

HOW DOES THE USE OF SCIENCE NOTEBOOKS AS FORMATIVE
ASSESSMENT INCREASE STUDENTS' CONCEPTUAL UNDERSTANDINGS IN
SCIENCE?

by

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A professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2012

STATEMENT OF PERMISSION TO USE

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.

Jessica Hughes

July 2012

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ABSTRACT

In this study, kindergarten students used science notebooks as formative assessment to deepen their understanding of science concepts. The class participated in four science units, two were taught as curriculum suggested and two were taught using science notebooks, with pre and post-tests to show growth. The result of this study showed positive effective use of formative assessments, such as journaling, helped students form strong conceptual ideas about science content.

INTRODUCTION AND BACKGROUND

This action research study was performed at Arlee Elementary School in my kindergarten class where I have taught kindergarten for three years. My class is located in Arlee, Montana and is a K-12 district located at the southern end of the Flathead Indian Reservation in the Jocko Valley. Of our 285 K-8 students, 65% are Native American of predominate Salish, Kootenai, and Pend Oreille tribes, 75% are economically disadvantaged, 40% are English Language Learners (ELLs), and 72% are on free and reduced lunch (D. Smith, Nov. 2011). In my kindergarten class, I have 20 students, 11 boys, 9 girls and 13 Native American students (Arlee Infinite Campus, 2011).

Throughout my teaching at Arlee Elementary, I have noticed that students do not have strong skills which to communicate their knowledge, especially at the kindergarten level. However, at this age students enjoy drawing and talking about their creations. I decided to use this as a basis for my focus question: How does the use of science notebooks as formative assessment increase students' conceptual understandings in science? This question allowed me to use drawings in science notebooks as a formative assessment to help students deepen their understanding of the concepts through their being able to draw and describe what they were learning. This led to the sub question, Will students' writing skills increase through the use of journaling? Using the notebooks allowed the students to express their ideas through drawings and writing to describe their pictures, both to deepen their understanding of the content knowledge while strengthening their writing skills.

CONCEPTUAL FRAMEWORK

Assessment in schools is used to understand students' ideas about the concepts and content in any given subject (Ebert-May, Batzli, & Lim, 2003). Throughout instruction, a student will take the concept and continue to develop their knowledge if the instruction given keeps them actively engaged in the learning process (Cech, 1999; Stokstad, 2001; Ebert-May et al., 2003). The information gathered from these assessments helps to direct what will be taught and improves the effectiveness of the teaching.

Assessment is used by the classroom teacher, the school district, and the state. These three stake-holders look at different types of assessment: accountability assessment, effectiveness assessment, and classroom assessment. All three types are important to a school because of the different purposes and intended users. At the state level, accountability assessment is used to determine if standards are being met to evaluate teachers, students, and the school system. Effectiveness assessment is used at the curriculum level to determine the quality of the program being used. For teachers, the most valuable form of assessment is found in the classroom assessments (Long, Malone, & De Lucchi, 2008).

There are two types of classroom assessment, summative and formative. Summative assessments evaluate students' knowledge at the end of instruction and are usually graded. Some common types of summative assessments are midterm and final tests. Formative assessments are used throughout teaching to gather information while the students are learning. These assessments *for* learning provide information about student learning continuously throughout the learning process (Stiggins & DuFour,

2009). Formative assessment comes in many forms and is generally short, focused on the content for that day, and can be graded or not. They are used to inform the teacher about the pacing and information of the lessons to meet the needs of the students (Sterling, 2005). By embedding formative assessments throughout a unit and using them frequently, a teacher can track and assess student comprehension (Angelo & Cross, 1993). Also, these embedded assessments assist the teacher in finding misconceptions, learning difficulties, prior knowledge, and skill development (NRC, 2007). Formative assessments can be the best tool a teacher can use in order to increase student achievement (Stiggins & DuFour, 2009).

In order to succeed in using formative assessment, teachers need to use the information to provide feedback to the students that will direct their learning (Trauth-Nare & Buck, 2011). The most effective formative assessments make students feel comfortable in sharing their knowledge and what they do or do not know about a subject. In doing this, a teacher can collect information in order to track progress and make decisions about the next step in their instruction, whether to move on or reteach. Students who can recognize what they do and do not know and make decisions about what they need to learn are more apt to learn concepts. Using formative assessment helps students in this process because it requires them to think about progress in their learning (Lee & Abell, 2007).

To make formative assessment effective, teachers need to frequently use different types throughout their lesson series. These types may include writing, drawing, or oral response to problems, predicting activities, reflective writing, concept maps, projects, investigations, and journals. These provide students with the opportunity to try out their

understanding and receive feedback from the teacher (Lee & Abell, 2007). When you included students in the learning expectations, this becomes another way formative assessment is used to meet the needs of the students. Crumrine and Demers (2007) state that, “when assessment is regular and ongoing, teaching can adapt to help students develop deeper understanding and actively participate in their own learning,” (p.68).

