TEACHING KINDERGARTEN SCIENCE USING AN INTERACTIVE WHITEBOARD: FRIEND OR FOE TO STUDENT LEARNING?

by

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of the requirements for the degree

of

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in

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In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This project compared teaching two science units. A weather unit was without the treatment, while the Earth and Sky unit was taught with a treatment incorporating an interactive whiteboard to display and provide student/teacher interaction(s) with educational video clips, web sites, simulations, images, and students' writing and illustrations. Data collection methods included whole group pre-, post-, and six week follow up KWL chart, teacher journal, and a student survey.

INTRODUCTION AND BACKGROUND

Project Background

I teach kindergarten at K. William Harvey Elementary School on the Flathead Reservation in Ronan, Montana. There are currently 373 students in our school kindergarten through fourth grade. Our ethnic diversity is approximately 60% Native American, 37% Caucasian, and 3% other ethnic groups (Ronan School District, 2013). Excessive tardiness and absences are common place, with a school wide attendance rate of 89% for the 2012-2013 from August 29, 2012 through May, 16, 2013 (Ronan School District, 2013). The Free and Reduced Lunch rate is approximately 72%, with the average household in Ronan making $28,355 dollars per year (City-Data, 2009). Sadly, poverty is a way of life for many students at our school. They often do not know where they will be sleeping each night or when they will be eating their next meal. Teaching and learning is a difficult task in the best of circumstances, however the struggles poverty creates only compounds the challenges students and teachers face in our district.

Two years ago the school district purchased interactive whiteboards (IWB), specifically Promethean boards, for every K-12 classroom in our district. In an era of reduced federal and state funding for public schools, this expense was an enormous undertaking with a high expectation of increased student achievement after its implementation. Having an extensive technology background, I was chosen by my administrator to be a teacher trainer to assist colleagues in the implementation of the IWB into their classroom instruction. I currently use the IWB in all areas of my teaching, and have found that my students are eager to learn and interact with this technology.

However, other than personal observation, I currently lacked data to share with my colleagues exactly how much, and to what effect the IWB's use is impacting the learning and achievement of the students in my classroom. I extensively use the IWB to integrate educational videos, images and web-sites into my science instruction, and chose to conduct my classroom based research project to collect data and determine how it is impacting the short and long term retention of knowledge of the kindergarten students in my class.

CONCEPTUAL FRAMEWORK

The interactive whiteboard is a large interactive multimedia whiteboard typically mounted to a wall or floor stand. Connected to a computer and projector, the computer's desktop screen is projected onto the board, which can then be manipulated by touching, or interacting with the board. When introduced in 1991, the IWB was originally designed for use in the business world (Greiffenhagen, 2002).

As educators and researchers explore the educational value and benefits this technology brings into the classroom, there is a general positive consensus for its use in an educational setting. In the past, whole class teaching with technology most often involved the use of a computer for demonstration with little manipulation or hands on interaction by students (Hennessy, Deaney, Ruthven, & Winterbottom, 2007; Rogers & Finlayson, 2004). A valuable benefit of an IWB is its interactive nature. It provides a new medium for tech-savvy teachers and students to write, draw, and manipulate ideas and knowledge while allowing spontaneity and flexibility during instruction (Cowie & Ryan, 2009; Kennewell & Beauchamp, 2007).

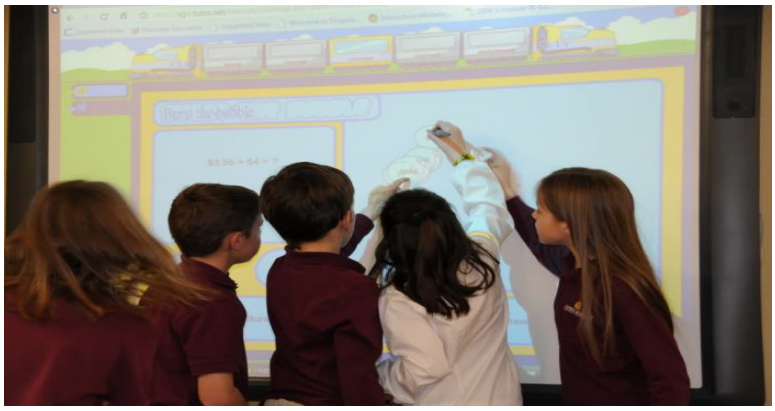


Figure 1. Students learning with an interactive whiteboard.

Another strong argument for classroom implementation of the IWB is the increased motivation and interactivity, which go hand in hand during its use. Teachers and students both report positive motivation during the use of the IWB in classroom instruction. Student motivation and enthusiasm for learning has been found to increase when IWBs are used during classroom instruction (Smith, Higgins, Wall & Miller, 2005; Hodge & Anderson, 2007). Research conducted by Hennessy and colleagues (2007) and Murcia (2008) found teachers were able to take advantage of the dynamic and manipulative functions of the technology to "focus thinking on key scientific concepts and processes, to unpack, explain and organically build them up and to negotiate new, shared understandings" (Murcia, 2008, p. 297).

