a Second Language) services; however, the language section showed a significantly higher increase in percentage over any other section. The findings for this section align to past research in which students writing using a visually rich technology program showed improvement in the language structures of their writing as became more complex (Vincent, 2001).

While analyzing the findings of Student 2's rubric scores of her handwritten and VRT narratives, the findings showed that the student showed no changes in score on the Focus/Setting and Organization sections; however, the student showed an increase in score on the Narrative and Language sections. The Narrative section showed an 11.11% increase in total composite score and the descriptors for the section are "describes actions, thoughts, and feelings," "uses dialogue", and "describes with both concrete and sensory words." This increase in score aligns with what has been seen in past research in which students are able to write using more sensory details while composing with Visually Rich Technology (Sessions, Kang, and Womack, 2016). The Language section showed the highest increase in

score for student 2 with a 22.22% increase in score of the rubric. The descriptors for this section are “correct and varied sentence structures,” “appropriate conventions,” and “strong, grade level word choice.” The student’s results in this section are in congruence with research conducted by Vincent (2001) that found that students using VRT programs showed increased complexity in the language structure present in their narratives.

**Qualitative Handwritten Composition.** Observation notes taken of student actions and behaviors exhibited while completing the handwritten narrative were also collected. Student 1 appeared less confident in composing her narrative (erasing frequently) than she did while completing her handwritten pre-writing graphic organizer. The student moved her finger along the page as though reading over her work during the process of writing, and then continued to write further. Student 1 took the full time to write. Student 2 wrote quickly and appeared confident, as she erased very little. The student finished early and did not want to continue writing. The student used her second sheet of notebook paper to begin drawing a picture to go along with the narrative she had written.

**Qualitative VRT Composition.** Observation notes taken of student actions and behaviors exhibited while completing the VRT narrative were also collected. Both students 1 and 2 began creating images with scenes with images and props right away. Student 1 changed the first scene after a few minutes and then began creating something new. This student showed skill in editing during the writing process as she looked over a scene and text, and then went back and made changes. Student 2 asked a technology question about how to find the undo button and the researcher pointed to undo button on the scene out to the student. Once student 2 had created her images and scenes for each slide, she moved onto the next, without going back to edit or revise during the process. For a brief moment, the two students looked at each other’s stories, showing interest in the scenes that the other had made. The writing process became more social when they were viewing the images created by another person.

### **Limitations and Future Directions**

The researcher found through observations, notes, and reflection that the inquiry project had some limitations. The first and most obvious limitation was time. There were occasions in which the student was not able to fully take advantage of the time provided because of technological issues (slow computers). Another element of the time limitation was that the students were still required to sit for their writing mini lesson during class before being released to participate in the inquiry project each visit, cutting the writing time from 45 minutes down to 35-

30 minutes. Future studies are needed to examine how to make the writing process more efficient, or conduct studies in which there is less of a time constraint.

The second limitation is the number of participants since only two students participated in the inquiry project. Due to this very small research population, the findings may not be used to make a causal relationship between VRT and increased motivation or writing proficiency. Future studies should examine more participants and expand to include more grade levels. Further, there is a need for research to include visual learners as well as others based on the VARK data.

Further, there is a need for subsequent inquiry projects that look at how VRT can influence motivation and writing proficiency across all of the stages of the entire writing process. In this inquiry project, we only collected data for pre-writing and composing, and not the editing and revising processes. The publication step in the process is another area of VRT and the writing process that people should explore further. This inquiry project was not able to explore how VRT affects the publication process or how it could increase motivation to publish.

**Recommendations for Practice.** From the findings and observations made during this inquiry project, we would recommend that educators of elementary age students take into consideration individual characteristics of each student. One of these characteristics would include which modality in which it is most effective for each student to receive information and create products. Providing opportunities for students to learn and be assessed in their preferred modality may be a solution to differentiating within the classroom. Rather than attempting to provide extra instruction to students that have been unsuccessful in mastering a standard taught and assessed in a one-size fits all manner, teachers may try pre-planning in this differentiated manner to meet the needs of individual learners during instruction and assessment.

**Recommendations for Teacher Candidates and Teachers to Engage in Inquiry.** As Dana (2015) writes:

teacher inquiry is a continual cycle that all educators spiral through throughout their professional lifetimes—a professional positioning or stance, owned by the teacher, where questioning, systematically studying, and subsequently improving one’s own practice becomes a necessary and natural part of a teacher’s work. (pp. 163-164).

Through continuous improvement and data-based decision making, the inquiry process should be a natural part of teachers’ and teacher candidates’ work.

Engaging in these processes benefits their students, and helps to contribute to the development as a future and beginning teacher in many ways. As a teacher candidate, I (first author) learned a lot about the inquiry process, especially ways to think about an issue, brainstorm an educational idea and collect data about it. Two years later now as a teacher I still engage in mini inquiry projects as I consider how to meet the academic, developmental, and social needs of all of my students. The whole process of teacher inquiry. Honestly, I (first author) felt challenges thinking about how to approach a teacher with my idea and the desire to do inquiry in an activity that involved students. For this inquiry project, the second author initiated conversation with the clinical educator, since she was a former teacher candidate in the program and they had an existing relationship.

As a faculty member who mentors teacher candidates in teacher inquiry and action research projects, I (second author) have seen the inquiry process pay countless dividends in the development of teacher candidates. There is an adjustment period for many as they think about how to systematically plan, develop, and design what they would like to do to improve some aspect of teaching and learning. For others the process of writing the formal paper can also be intimidating. The work and involvement of a faculty mentor to invest in providing candidates with support in those areas is invaluable. Further, this work shows that teacher candidates can publish and disseminate high quality studies. Teacher candidates have published journal articles about their action research and inquiry projects focused on technology and learning (Urbina & Polly, 2017), international comparative studies (Polly & Breindel, 2015), and how this work can develop leadership skills in teacher candidates and graduate students (Polly et al., 2020). At our university, we have a core group of faculty who do this work often, and have collaborated to share ideas, resources, and provide support during the process.

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