

Who Measures What in Our Neighborhood?

K-1 Classroom

Evaluation, Reflection, and Assessment

The classroom environment enables children to demonstrate what they know through a variety of authentic assessment strategies (exhibitions, demonstrations, journals, group discussions, debriefings, interviews, and conferences). Assessment is constant and ongoing so as to identify students' strengths and learning approaches as well as their needs. Teachers observe play, watch children drawing, listen to conversations and ask questions. As children explain their thinking, teachers can assess their level of understanding. "Students points of view are windows into their reasoning. Awareness of points of view helps teachers challenge students, making school experiences both contextual and meaningful. Each student's point of view is an instructional entry point that sits at the gateway of personalized education" (Brooks & Brooks 1993, p. 60).

Documentation is vital for assessment. Documentation includes narratives of child-to-child conversations, child-to-adult conversations, photo portfolios (photo narratives), wall displays, and written summaries. Documentation offers opportunities for children to evaluate their own work, for teachers to keep parents better informed (knowledge web), and for teachers to gain a better understanding of how children learn. Documenting conversations and representations at the beginning and at the end of the project for the group as a whole and for each individual child gives perspectives of growth in all dimensions including vocabulary, concepts, knowledge, skills and dispositions.

Tomlinson's "Planning Model for Academic Diversity and Talent Development" (Tomlinson, 1996, p. 162) is a useful tool for examining how children's responses showed growth. Instead of using the model to differentiate instruction, the teachers have used it to examine how responses to the activities were differentiated among students as well as how they demonstrated growth in students throughout the study. In a project-based classroom, where many activities are open-ended, using Tomlinson's indicators can show growth. Teachers can demonstrate through child portfolios how children have gone from simple to more complex responses; concrete to more abstract understandings, and less independence to more independence in work habits and dispositions.

In an environment of inquiry, teachers look for evidence of children's growth (Klein & Toren, 1998). Children's questions may evolve from general to more specific once children have more knowledge about a topic. They may transfer their learning by making links to other things that they know and with which they are familiar. They may incorporate the new vocabulary into their every day language. Teachers look for growth in fluency of ideas and in ways in which children generate questions, solutions, hypotheses and theories. Teachers look for growth or change in students' understandings by examining artifacts of learning, which include drawings, structures, writings, and conversations. Children may also become more self-directed, more engaged, and may strengthen their dispositions to inquire, to assume responsibility, to persevere, and to take on leadership roles within a group.

Growth and Awareness of Measurement in Different Fields of Study

At the beginning of the project, when the students predicted what kinds of measuring they thought people were doing in and around the school (Phase 2 predictions), twenty-one predictions were related to prior experiences of the class. The students were surprised that the preschool students and the people in the offices outside the classroom were not engaged in the kind of measuring that they predicted. However this opened their minds to a broader view of measurement in the neighborhood.

A close look at the web (Student Measurement Topic Web 2) created at the end of the project, indicated that the students were influenced by their experiences. A comparison of the web created at the end of the project with the web from the beginning of the project showed students had increased their understanding of the measurement in different fields of study, the kinds of measuring tools that are used for collecting data, and the many things in their lives that can be measured.

To gather more information about what the students understood, the teachers asked parent volunteers to elicit more detail from the students about brainstormed web responses. Students dictated and embellished their original ideas as parents typed their responses on classroom computers. Many students named a fact from an expert, an experience, or a field visit from their work during the project. The text of these expanded responses are found in the Expanded Web. Some examples are listed below:

- NB: I didn't know you could measure water underground. You get a baler and you put it in a well and water comes up in it and you take a thermometer thingy and you put it in the water to see how hot or cold it is. You can measure where the water begins in the hole in the ground. You take a coil and put it in the hole and it beeps when it touches the water.
- ER: Clocks measure by hands because every hour it tells a different number. There are 12 numbers on a clock. There is one number for every hour. There's a long hand and a short hand on the clock. The long hand tells the minutes and the short hand tells the hours.
- MW: If it's not the right temperature for chicks they will burn or freeze. The right temperature is 100 degrees Fahrenheit. 99 degrees is okay too, I think. The incubator keeps the eggs at 100 degrees.
- AH: You can measure in a car. You can measure how much gas you still have or how much air is in your tire.
- HB: I know there is such a thing as a balance scale. It balances to show you weight. If one side is down, it means that side is heavier. If the scale balances both sides weigh the same. There are also doctor's scales where you can have yourself measured. On a bathroom scale, you can measure yourself.