Formative assessment is assessment *for* learning where the focus is to promote student learning. As stated by Black, Harrison, Lee, Marshall, and William (2004), “assessment activity can help learning if it provides information that teachers and students can use as feedback in assessing themselves and one another. Such assessment becomes formative when the evidence is used to adapt teaching work to meet learning needs,” (p. 10).

Using the assessment cycle ensures student success and allows the teacher to identify the needs of the students and how to set instruction and the concepts. Formative assessment gives the teacher the information needed to find misconceptions, assess prior knowledge, and judge the effectiveness of the lessons (Britton, 2011). Assessment *for* learning is also an important tool for the teacher because it provides information about the strengths and weaknesses of the students and how to structure the lessons in order to accommodate the students (Britton, 2011). Formative assessment needs to be embedded throughout the learning cycle, performed frequently, and administered in different formats in order to be successful. Timely feedback to the students is also important in assessment for learning because it gives the students knowledge about their own learning.

Formative assessment is assessing progress from one starting point to another showing there was a change in students understanding from a starting point to an end

point and is a fair way to measure teacher success (Long, Malone, & De Lucchi, 2008). In a progress based assessment system, teachers and students are provided the necessary tools to complete the learning cycle. Formative assessment is one part of the puzzle needed in order to complete the learning cycle and ensure the success of the students.

Black and Wiliam (1998) state that formative assessment allows for significant learning gains throughout the classroom by using a variety of formative assessments. Using them frequently and effectively will also create an increase in both content comprehension and achievement.

One type of formative assessment is student journals. According to Shepardson and Britsch (2004), “they are both diagnostic and pedagogically informative to teachers,” (p. 44). Using journals allows for a teacher to understand and analyze where the students are in their learning and where the teacher needs to go to deepen their understanding. When students are using journals, they are creating a tool to track their thinking and the changes they may have from their first thoughts. Journals allow students to go back and revise their ideas to reflect their new understandings (Clidas, 2010).

METHODOLOGY

The treatment for this study was based on the focus question: How does using science journals as formative assessment increase students’ conceptual understandings in science? The sub-question was, Will writing in journals increase the students’ writing abilities? 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.

To determine the effectiveness of using science journals in a kindergarten class, the students were first given the five item Hughes Attitude Survey (Appendix A) to assess how the students felt about drawing and writing. The questions were related to students' opinions about writing and drawing. The students answered each question by circling a happy face, neutral face, or sad face. While the students were completing their surveys, the teacher asked questions about how they felt about drawing and writing.

Students used science notebooks throughout four science units. Two science units were taught straight from the Harcourt Science Kindergarten Curriculum. The next two science units were also from the Harcourt Science Curriculum but included added formative assessments written in their science journals. The science notebooks consisted of pages that were divided in two, one section was used for the drawing and the other section was for the students to write a description. The notebooks went into effect in the month of December; this is when kindergarten students can really start to write on their own. For two weeks in December, the students learned how to use the science notebooks. Starting in January, the students used science notebooks throughout the units and lessons.

During the units, students were given a pre assessment and a post assessment from the Harcourt Curriculum with the added question: How do you know? (Appendix B). The assessments from the units were compared to see whether there was more growth in the content knowledge in the two units taught with the added formative assessments in their journals as compared to the two units taught without the formative

assessments. Students drew and wrote in their journals about the lessons, stating facts they had learned and explaining why they believed them to be true. The notebooks were used after each lesson for the students to explain what they had learned through pictures and words. The teacher sometimes helped with dictation if it was apparent that the students were not able to write on their own.

Throughout the units with the added journaling assessments, the students were allowed to share their findings, thoughts, and ideas with their peers in order to make sure they could read what they had written and share their thoughts and ideas and to expand on their journal entry if they felt it was necessary.

The students were also asked to give a pre-writing sample about a science concept to provide the teacher with a starting point to allow comparison of writing ability pre and post treatment. These samples were compared to benchmark expectations of kindergarten students for this particular time of year to see if the current class had more growth in writing ability. This information came from Arlee district standards and Montana state standards. The Next Generation Learning Tool Writing Assessment (Elser, 1998) (Appendix C) was the basis for assessing the starting and ending writing ability of the students. The writing assessment is broken into three phases and each phase has three levels. Phase 1: Emerging Literacy, levels 1-3, Phase 2: Developing Fluency, levels 4-6, and Phase 3: Conscious Control, levels 7-9. This assessment was given pre and post treatment using student writing samples. In order to show the growth of writing abilities, the 2011-2012 kindergarten class was compared to the 2010-2011 kindergarten class. Writing samples were collected throughout the treatment in order to identify

patterns in writing and development. These writing samples were artifacts from tasks completed throughout the units in the forms of performance tasks and projects.

Throughout the treatment period, the teacher kept a detailed journal of the observable attitudes held by students while performing the given tasks. Also included were informal student interviews about their feelings when engaged in activities.

At the beginning of each science unit, the students completed a pre-assessment of their content knowledge about the specific topic of each unit. This assessment started with the test from the Harcourt Curriculum with the added statement, “How do you know”? This question was added to allow the students to explain their responses so the teacher could see where the students were at in their learning and help them scaffold their information and close the gaps in their learning.