Appropriate instructional pedagogy while using the IWB is a valid concern. As described by Haldane (2005) the IWB is not interactive itself, but the user and the way it is used determines its effectiveness. The ability of the teacher to structure a fluid learning environment is of most importance. The capability of teachers to organize lessons, scaffold learning, and integrate text with visually appealing images, videos and other technological media supports arguments for the use of IWB in the classroom (Murcia & Sheffield, 2010; Hodge & Anderson, 2007, Gerard, Widener, Greene, 1999; Smith et al.,

2005). Although some evidence suggests that organization and execution of lessons is assisted by the use of IWB (Hodge & Anderson, 2007), others caution that the interaction during whole group instruction can actually slow down the pace of learning and create boredom for students (Smith 2001; Smith et al., 2005).

While there is an overall general positive regard for the implementation of the IWB, the fact remains that there is currently a tremendous lack of evidence to show what effect it is having on achievement, if any. Are students learning and retaining information, or are they simply being entertained without being asked to take in new information, process it, and solve problems in unique and meaningful ways? These questions led me to conduct my own classroom based research project. I focused my research to answer the following questions: *How does integrating an IWB with traditional instructional methods affect students' content knowledge in science?* and *How does integrating an IWB with traditional instructional methods affect students' long term retention of science content knowledge?*

METHODOLOGY

This classroom based research project included 20 kindergarten students, 13 boys and 7 girls, learning 2 science units, Weather and Earth and Sky. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained. A non-treatment science unit was taught on weather and a treatment science unit was taught on the Earth and sky. Each unit was taught for ten days, a common standard for early childhood science instruction. This project was conducted during severe outbreaks of Influenza A and B, so 100% attendance of all 20 students was not

achieved during the 20 days of instruction and follow-up data collections. In order for a student to be eligible for inclusion in this study, students could miss no more than four days during the 20 days of instruction and must have been present for all data collections. This resulted in seven girls and 11 boys, or 18 of the 20 eligible students participating in this study.

The Earth and Sky treatment unit was taught integrating the use of an IWB to display or provide student and teacher interaction(s) with the following: educational video clips, web-sites, iPad apps, simulations, educational games, IWB flip charts, vocabulary words, pictures, and students' writing and illustrations. The Weather unit was taught without the treatment. For each new concept or vocabulary word in the treatment unit, I incorporated an educational video that enhanced the concept or vocabulary being taught. Educational videos ranged from songs and animations to real-life space explorations and images. I then incorporated websites, simulations, educational games, iPad apps, and students' writing and illustrations to enhance students' learning. To assess the impacts of the educational media and the use of the IWB compared to traditional instructional methods which included read aloud books, experiments, and discussions, I used a Know, Want to Know, and Learned (KWL) background knowledge probe to compare pre, post, and six week follow-up data, a teacher journal, student science journals with one on one conferencing, and a student survey.

I modified a KWL chart to create my own KWL Assessment. This assessment allowed me to document students' comments pre, post, and six weeks following each unit's completion (Appendices A & D). A Likert scale (Table 1) was used to score students' knowledge on 11 different science concepts in each unit. Scores ranged from

zero to four, and a total of 44 points could be earned for each KWL assessment. The pre, post, and six week follow up scores were analyzed and then compared to evaluate the non treatment and treatment units' instructional effectiveness and students' long term retention of concepts.

Table 1
Weather & Earth and Sky KWL Rubric Scoring Assessment

Rubric Score	Science Concept Descriptions
0	Not mentioned
1	Concept brought up without valid supporting details and explanations
2	Concept discussed with good supporting details and explanations, some misconceptions present
3	Concept discussed with good supporting details and explanations
4	Concept was thoroughly discussed with detailed elaborations and examples

To start each unit's instruction, I used the *Think, Pair, Share* model of questioning. In a whole group setting, students were first asked to *think* quietly about what they know about weather or about the Earth and stars, depending on the unit I was teaching. Next, students were told to *pair* up and share what they know with the friends sitting around them. Finally, students could raise their hands to *share* their knowledge with the entire group. By using this strategy, students were allowed ample time to think and discuss the topic without feeling singled out or put on the spot. As students volunteered their knowledge, I wrote down their comments on the *KWL* Assessment. This section of the assessment provided valuable insight into students' knowledge and misconceptions, and helped to guide my instruction throughout each unit.

At the completion of both units, I again followed the same *Think, Pair, Share* protocol to complete the Post Unit *Know* section of the KWL Assessment, writing down students' responses. Six weeks after the completion of each unit, I then completed the final section, *6 Week Follow-Up Know* section. Using a rubric (Table 2) for each unit, I

was then able to compare pre and post unit knowledge, along with comparing the retention of knowledge six weeks after each unit's completion (Appendices B & E).