The teachers wanted to know if students had a definitional concept about measurement. On the last day of the project, teachers prepared a handout that asked, “What is measurement?” Student responses included volume, quantity, number, and time. The teachers noted that the students in the class had broadened their views of measurement. They referred to the practical applications of measuring that they had engaged in during the project investigation. These responses reflected that they had answered their original researchable question, “Who measures what in our neighborhood?” They also gained an operational definition of measurement through their experiences.

What is Measurement?

- TB : Measurement is what you do to see how much people weigh and how tall somebody is and what time it is and the date and how wide somebody is. (7 yr)
- CS: Measurement is how deep, how big, how wide, how large, how much, how much volume, and how much stuff. (7 yr)
- JC: Measurement is when you measure. Measuring is a lot of things like chicks, clocks, volume, tall, short, and deep. (6 yr)
- NB: Measurement is measuring all kinds of things like chicks, money, garbage, air and how long, short, how much and how heavy. (6 yr)
- SD: Measurement is when you see how much something is. (6 yr)
- AH: Measurement is how tall people are, how much they weigh, and how the time passes. (6 yr)
- JN: Measuring is having enough, measuring is width, measuring is volume. (7 yr)
- WJ: Measurement is how big, how much, how long, the depth, and a 1 to 10 scale. (7 yr)
- KC: Measurement is a 1 to 10 scale, ruler, measuring tape, and a balance scale. (6 yr)

Growth in Knowledge About Measurement

Teachers noticed an increase in the number of students including the units of measure in their conversation and recording sheets. In January, when asked how tall they were, students responded with a number without a unit such as 11, 5, 4, 8, 5, or 60. In most cases the number was in error. Students measured themselves and many other items throughout the project. On 2/19, one of the students shared his measuring work at a group meeting.

- MB: I measured all around the room during project activity time.

- DM: I did too.
MB: I measured the plastic turtles and they were 9 and the dinosaurs were 20.
T: Were you using the ruler, or your finger?
MB: I used the ruler.
T: Were you using the inch side or the centimeter side?
MB: I don't know. I'll show you. (Gets the ruler).
T: What's the difference in reporting 9 fingers or 9 inches or 9 centimeters?
MW: 9 inches is a bigger amount than 9 centimeters.
WJ: 9 fingers would depend on the size of your finger.

By the end of the project when measuring and weighing the chicks, all students included units of measure on their recording sheets. This demonstrated that they gained a better understanding of units of measure. Students also improved their abilities to manipulate measuring tools and to measure using both standard and non-standard units.



LS records the predictions and results of measuring chicks and includes in temporary spelling ounces ("os") and inches ("n").



AC (kindergartener) uses temporary spelling to write centimeters, ounces, and inches.

Growth in Representation

Teachers saw growth in student's ability to make three-dimensional representations out of boxes and junk. Teachers guided students' work by placing the digital photographs near the student and asking them to refer to it as they proceeded to make their representations. The teacher also asked questions to facilitate problem solving:

- What materials do you think would work best in making your representation?
- How do you plan to show this feature?
- What has worked so far?
- What other materials could you use?
- Look carefully, is this the color you want?

A comparison of representational structures made first semester to those made during the measurement project, showed growth in using rulers and comparing sizes and proportions to create more sophisticated three-dimensional models.



The students taped two different sized lids for wheels on the garbage truck from the fall project.



In the measurement project, the student measured the fire truck wheel to fit the truck proportionally. It attached to the truck with an axel.

Strengthened Dispositions to Cooperate and Persist at a Task

During Phase 2, students self-selected to work independently, in pairs, or in small groups to make their representations. All groups that worked together to make a common product reflected on the importance of cooperation. Most students listened to each other and shared their views about problems that needed to be solved. Teachers noticed that students became more articulate and backed up their opinions and ideas with reasons.