The students were to write as much as they could in their notebooks about the question and the picture. The teacher interviewed the students while they were completing their journals in order to get a better understanding of what their picture was showing and why. The students wrote about their picture with no help from the teacher, unless the teacher was unable to read what had been written, in which case the teacher wrote what the students said they had written. Science notebooks were kept throughout the treatment period, with a new notebook for each unit.

At the end of each science unit, the students were asked to complete a post-assessment consisting of a written response to the questions from the Harcourt Curriculum post-test. The pre and post assessments were compared to see the learning that had taken place. Using the Next Generation Learning Tool Writing Assessment the written piece of the assessment was again compared to grade level expectations of

kindergarten students at this particular time of year to see if this class had experienced more growth in writing ability.

The conclusion of the treatment period was followed by a post Hughes Science Attitude Survey and an interview about the students' attitudes toward the journaling and drawing process. In some cases, the teacher had to probe students about their answers in order to really get a sense of the students' feelings and understandings. Table 1 shows the triangulation matrix of data collection techniques.

Table 1
Data Triangulation Matrix

Focus Questions	Data Source 1	Data Source 2	Data Source 3
<i>Primary Question:</i>			
1. What are the effects of using science notebooks and student drawings to increase students' knowledge of science content?	Harcourt Science Curriculum pre and post-test	Student journals	Hughes Student Attitude Survey
<i>Secondary Question:</i>			
2. Will using science journals increase students' writing ability?	Next Generation Learning Tool Writing Assessment pre and post writing samples	Observations	Student journals

DATA AND ANALYSIS

The results of the Hughes Attitude Survey showed that 75% of the class enjoyed drawing pictures. Eight students talked about how they enjoyed drawing and coloring. During the interview, one student stated, "I like to draw because it is so fun." However

the results showed that 70% the students were *unaware* or *neutral* in knowing that their pictures or pictures they see in books or other media can assist them in learning. The survey also showed only 40% of students liked to write sentences (Figure 1).

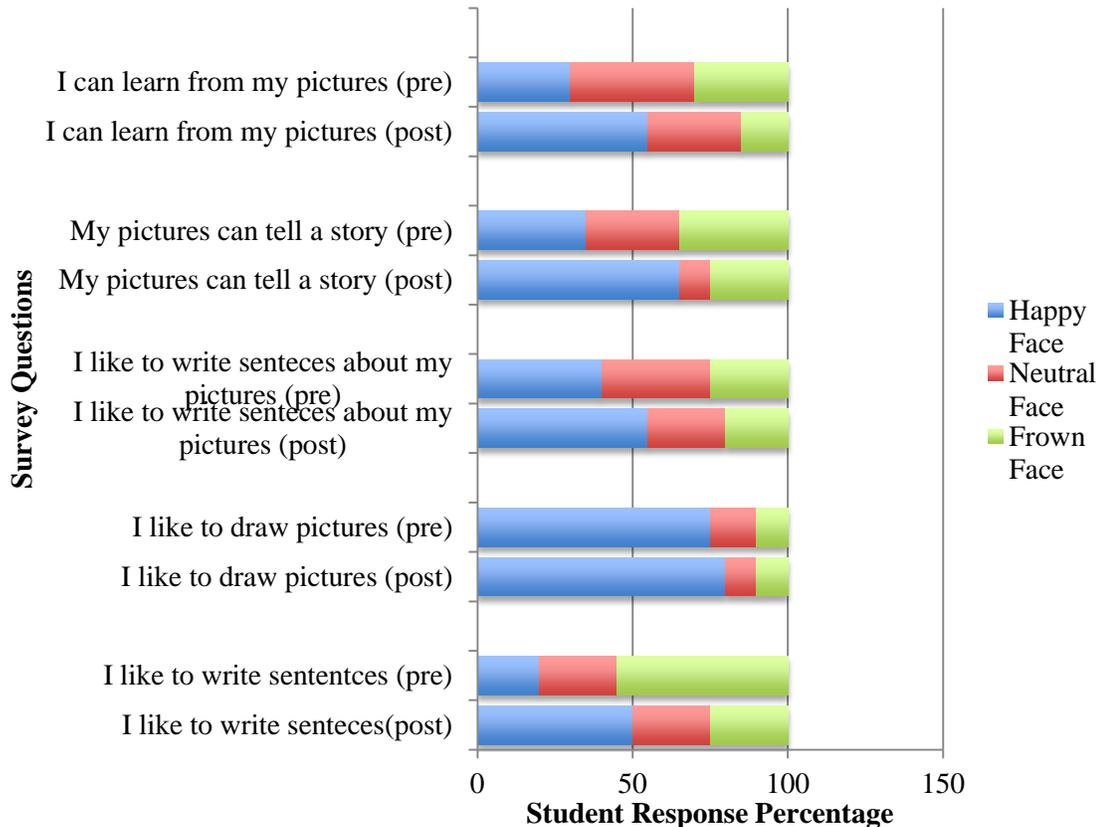


Figure 1. Hughes Science Attitude Survey.