Science journals, in conjunction with individual student conferences, were used multiple times during each unit's instruction to check for individual student understanding or misconceptions of the new science concepts and vocabulary being taught. Students in kindergarten are moving through several different developmental writing phases as the year progresses. Kindergarten writing can range from scribbles or pictures, to simple sentences (Figure 2).

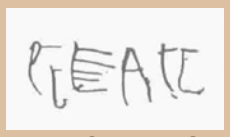
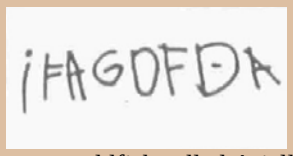
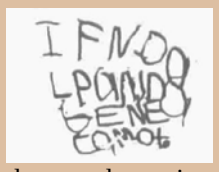
	Level 1: Emerging/Scribble
 The flower is growing.	Level 2: Pictorial
 There are webs in Spidertown.	Level 3: Precommunicative
 I have a goldfish called Arielle.	Level 4: Semiphonetic
 I found a lamp and a genie came out.	Level 5: Phonetic

Figure 2. Developmental writing stages in kindergarten.

An example of a student's Earth and Sky unit journal entry is included in Figure 3.

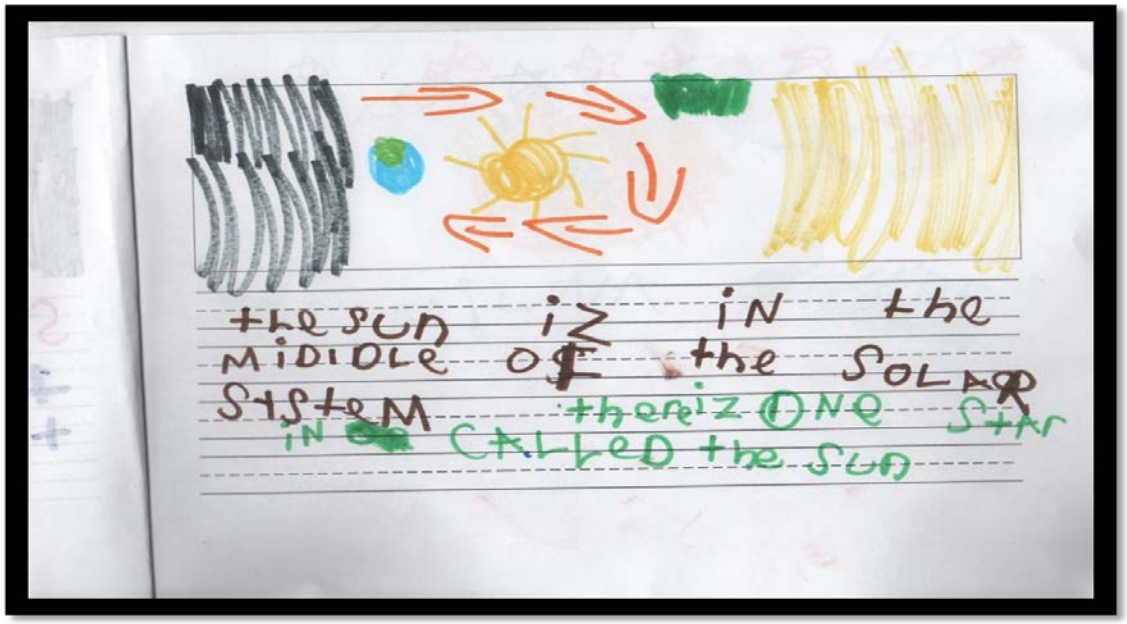


Figure 3. Student earth and sky unit journal entry.

Conferencing with students about their writing ensured an accurate assessment of their understanding, while providing another opportunity to re-teach any misconceptions or deepen current knowledge. A Weather Student Journaling Rubric and an Earth and Sky Student Journaling Rubric were used to score each student individually on each science concept (Appendices C & F). Each concept was scored two ways. The first score was on the student's writing and drawing while the second score was his or her ability to verbally discuss his or her understanding of the concept. A Likert scale (Table 2) was used to assess each student and assign a score to students' content knowledge. Scores ranged from zero to three, with the potential for six points to be earned for each concept. Scores were used to assess student's understanding of concepts and guide further instruction throughout each unit.

Table 2
Student Journaling Rubric

Scoring Rubric	Written Score	Verbal Score
0	Did not draw/write about concept	Was not able to talk about concept
1	Drew some illustrations/words of concept	Had some understanding of concept, but had no examples or supporting details to explain thinking
2	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Had a clear understanding of concept and used good examples and or supporting details, but had some misconceptions
3	Illustrations/words clearly showed understanding of concept	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking

Upon completion of both units, the How I Like to Learn Science Student Survey was administered during small group work to determine which learning methods students preferred to learn science (Appendix G). To accommodate the needs of young learners who are not able to proficiently read and write yet, students were asked to cut and paste pictures onto their survey paper to show their three favorite ways to learn science. Students had a wide range of choices which included singing songs, interacting with the IWB, writing and drawing in a science journal, listening to a book read aloud, doing experiments, and discussions with peers and teachers. Students' top three selections were tallied and compared to see how students preferred to learn science, and then used in the analysis and interpretation sections of this study.