After returning from the Credit Union, four girls decided to work together to make a cash drawer. They drew their plans and chose to make their cash drawer from boxes and cardboard. Some problems stumped the group. They wanted to make partitions in the drawer to hold different sized bills. They had difficulty getting the cardboard to stand upright. The girls presented their problem at a large group meeting. CS offered to help them solve their problem. However, his solution did not influence their group. The next day, the girls brought their problem back to the large group. Another child offered to assist them. She cut a piece of cardboard and taped it to the cash drawer. (Interestingly, her suggestion was very similar to CS's idea.) For two days the girls diligently taped cardboard partitions in place and the cash drawer held separate bills.

This group also wanted to make dollar bills, coins and coin wraps that each of them had received as an artifact from the Credit Union. It was small detailed work and after a while, the group decided to donate their personal coin wraps to the representation to make it just right for the Open House. The next day, individuals changed their minds, and decided to keep their wraps at home. However, they still wanted to create representations of coin wraps.

AH: Teacher, LS just quit the group.
T: Why do you think she quit?

- AH: She wants us to make the coin wraps this way. But we don't think it will work that way. See.
T: What can you do?
PJ: We'll just have to keep working.
ER: Maybe she'll come back when she's done with Portuguese.
AH: Maybe.
PJ: Here's my idea of how the money wraps should go. (She shows)
ER: Yeah. Lets try it that way.

After two weeks, all four were very pleased with the cash drawer, money, money wraps, a key, and a keyhole. They reflected on the process.

Money Drawer

- AH: This is a money drawer.
LS: We saw it at the credit union.
ER: We had problems making the inside of it. We tried to tape it up and it didn't work.
PJ: We learned to work together. And you have to have meetings...
AH: ...To talk about how you solve the problems.



Members of the group work on the partitions of the cash drawer.



LS attempts to attach the partitions to the drawer.



The girls continue to work on the cash drawer.



PJ perfects the coin wraps.



The money drawer displayed at the Open House with the digital picture below.

Conclusions

Teachers used students' misconceptions and misunderstandings in Phase 1, to develop instructional activities that supported conceptual growth. In a multi-age classroom not all students gain the same level of understanding about abstract and complex concepts. The discussion during the categorization of their memories showed some possible confusion between linear and weight measurement. The teacher decided to use this question to survey the class about what other children understood about types of measurement. On January 24th, the morning sign-in question asked, "Is measuring a baby's weight the same as measuring the inside of a clubhouse?" This time, two students who previously thought that it was the same answered no, along with the rest of the class. One child responded that the two types of measurements were the same. By the end of the project all students understood the difference between linear and weight measurement.

Some aspects of measurement continued to challenge students. On 4/16, some students asked questions at a large group meeting in an attempt to better understand the relationship between measurement and time.

- HB: How does how many hours and minutes that there are in a day tell time?
BH: Hands can tell the time. But, how does it measure?
CS: Does it measure how fast the ticks go?
ER: The numbers measure.
MB: The hands tell time. What about digital?
CS: The measuring is what is happening inside the clock.
MW: What about hours?
DM: You have to get a magnifying glass to see the numbers on watches.
LS: Watches are clocks. Some of them don't have numbers.
NB: Some have lines that stand for numbers.
CS: You have to know where the numbers are so you don't need the numbers there.
DM: My watch has lines on it.
NB: You have to know that 12 is at the top and 6 is at the bottom.
AC: Some lines have a number called a Roman numeral.

- BH: The five is a V.
TB: On the clocks with just lines the numbers go in order.
CS: I have something to add to NB's comment. You don't HAVE to know, but it helps.
HB: (nods) But how do the hours and minutes tell time?
T: The first people to use a clock to take the day and divide it into segments used the sun. We can make a sun clock.
AB: Yeah.



Over a series of days,
students mark time by
drawing the shadow of the
rod.