After treatment, only 45% of the students were unaware or neutral in knowing that pictures can assist in their learning and 55% became interested in writing about their pictures and in writing overall. One student said, “It (the picture) talks all about it to help me write.” Another student stated, “I look at the picture to see what word to write.” When asked if they like to write sentences pretreatment, 55% of the students circled the frown face and post treatment only 25%. During the interview, a student stated, “It is fun

to write and sound out words.” By the end of the units, the students in the lower achieving group were able to hear sounds in words more effectively (Figure 2).

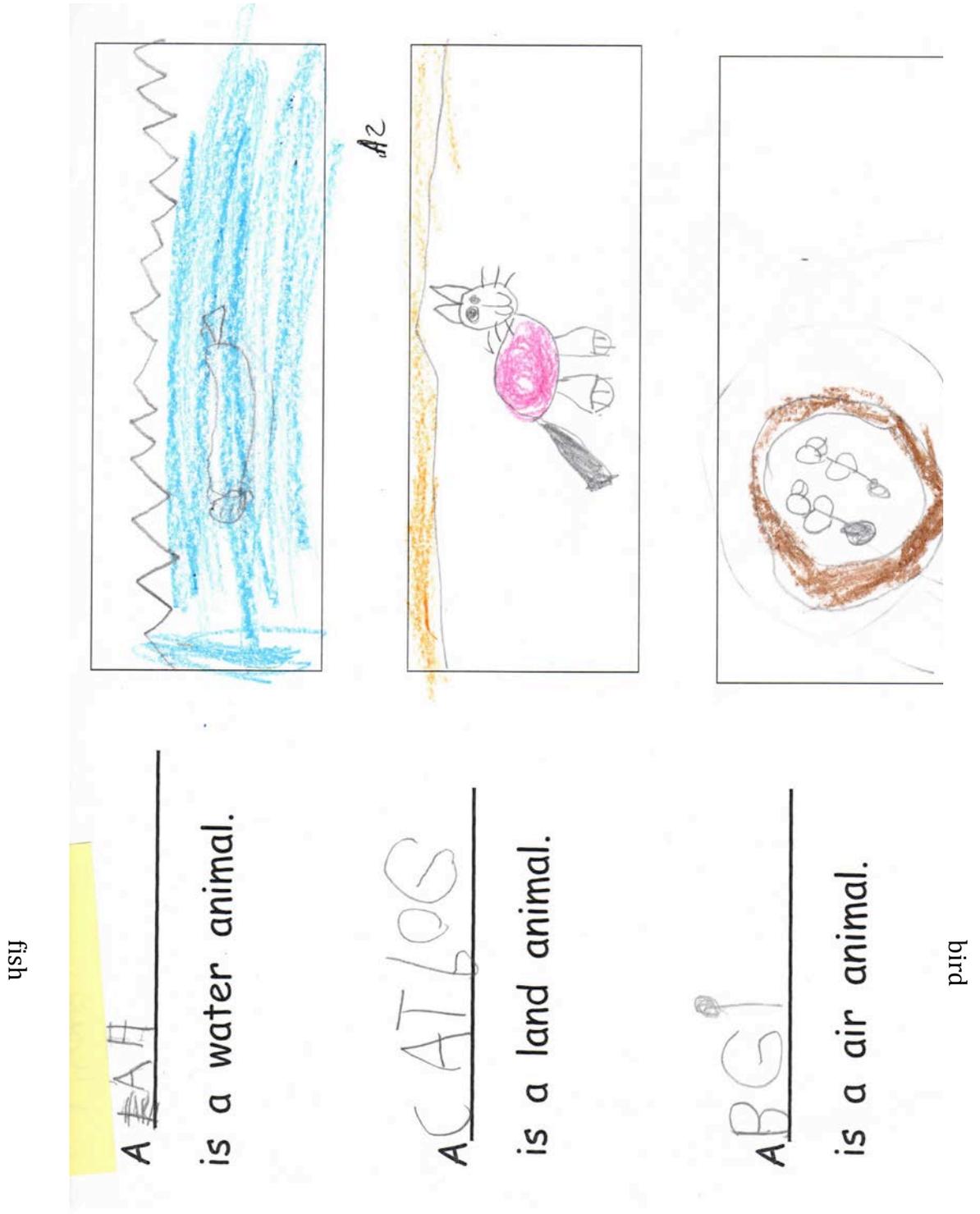


Figure 2. Student journal entry.

For both units, there was a pre and post-test given and more growth was shown in unit three and four, with an increase of 16% compared to only 10% in unit one.

Throughout the units, notable growth was shown in comprehension of science concepts in unit three and four where formative assessment was added (Table 2).