A teacher journal was used to provide a detailed documentation of each day's instructional methods, group discussions, and observations of student's learning. This documentation was used to guide instruction, along with providing a comprehensive look

back at instructional methods, misconceptions, and student/teacher dialogue. It was used to help analyze data and provide insight into the learning that took place during the study. Using the triangulation matrix (Table 3), I was able to compare the collected data.

Table 3
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Primary Question: 1. How does integrating an IWB with traditional instructional methods affect students' content knowledge in science?	KWL Assessment used pre, post and 6 weeks after unit completion	Student science journals with 1-1 teacher/student conferencing	*How I Like to Learn Science Student Survey*	Teacher Journal
Secondary Question: 2. How does integrating an IWB with traditional instructional methods affect students' long term retention of science content knowledge?	KWL Assessment used pre, post and 6 weeks after unit completion	Student science journals with 1-1 teacher/student conferencing	*How I Like to Learn Science Student Survey*	Teacher Journal

DATA AND ANALYSIS

The non-treatment Weather KWL Rubric Assessment scores showed an initial increase of 87% from the Weather Pre KWL Rubric Assessment to the Post Weather KWL Rubric Assessment, while a decrease of 17% occurred from the Post Weather KWL Rubric Assessment to the Weather Six Week Follow Up KWL Rubric Assessment *(*N = 18*)* (Figure 4). During each assessment, students were asked to share what they knew about the weather. Although students have had numerous personal experiences with all aspects of weather, such as hot sunny days, observation of clouds in the sky, and different forms of precipitation such as rain and snow, students' responses initially

showed that they had little understanding of how the Sun creates all forms of weather and the water cycle, compared to comments upon completion of the unit.

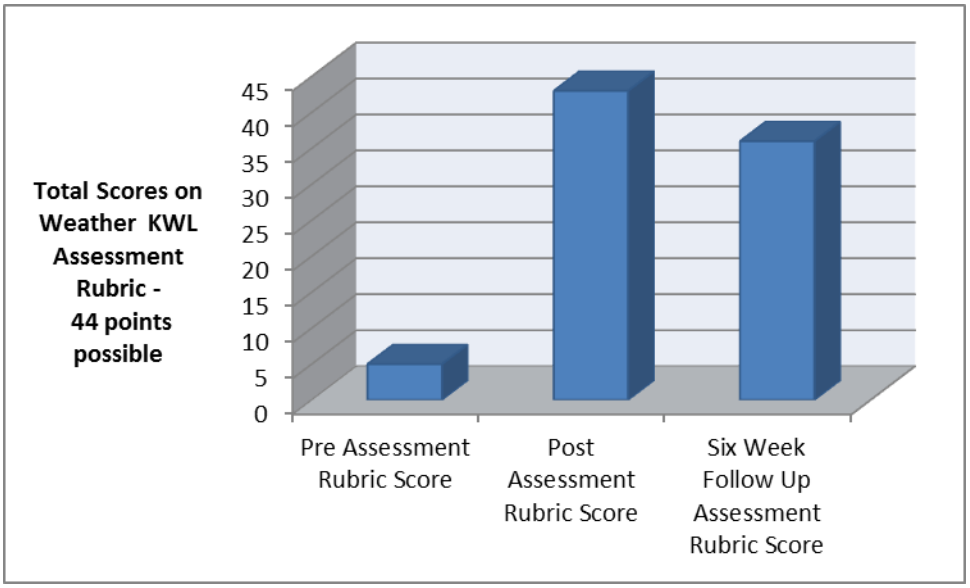


Figure 4. Weather KWL assessment rubric scores, (*N*=18).

During the Weather Pre KWL assessment one student commented, “Mother Nature changes the weather, she’s like a guardian spirit.” Another student commented, “If you see black on the clouds it can rain.” Several students made the connection between weather and the seasons as a cycle. One student commented, “It’s a pattern: winter, spring, summer, fall.”

The Post Weather KWL assessment scored 98%, resulting in an 87% increase in content knowledge compared to the Pre Weather KWL assessment. During this assessment students were able to accurately draw and explain how the Sun makes the weather and describe in great detail how the water cycle contributes to the weather we experience on Earth (Figure 5). When I asked students what they knew about the weather, students suggested that they draw a water cycle on the whiteboard, and that the Sun should go first. Students’ comments ranged from “The Sun makes the weather.”

and “The Sun heats up the water (from puddles and oceans) and it rises” to comments like “Water goes up into the sky and forms a cloud.” Students also stated the following about condensation “Water and dirt comes together to make clouds.” When students were asked to share what they knew about precipitation they said, “The cloud is too heavy, too much water and it rains.” “Graupel is snowballs falling from the sky.” and “Sometimes it snows because the thermometer is below 32 degrees.”