The relationship between measurement and money also continued to challenge students. Students going to the Credit Union asked questions about the size of money and checks and how much money the bank had. ST's questions represent those of others in the group, "How do you measure money? How big or how small is it? Why do you want to know how big the money is? How much money do you have?" At the end of the project some students in the class understood the relationship between the value of money and measurement.

At the beginning of the project, students knew there were numbers involved in measurement, but they did not have enough experiences to know the relative meanings of the number. For example, 100 degrees Fahrenheit is very hot to go outside, just right for the chicks to hatch, but not hot enough to cook the Gingerbread boy. HB wrote in her Gingerbread story that the oven was very hot at 100 degrees. She did not indicate Fahrenheit or Celsius. In a conference with the teacher, she said it was Fahrenheit. Even at the end of the project, some numbers that the students wrote, although close, were still not exact.

In conclusion, this project helped students gain an awareness of measurement in different fields of study and the importance of measurement to the world around them. Students had authentic purposes to measure, collect, analyze, and evaluate data that gave them a meaningful context for learning basic skills in mathematics. Students matured in their dispositions. They improved in their ability to collaborate and cooperate and increased their curiosity about measurement. Because the project was multi-faceted, it engaged the children for five months. The comments

from student and parent reflections demonstrated that the children enjoyed the challenge of working in-depth and having the opportunities to investigate their own questions.

Student Reflections

To gain a better understanding of what students have learned about measurement, the teachers asked them to complete a questionnaire. If students could not write their own responses, parent volunteers asked them the questions verbally and typed their responses on the computer. The questions and their responses are listed below:

1. What they would tell a friend about measurement?
2. What would you like to keep doing with measurement?
3. What are you still wondering about measurement?

1. What they would tell a friend about measurement?

ST: I would tell them a lot of things about measurement. If they said, "I don't know what to measure," I would say you can measure lots of things like how tall you are, you could measure a fish or a pond or a marker, a tank, a frog, a tadpole. But you would have to be fast to catch a frog or a tadpole.

AC: Policemen measure and doctors measure people on a doctor's scale. It's a spring scale.

AH: That you can measure your mom's car, and you can measure when you cook.

ER: I would ask them if they measure. I would tell them I measure at my school.

VM: Nothing. I don't have anything to tell them about it. They probably know about rulers.

PJ: Measuring is important because you need to know things. If you don't keep the chicks at the right temperature, they will die.

JC: I would say you could measure a horse.

NO: I would say that measuring is important.

HB: Measurement helps you. If you didn't have a ruler, you couldn't measure a person. The doctor measures you to decide how much medicine to give you. I would tell him that you can measure a flower.

NB: I would say we could measure each other. We could weigh ourselves and find out how tall we are.

LS: I would tell them that measuring is important because you might not know how big you need it to be.

KC: That you can measure almost anything.

TB: There are a lot of ways to measure, like using a scale or a ruler or a yardstick.

MB: I'd say you could measure with a ruler, a tape measure, or a scale.

JN: It's important because if they didn't measure they wouldn't know how long things are.

DM: You can measure a letter like the letter A. You can use a tape measure.

MW: You can measure with a tape measure or a ruler.

AB: I would tell him about scales.

JK: My dad will measure bikes.
BK: You can measure a building, plants in a garden, and that's all I can think of so far.
WJ: That measuring tapes measure.
CS: I would tell him it is a good thing.
CW: You measure things that you build. You can measure eggs.