Table 2
Unit Score Percentages

Unit	Pre Test	Post Test	Lesson 1	Lesson 2	Lesson 3	Lesson 4
1	69%	69%	73%	71%	75%	74%
2	68%	72%	72%	70%	73%	70%
3	79%	85%	80%	81%	83%	81%
4	72%	81%	79%	82%	80%	83%

The Next Generation Learning Tool Writing Assessments were used to score the students writing fluency. In both classes, the beginning of the year pre writing sample placed all students in the Emerging Literacy Phase and the end of the year post writing samples placed all students in the Developing Literacy Phase. The growth was shown by how many levels the students increased (Figure 3).

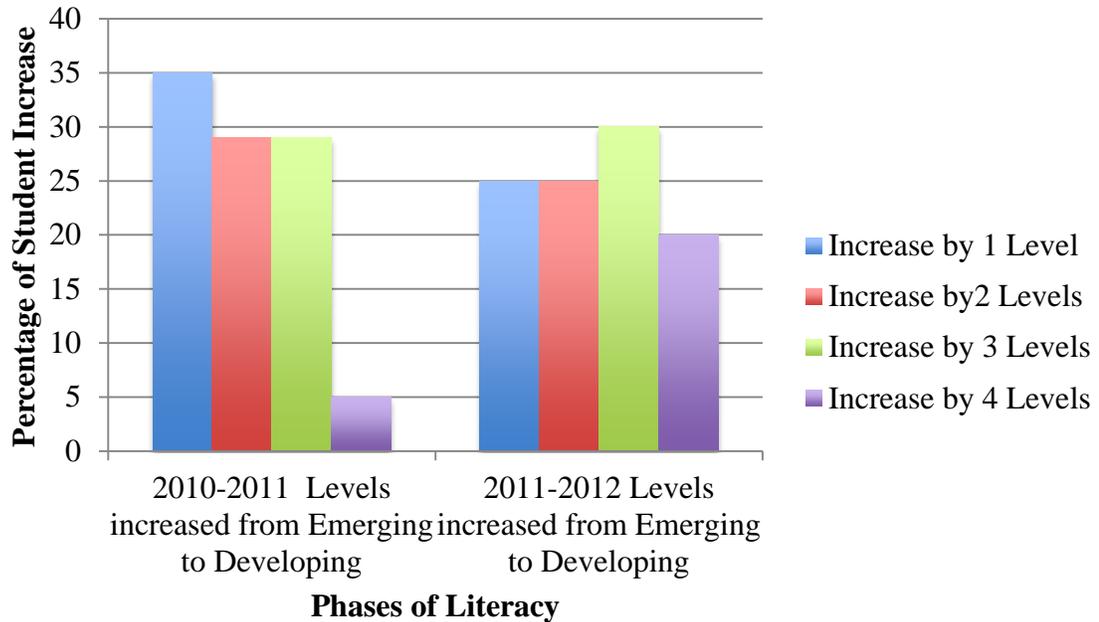


Figure 3. Kindergarteners' phases of literacy 2010-2011, ($N=17$, 2011; $N=20$, 2012).

In both years, the students showed growth in their writing fluency. The average growth for kindergarten students using this instrument is 2-3 levels. However, in the 2011-2012 school year there was an increase in the amount of levels gained. In 2010-2011 school year, 35% of the students increased their writing fluency levels by 1, 29% increased their writing levels by 2 or 3, and only 5% went up 4 levels. In the 2011-2012 school year, 25% increased 1 and 2 levels, 30% increased by 3, and 20% increased by 4 levels.

When the students were asked to write how they knew their answers, it was observed that they put more thought into their answers. They thought about their answers and tried to spell their words so that they and the teacher would be able to read what they had written. As they were writing, the students seemed to recall more information than if they were just asked to finish a worksheet. The students added details about color, size, and how things felt when they were journaling after a lesson. Figure 4 shows one

student's journal entry after observing rock characteristics, *I see a little cool rock they are blue and red and pink and purple they are solid and smooth and hard and pointy.*



Figure 4. Student journal entry.

The journals showed that students were using the information from the lessons and applying it to situations presented. In one lesson, all the students were able to use their knowledge of wheel and axel to be able to write and draw how this simple machine helps make work easier and give examples. In another lesson, twelve students were able to describe why certain items were able to roll, slide, or fly and provide examples.

INTERPRETATION AND CONCLUSION

Throughout the research process, I was really able to see how the students gained and processed the information. Using formative assessments throughout the units made it possible to cover the areas needed and help the students deepen their understandings of the science concepts. Using the journals as formative assessment enabled the students to organize their ideas and ask questions. The students came to conclusions and were able to write them down and read them back to each other and the teacher. When the students were learning during other lessons, the students were able to recall the information from previous lessons. This scaffolding of information and concepts allowed the students to figure out the task in a supportive environment where I was able to provide support when needed.

When I was teaching the science units without the formative assessment, I noticed that the students were able to tell me information but were not able to explain why or how they knew. The worksheets and activities seemed more like busy work instead of tasks that would really allow the students to understand the concepts and form a solid background for future learning. I observed that the students also were not able to recall the information from previous lessons and apply it to the task at hand.