Figure 5. KWL post weather assessment.

The Six Week Follow Up Weather KWL Assessment Rubric resulted in a 17% decrease in science content knowledge and details regarding the weather content assessed. Scores showed that students retained a solid understanding of how the Sun creates the weather and water cycle; however scores revealed that they did not elaborate on the details of the water cycle compared to the Post Weather KWL Assessment Rubric.

The treatment unit Earth and Sky KWL Rubric Assessment scores showed an initial increase of 77% from the Earth and Sky Pre KWL Rubric Assessment to the Post Weather KWL Rubric Assessment, with an additional 17% increase occurring during the Earth and Sky Six Week Follow Up KWL Rubric Assessment, resulting in a final score

of 98% compared to the initial 4% (N = 18) (Figure 6). During each assessment, students were asked to share what they knew about the Earth and the sky. Although students have had numerous personal experiences living on the Earth and observing the sky, scores revealed that students' initially had little understanding of what makes day and night, the orbit of the earth around the Sun, the difference between shooting stars and actual stars, and the composition of the Sun, compared to comments upon completion of the unit.

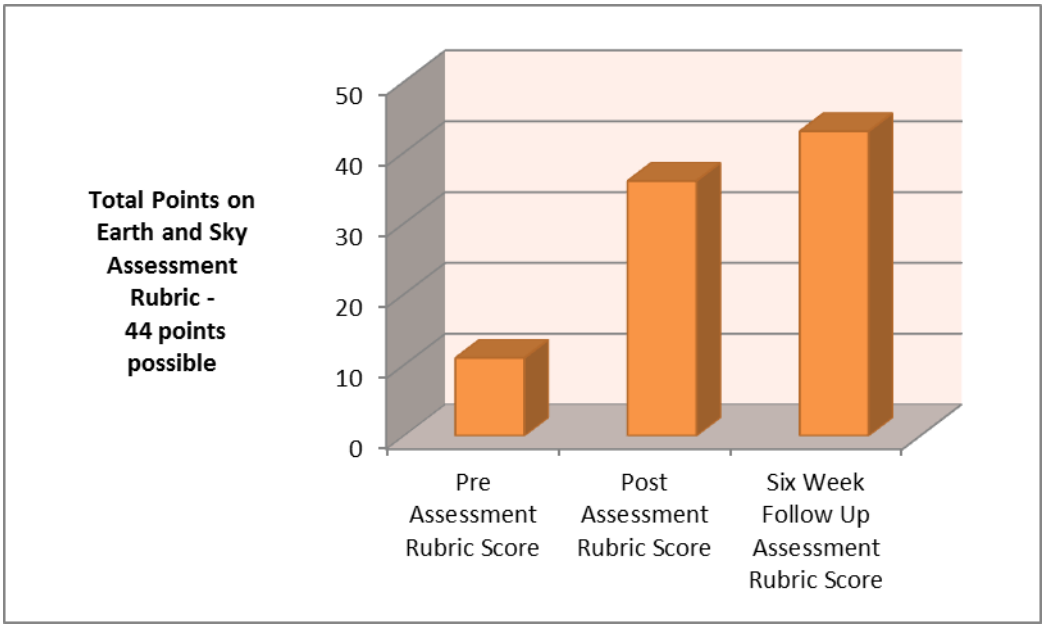


Figure 6. Earth and sky KWL assessment rubric scores, (*N*=18).

During the Pre Earth and Sky KWL Assessment students made the following comments: "The Earth is a big rock. It is colorful," "The Moon goes up at bedtime, and the Sun goes down," "The *Sun* goes around the *earth*," "One of the stars is a Sun," "The Moon can make the stars shine," and "Stars shoot out and you can make a wish."

During the Post Earth and Sky KWL Assessment students scored an 81%, resulting in a 77% increase in content knowledge compared to the Pre Earth and Sky KWL assessment. During this assessment students were able to accurately explain how

the Sun is in the center of our solar system and everything, including the Earth, orbits around it, the Earth spins to create day and night, stars are made of hot gasses and we have one star, named the Sun, in our solar system. When I asked students what they knew about the Earth and sky, students had the following comments: "All the planets go around the Sun," "The Earth is small and the Sun is bigger than planet Earth," "The Earth has more water and a little land, and it's a circle," "You can see the Moon in the day time, and you can't see the Sun in the night time," "The Earth spins fast like a Bey Blade, but it doesn't slow down like one," and " There is one star in our solar system and it's made out of gas that's on fire, like the gas that you put in balloons."