2. What would you like to keep doing with measurement?

ST: I don't really measure a lot. My mom does it. I only do it at school, but I want to keep measuring myself.
AC: I'd like to keep measuring how tall I am and how much I weigh.
AH: I would like to cook a lot.
ER: I'd like to measure chairs because there are a lot of parts to measure like the leg, where you sit and down the back.
VM: Nothing. I'm hooked on the computer, not measuring.
PJ: I'd like to just keep on measuring. I'd like to measure cars, computers, and TVs.
JC: I would like to measure a horse with a ruler.
NO: I don't know. I like to measure tables.
HB: I'd like to keep measuring myself.
BH: I'd like to measure all kinds of stuff like how much food I eat or what buildings I build.
NB: I'd like to measure myself to see how tall I am or how much I weigh.
LS: I'd like to keep measuring eggs, people, and other things.
KC: I'd like to measure clothes.
TB: I'd never like to stop measuring because I like measuring.
MB: I'd like to keep measuring myself. I'd like to make new amusement park rides. I'd have to measure for that so I can make them safe.
JN: I'd like to measure my baby gerbils.
DM: I would like to keep on measuring sticks, because I want to see how long they are.
MW: I'd like to know how tall people are.
AB: I'd like to measure my sister and my mom so I'd know what they weigh and how tall they are.
JK: I'd like to measure my plant.
BK: I'd like to measure buildings.
WJ: I would like to keep measuring things like my house.
CS: I would like to keep studying about it.
CW: I don't like measuring. It is too hard. I would like to keep measuring chicks.

3. What are you still wondering about measurement?

ST: I don't have any questions.
AC: I wonder how long the dragon is that hangs in our classroom.
AH: I wonder if I can measure my cat so I could see how big she is. Her name is Doodle.
ER: Do they measure in different parts of the world?
VM: Nothing. Well, maybe not nothing. I wonder how you measure a building.

- PJ: How do you measure the playground?
JC: Nothing. I'm too busy thinking about going to Florida and other things.
NO: Nothing, because there's nothing else to learn about measuring except maybe when I'm in high school.
HB: How does a doctor measure with a scale? How does it work? How does the doctor know how to do it?
BH: How do they build all those rulers and stuff?
NB: I was wondering what number a yardstick went up to, but then I found I could find out easily by looking at a yardstick.
TB: How many ways are there to measure?
MB: I wonder how they measure rides. Do they measure the engine? Do they measure the tracks?
JN: I wonder how big my baby gerbils are now. When they were first born, I measured them with my finger.
DM: I wonder if it is great to measure.
AB: I'm still wondering if tape measures can have centimeters?
JK: How do you measure a little string? You can't use a ruler because string is much longer than the ruler.
WJ: How do greenhouses measure?
CS: I would still like to know how tape measurers work.
CW: I'm still not wondering about anything about measurement. I am wondering about Pokeman.

Parent Reflections

The teachers gave questionnaires to parents to determine if there was transfer of information from school to home and if students were able to generalize their newly learned concepts and apply them outside of the school context. The following are the responses from the parents:

1. Did you see evidence of your child's interest in the measurement topic? (Involvement in or excitement about the field trips, classroom, activities, products, etc?)
 - Yes, KC tried to measure many more items in the house. This was especially evident with regards to cooking and measuring ingredients. She really enjoyed the field trips but she tended to enjoy all the class trips.
 - Yes, LS always told us about field trips and projects and representations she worked on.
 - Yes! "Hey! They're/ you're/we're measuring!" "That's measuring!"
 - Yes. ST discussed the field trips a lot. She enjoyed books that related to the topic.
 - Yes

- Yes
- Yes. WJ really enjoyed the project. He talked at length about many aspects.
- Yes. The sheep farm field trip was particularly interesting for AB. He also enjoyed hearing from the pilot and what he measured. The field trips were very good.
- Yes - we weighed our kittens and she uses rulers to measure things for fun. She notices a tire gauge and gas gauge.

2. Did your child talk about any aspect of the topic away from school? Did the conversations or statement reveal new knowledge about the topic?

- During this time we took a two-week road trip to California. She became very interested in the mileage and time of day. Basically how much you could drive in a day and that was related to different modes of transportation (i.e. car vs. plane vs. train).
- Yes, even in her play at home she would talk about measurement or try to measure things. She also became more aware of instruments used for measurement. In addition, she asked friends and family whether they did any kind of measurement at their work and if they wanted to come and talk about it.
- Yes, AC has new vocabulary words (measuring tools and units of measurement). She also has a greater understanding of how and why things might need measuring.
- Yes, she was especially interested in sheep and how they were measured.
- Yes. He loved learning "words" to help identify ideas.
- Yes.
- We talked about measuring and many other terms. Lots of new vocabulary, new words.
- Yes. He likes to take the tape measure and measure things and talk about how long they are. He made his own ruler at home. The topic certainly helped him learn more about the items, circumstances, and professions discussed.
- She measures how long lines are on paper.