Using science notebooks as the main form of formative assessment and the Next Generation Learning Tool Writing Assessment, allowed me to answer my second research question. This assessment has been used throughout Arlee Schools for four years and has become a solid way for teachers to see how their students have progressed from the beginning of the year to the end. By using this assessment and comparing it to last

year's kindergarten student data, I was able to see substantive growth in my students writing abilities. Having the students write throughout every lesson in the science units allowed them to take what we have learned from reading and writing lessons and apply this to their science writing. Again, the students were scaffolding their learning from previous lessons and incorporating it throughout multiple subject areas.

VALUE

During this action based research project, I found there is a great need to include formative assessments within my teaching. Having the students write in journals about what they learned and explain their thinking was a way to allow the students to scaffold their learning. As the teacher I was able to see where there were gaps in their learning and this made it easy to go back and reteach specific concepts within the lessons. I was also able to get a better understanding of how my teaching was affecting their learning and how the students were interpreting what was being taught. When the students were writing in their journals for unit two, they were able to describe and make connections with the science concepts as compared to unit one in which all the students did was answer questions.

The journals were a good way for the students to go back and read what they had written and to be able to describe the picture they had drawn in their notebooks about the lesson. Allowing the students to share what they had written and compare it with their peers provided opportunities for them to defend why they wrote what they did, which was also a way to deepen their understanding of the concept.

While working with through the action research, I was able to see a dramatic increase in the students' writing ability. While journaling in our science notebooks, I did not focus on writing conventions or correct spelling and grammar. However, while they were writing, the students were recalling writing skills and using them as evidence. This was shown by the improvements evidenced in their writing skills and the ways they answered their questions. In one journal entry, a student shows the use of vowel combinations and trying to use an apostrophe (Figure 4).

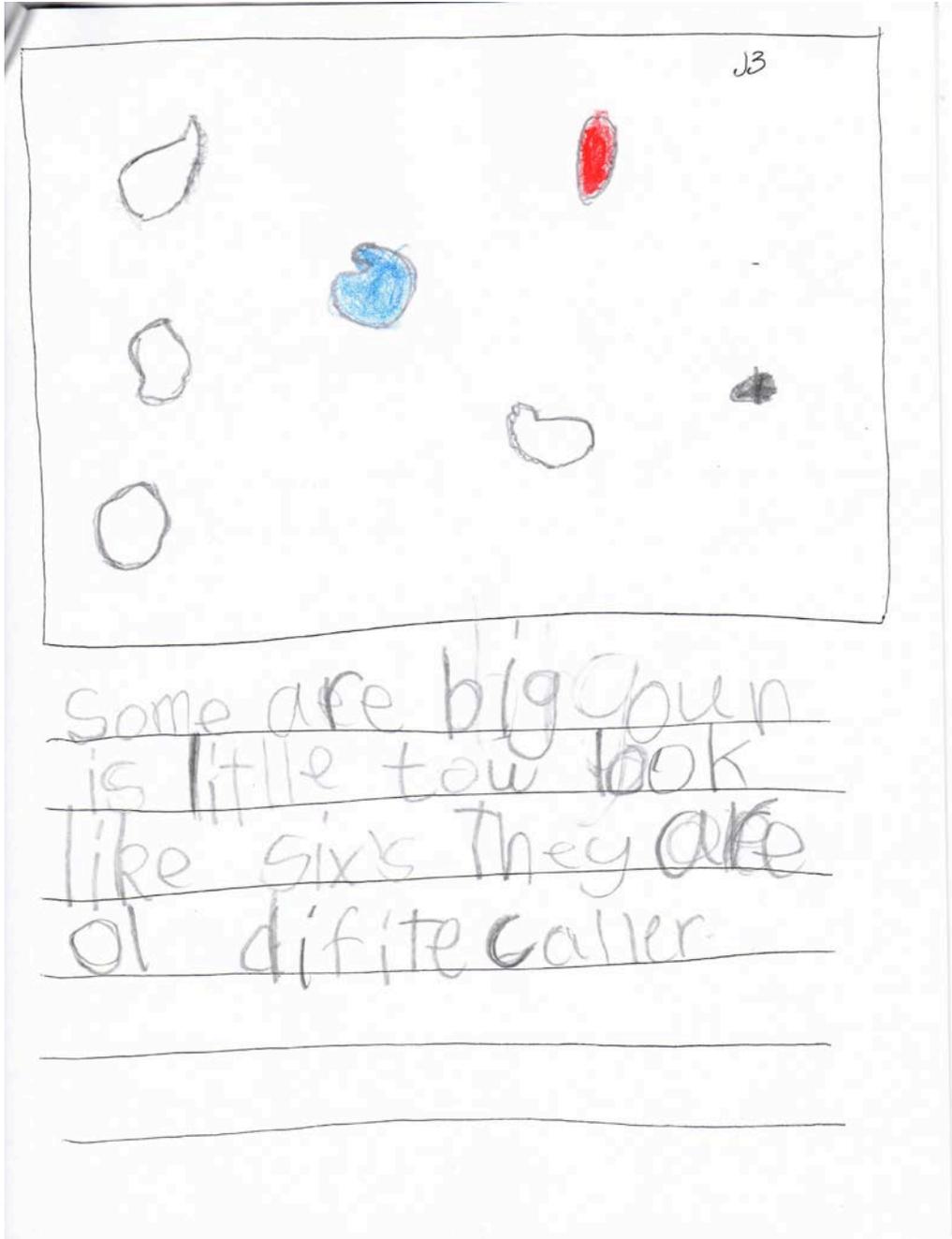


Figure 5. Student journal entry.