The Six Week Follow Up Earth and Sky KWL Assessment Rubric resulted in an additional increase of 17% in science content knowledge and details regarding the Earth and sky content assessed. Scores revealed that students retained a solid understanding of the Earth and sky concepts and were able to provide additional elaboration and in depth comments of science content compared to those during the Post Earth and Sky KWL Assessment Rubric. When students were asked to share what they knew about the Earth, their comments included the following: "The Earth rotates, it turns and doesn't stop," "It goes the same speed," "One side is dark and one side is sunny," "The Earth orbits, circles the Sun," "The Earth is tipped," "The tilt creates the weather," "If the Earth is straight up and down it would cause a flood." When I questioned the student further about why there would be a flood, she stated, "The Sun can shine on the North Pole, and it is hot, the snow would melt and cause a flood." Another student commented, "Seasons are a gradual change. If straight [no tilt on the Earth] we would be stuck in one season." When asked about the stars, students had the following comments: "Stars are different

colors and red stars, like Betelgeuse are ready to die," "Stars are made out of hot gasses," "Shooting stars are asteroids," "Shooting stars go fast. Some are big and some are little."

The How I Like To Learn Science Survey revealed that 32% of students preferred to learn science content using an IWB, compared to other learning methods (N= 54) (Figure 7). Writing and drawing in journals was the second preferred learning method, while singing songs and conducting experiments tied for third.

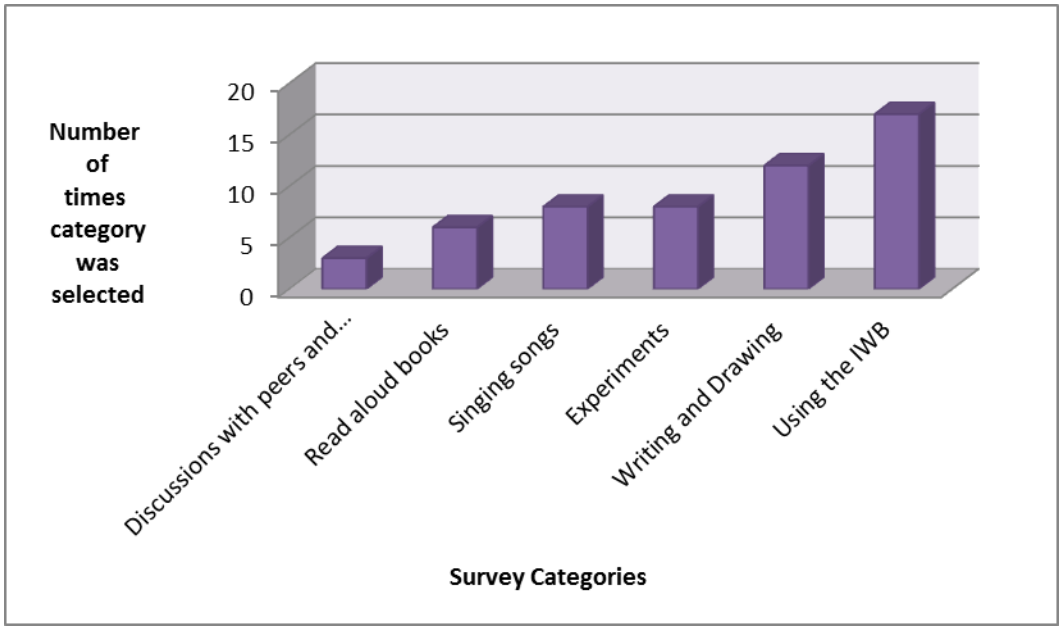


Figure 7. How I like to learn science student survey results, (*N*=18).

INTERPRETATION AND CONCLUSION

This study was examining the effects of IWB use on student content knowledge and retention. While the post assessment of content knowledge scores for both the treatment and control units increased similarly, the six week follow up scores indicate that student retention was greater for the treatment unit. The differences between the treatment and non-treatment unit's Post and Six Week KWL Assessments were surprising. The Six Week KWL assessment was focused on analyzing the long-term

retention of the science concepts taught; however the 17% increase in the treatment unit's scores was unexpected. My goal was to simply maintain retention at the same level as in the Post KWL Assessments. So now the pertinent questions became: Why did the treatment scores go up?, What factors contributed to this increase?, and Can this research be replicated?

When I reflect on the learning that took place and the enthusiasm for the content, the results were not as surprising as they first seemed. Students were extremely interested in the content and posed valid and thoughtful questions as they attempted to assimilate their new learning within their current schema. Their curiosity and questions continued to resurface, even after our unit instruction was complete. Each day during our calendar time, we continued to talk about the weather on Earth and how the Earth's tilt and orbit around the Sun creates a gradual changing of the seasons. While the weather concepts were also discussed each day, students exhibited more interest in the science content of the Earth and Sky unit then the Weather unit. Students' continued interest in the Earth and Sky science concepts can help to potentially explain the increase in the treatment unit's score increase.

In addition to student curiosity, the order in which the units were taught and the time of year this research was conducted could have also aided in the increased retention for the Earth and Sky treatment unit. The Weather unit was taught first, and its six week follow up was administered just prior to the beginning of the Earth and Sky unit's instruction. With the Weather unit's science content as background knowledge, and the understanding that the Sun creates the weather, students were able to scaffold their learning and develop a thoughtful and elaborate understanding of the effects the Earth's

orbit around the Sun has on the Earth. Had an additional assessment been done on the Weather unit after the Earth and Sky unit, the results may have been quite different.

Along with an increase in the scores of the relationship between the Sun and the Earth, students also exhibited more elaboration in content regarding stars in the Six Week KWL Assessment compared to the Post KWL Assessment. Students were able to easily explain why stars were different colors and used Betelgeuse as an example of the life cycle of stars. One student stated, "The stars are different colors and red stars, like Betelgeuse are ready to die." Although this specific content was not continued in our daily discussions, the scores of this content showed a similar increase as did other Earth and Sky content that had continued daily discussion upon completion of the unit. I am not able to definitively identify the factors that resulted in this increase; however with 64% of the science concepts in the Six Week KWL Assessment showing an increase in scores, the instructional methods used in the treatment unit could be a possible explanation for the increase.

Finally, there is a correlation between the increase in student retention and the use of educational videos and the IWB. The informative and engaging videos created a highly productive and motivated learning environment. Students were highly engaged during this unit's instruction that continued well after the unit's completion. The How I Like To Learn Science student survey revealed the IWB as students' favorite instructional method to learn science content. In addition, research conducted by Smith and colleagues (2005), suggests that motivation and learning increased when an IWB was used. Drawing on the last 14 years of my teaching experience, I can validate the statement that students are more engaged when effective instruction is being used in combination with an IWB,

compared to traditional methods of instruction. For the last three years I have used videos and the interactive ability of the IWB to instruct students on key science concepts. The learning and discussions that have taken place have transformed the way I deliver content to enable students learn and understand science content. While science instruction tends to take a back seat to reading and math in the primary classroom, when science content is effectively integrated into reading and math instruction, the depth of knowledge and students' ability to elaborate, discuss, and make connections to real world situations around them significantly increases, which was corroborated in the treatment unit results.

VALUE

Overall, this was a challenging but rewarding experience. It brought a surprising validation to the teaching methods I have been working hard to achieve over the last three years. While science is not routinely tested in kindergarten, I feel that it is important to critique my own instruction to ensure that students continue to receive meaningful and effective science instruction. I believe that learning science is all about making connections to the world around you. Regardless of age, when students are presented with motivating, engaging and authentic science content that enables them to relate and make connections to the world around them, the sky's the limit to the learning that can occur. Unfortunately, kindergarten students are often underestimated because of their young age and the difficulty in creating accurate, easily administered standardized testing. However, I stand firm in the belief that all children, young or old, can achieve great things with great teaching.

Participating in the Big Sky Science Partnership (BSSP) and the MSSE program was one of the hardest, but most rewarding experiences I have had in my career as a teacher. As a student, I acquired valuable science content knowledge while learning top notch science instructional methods. This learning combination inspired me to create my own classroom curriculum and learning environment where the science content students experience everyday no longer becomes a mystery, but a place where students can see patterns, make connections, and begin to develop an understanding of the world around them.

Although I am officially done with this classroom based research project, the BSSP and the MSSE program, I plan to carry out similar, but less formal evaluations over the next several years as I teach the same units to compare my instructional methods and student achievement. For me this end is just the beginning to many more years of learning, teaching and changing the future, one student at a time.

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APPENDICES

APPENDIX A

WEATHER KWL ASSESSMENT

Know Pre Unit Instruction	Know Post Unit Instruction	Know Six Week's Following Unit Instruction

APPENDIX B

WEATHER PRE, POST, & 6 WEEK KWL ASSESSMENT RUBRIC

Science Concept	0 – Not mentioned	1 – Concept brought up without valid supporting details and explanations	2 – Concept discussed with good supporting details and explanations, some misconceptions present	3 – Concept discussed with good supporting details and explanations	4- Concept was thoroughly discussed with detailed elaborations and examples
The Sun makes the weather.					
Condensation – water vapor/droplets coming together to form clouds					
Evaporation – water being warmed by the Sun into water vapor/water droplets					
Precipitation – water falling from the clouds in the form of rain, snow, hail, sleet, graupel					
Water vapor - tiny droplets of water almost invisible to the eye					
3 components of a					

simple water cycle: evaporation, condensation, precipitation					
Clouds are made of water					
Precipitation falls from the sky when the water is too heavy to remain in the cloud					
Precipitation is rain, snow, hail, sleet and graupel					
Water freezes at 32 degrees/ Snow and ice melts above 32 degrees					
Warm air/water vapor, rises					
Total Scores					