The continued use of the journals provided the students with more opportunities to practice their writing skills and to become better writers. As the students wrote more in their notebooks, they slowly started asking for less help with spelling and grammar, an indication of their growing more confident in their writing skills, which allowed them to

focus more on what they were writing and not how they were writing. This was shown throughout all the subjects in which there was writing involved.

In all, I was able to successfully answer my questions by providing evidence that indicates that using journals as formative assessments does in fact increase the students' conceptual knowledge. It helps the students scaffold their learning and makes it easier as an educator to determine where extra re-teaching may be needed.

This research process also led me to think about how I teach throughout all subject areas. Using formative assessment in all areas of the classroom is beneficial to the students and the teacher. It has allowed me to adapt my teaching more towards what the students need and has allowed the students to form a strong base and background knowledge for concepts they will encounter throughout their school careers. Having this strong background and the opportunities to scaffold their knowledge will provide support for the students when they come across new information.

When I completed my research, I was able to reflect on my own teaching and discover new ways to improve my teaching. I have considered looking at ways to incorporate educational videos and note taking to assist with conceptual understandings. Teaching is a continuous learning process and I have become more aware of how I deliver my lessons and how to take what the formative assessments are showing me and redirect in the learning process.

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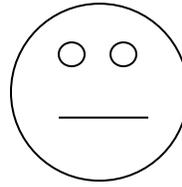
APPENDICES

APPENDIX A

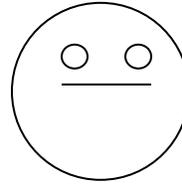
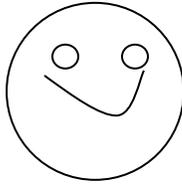
HUGHES ATTITUDE SURVEY

Hughes Science Attitude Survey

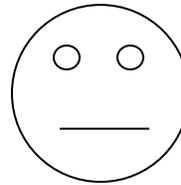
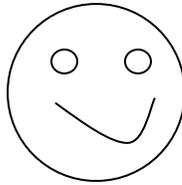
I think Science is fun.



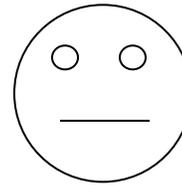
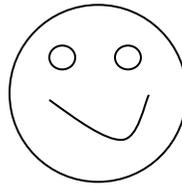
I like to write sentences.



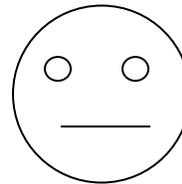
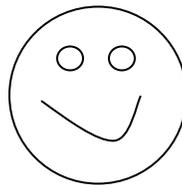
I like to draw pictures.



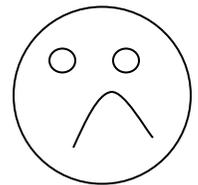
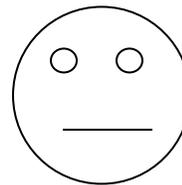
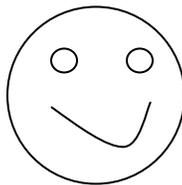
I like to write sentences about my pictures.



My pictures can tell a story.



I can learn things from pictures.



APPENDIX B

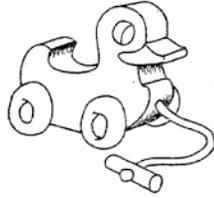
MODIFIED HARCOURT CURRICULM TEST

Modified Harcourt Curriculum Test

Name _____ Date _____

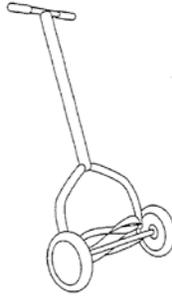
Chapter 3 Assessment

I. Circle things that slide.



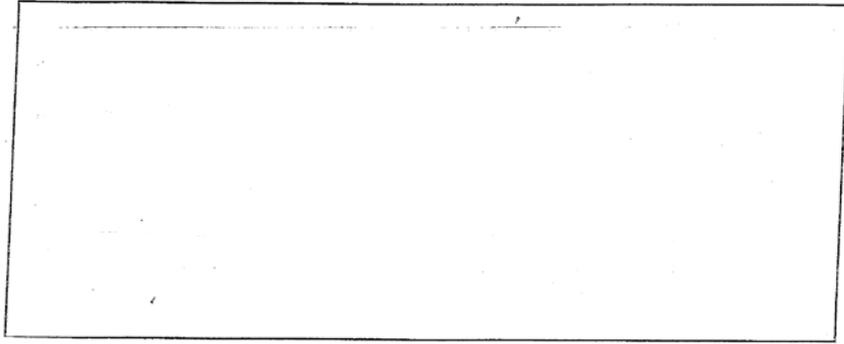
How do you know?