APPENDIX C

WEATHER SCIENCE JOURNAL AND 1-1 CONFERENCING RUBRIC

Concept: The Sun makes the weather.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Condensation – water droplets / vapor coming together to make clouds	0	1	2	3	Score
Writing/drawing	Did not	Drew some	Illustrations/words	Illustrations/words	

	draw/write about concept	Illustrations/words of concept	clearly showed understanding of concept, but had some misconceptions	clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Evaporation – water being warmed by the Sun into water vapor	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some	Illustrations/words clearly showed understanding of concept	

			misconceptions		
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Precipitation – water falling from the clouds in the form of rain, snow, sleet, hail, or graupel	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk	Had some understanding of	Had a clear understanding of	Had a solid understanding of	

	about concept	concept, but had no examples or supporting details to explain thinking	concept and used good examples and/or supporting details, but had some misconceptions	concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Water vapor is tiny droplets of water almost invisible to the eye	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had	Had a solid understanding of concept and used good examples and/or supporting details to explain	

			some misconceptions	thinking	
Total Combined Score					

Concept: 3 components of a water cycle, evaporation, condensation, precipitation	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Clouds are made of water	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Precipitation falls from the sky when it becomes too heavy to remain in the	0	1	2	3	Score

cloud					
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Precipitation is rain, snow, hail, sleet and graupel	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some	Illustrations/words clearly showed understanding of concept	

			misconceptions		
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: Water freezes at 32 degrees/ snow and ice melts above 32 degrees	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or	Had a clear understanding of concept and used good examples	Had a solid understanding of concept and used good examples	

		supporting details to explain thinking	and/or supporting details, but had some misconceptions	and/or supporting details to explain thinking	
Total Combined Score					

Concept: Warm air/water vapor rises	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

APPENDIX D

EARTH AND SKY KWL ASSESSMENT

Know Pre Unit Instruction	Know Post Unit Instruction	Know Six Week's Following Unit Instruction

APPENDIX E

EARTH AND SKY PRE, POST, & 6 WEEK KWL CHART

Concept	0 – Not mentioned	1 – Concept brought up without valid supporting details and explanations	2 – Concept discussed with good supporting details and explanations, some misconceptions present	3-Concept discussed with good supporting details and explanations
Earth is a planet in our solar system				
Earth is round/sphere				
¾ of the Earth's surface is water – more water than land				
Earth spins to make day and night				
Earth spins at the same speed				
Earth travels around the Sun				
The Sun is our daytime star				
Our Sun is the only star in our solar system, but there are more than we can count				

in the Milky Way Galaxy				
Our Sun appears large, but is not the largest star in our galaxy				
The Sun is very hot				
The Sun is made of hot gasses				
Total Scores				

APPENDIX F

EARTH AND SKY SCIENCE JOURNAL AND 1-1 CONFERENCING RUBRIC

Concept: Earth is a planet in our solar system	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Earth is round/sphere.	0	1	2	3	Score
Writing/drawing	Did not draw/write about	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of	Illustrations/words clearly showed understanding of	

	concept		concept, but had some misconceptions	concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: ¾ of the Earth's surface is covered by water – more water than land	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal	Was not	Had some	Had a clear	Had a solid	

conferencing	able to talk about concept	understanding of concept, but had no examples or supporting details to explain thinking	understanding of concept and used good examples and/or supporting details, but had some misconceptions	understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Earth spins to make day and night.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	

Total Combined Score					

Concept: Earth spins at a constant speed.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Earth travels around the Sun.	0	1	2	3	Score

Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Sun is our daytime star.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk	Had some understanding of	Had a clear understanding of	Had a solid understanding of	

	about concept	concept, but had no examples or supporting details to explain thinking	concept and used good examples and/or supporting details, but had some misconceptions	concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Sun is the only star in our solar system, but there are more than we can count in the Milky Way Galaxy	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or	Had a clear understanding of concept and used good examples	Had a solid understanding of concept and used good examples	

		supporting details to explain thinking	and/or supporting details, but had some misconceptions	and/or supporting details to explain thinking	
Total Combined Score					
Concept: Our Sun appears large, but is not the largest star in our galaxy	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

Concept: The Sun is hot.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had misconceptions	Illustrations/words clearly showed understanding of concept	
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

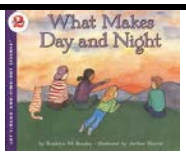
Concept: The Sun is made of burning gasses and is not solid.	0	1	2	3	Score
Writing/drawing	Did not draw/write about concept	Drew some Illustrations/words of concept	Illustrations/words clearly showed understanding of concept, but had some	Illustrations/words clearly showed understanding of concept	

			misconceptions		
1-1 verbal conferencing	Was not able to talk about concept	Had some understanding of concept, but had no examples or supporting details to explain thinking	Had a clear understanding of concept and used good examples and/or supporting details, but had some misconceptions	Had a solid understanding of concept and used good examples and/or supporting details to explain thinking	
Total Combined Score					

APPENDIX G

HOW I LIKE TO LEARN SCIENCE STUDENT SURVEY

Sing Songs

Write and Draw
 Using the IWB
 Talk about science
 Read Books
 Experiments