2. Color two pictures of objects that move the same way.



How do you know?

3. Draw something that can move fast.



© Harcourt

How do you know?

Handwritten lines for writing an answer.

4. Color the pictures that show something you can push.



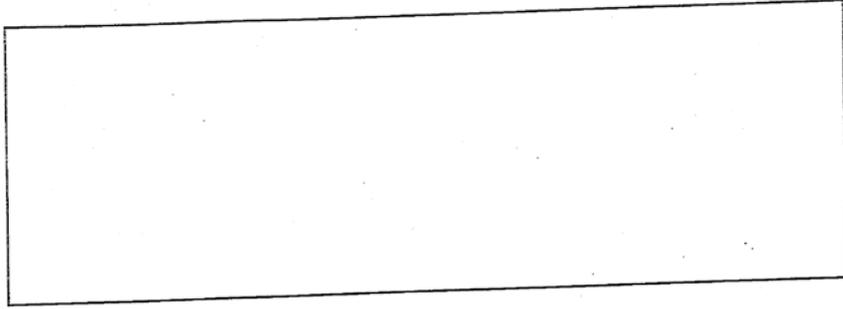
How do you know?

Name _____

Date _____

Chapter 4 Assessment

I. Draw a picture of Earth.



How do you know? What can you tell me?

2. Circle the place where it is best to plant crops.



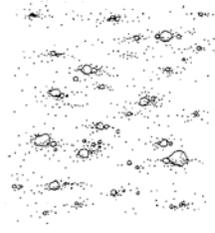
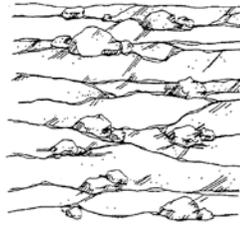
How do you know?

3. Circle two places where animals live.



How do you know?

4. Draw a line under the sandy soil.



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How do you know?

5. Color the water.



How do you know?

6. Color the picture that shows people using land as a resource.



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How do you know?

APPENDIX C

NEXT GENERATION LEARNING TOOL WRITING ASSESSMENT

Next Generation Learning Tool Writing Assessment

Understanding WRITING ASSESSMENT Scores - FLUENCY**FLUENCY: Phase One: Emerging Literacy**

1	{	<ul style="list-style-type: none"> - scribble writing - real letters copied with no letter/sound correlation evident - real letters randomly typed if done on computer - student may write his/her name - student can often "read this "kid-writing" but adults cannot
2	{	<ul style="list-style-type: none"> - unrelated words copied or memorized - family names; i.e. Mom, Dad, Sis, etc. - no story line present - possible new words developmentally spelled - limited letter/sound correlations may be evident - generalized knowledge about words, i.e. fun, sun - or cat, fat, bat, etc. - content unconnected or unrelated
3	{	<ul style="list-style-type: none"> - single original sentences - story beginnings but no development - 'fat cat sat...' stories - plug in new nouns or verbs to a consistent sentence pattern - recognition and repetition of pattern; pattern stories

FLUENCY: Phase Two: Developing Fluency

4	{	<ul style="list-style-type: none"> - several distinct related sentences - story line or purpose apparent; could include sequence of events - factual recall of events with no reflection or embellishment - chronological listing is typical; may begin: "On Sunday..." "Last night..." - highly literal - author seems to write all he/she can write, indicating limits to fluency
5	{	<ul style="list-style-type: none"> - simple narratives or stories - sequence of events may be presented as a story - some detail or personal reflection used to embellish story - sequence is mostly complete with beginning, middle and end apparent - pieces may end abruptly with 'the end' - author seems to write all he/she can write, indicating limits to fluency
6	{	<ul style="list-style-type: none"> - simple narratives typical which may be flooded with superfluous detail - story line or purpose evident, but not always easily followed - irrelevant embellishment: no item or episode appears more important than any other - may ramble and become boring to the reader - increased fluency evident but fails to control language for intended purpose

FLUENCY: Phase Three: Conscious Control

7	{	<ul style="list-style-type: none"> - details or reflection selected to further intended purpose - piece holds together and has more developed beginning, middle, and end - author exhibits conscious control over writing process - more concise, less rambling - awareness of audience evident - ending brings more closure than "The End"
8	{	<ul style="list-style-type: none"> - increasing clarity and conciseness - author may use style, voice, or form to enhance but may not follow through - increasing levels of conscious control - increasing levels of audience awareness - risk-taking with style, voice, or form may be evident
9	{	<ul style="list-style-type: none"> - author has a clear purpose and fulfills it - voice and tone more evident and manipulated for effect - style established and style modified based on audience, form, or purpose - conscious control and audience awareness are consistent throughout piece - risk-taking evident and often successful