3. Did your child like this topic?

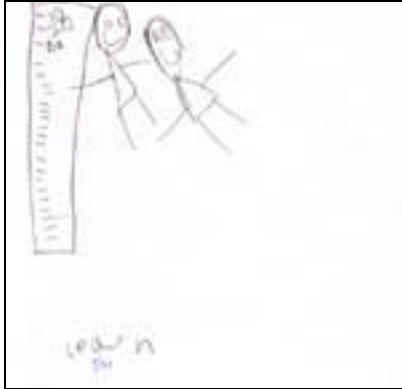
- Yes she really enjoyed the topic, but there again, she has enjoyed the other project this year.
- I believe so.
- Yes
- Yes. I think it will be a topic of discussion for a while.
- Yes.
- Yes.
- Yes. WJ enjoyed the project. I am sure he will continue to ask questions in the future.
- I think talking about measuring was a good way to introduce children to lots of different experiences, professions, and systems, while at the same time, bringing them together under the theme.
- Yes, being interactive she found it fun.

Individual Student Growth - Student Portfolios

Teachers maintain portfolios of students' work samples throughout the year. To evaluate individual growth in a project, the teachers and students reflect and examine the documentation in the students' project portfolios. Five examples of students and their areas of growth are included below.

LS's (6 yr) and Growth in Observational Drawings - From Simple to Complex

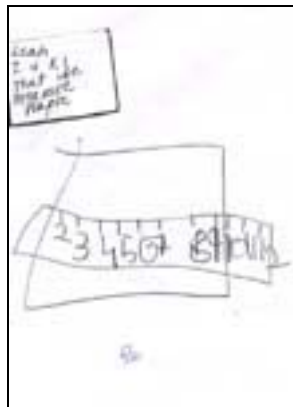
Drawing represents children's thinking. As students progress from simple to complex drawings, they are demonstrating that they understand more about the topic. Teachers saw evidence of growth and change of understanding over time in LS's observational drawings.



In January, LS places a few random numbers on the ruler in her drawing.



LS's memory drawing shows a large ruler with a few numerals on it.

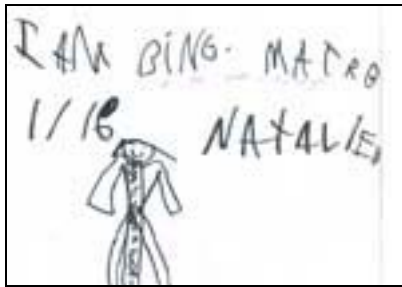


In May, LS draws a more accurate representation of a ruler at the end of the project.

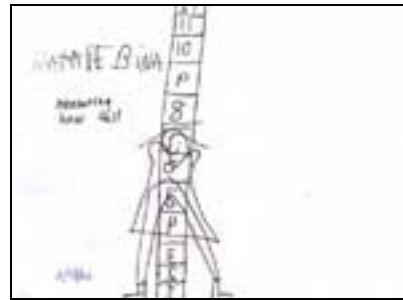
Not only did LS become more aware of measurement tools, she even asked a friend of her family if he could come and talk about the kind of measuring he did as a food inspector. LS arranged for the food inspector to come and talk to the other students at school.

NB's (6yr) Growth in Representing and Understanding - Smaller Leap to a Greater Leap

In April, NB predicted that she was 8 inches tall before being measured. Early in the project she drew and labeled her picture, "I am being measured." A month later she drew the ruler taller than her body. However, in each drawing, the ruler indicated that she was 8.



On 1/16, NB draws the ruler stopping at 8. However, it was too short to measure the person.



2/13, NB draws the ruler going taller than the person.

After a parent measured her at school, she proudly announced that she was 47 inches tall. At the end of the project in May, NB wrote about foot rulers for measuring small things like a chick. She also talked about yard rulers for measuring taller things. She commented that she would need “two yard rulers,” not foot rulers, to measure her. The student reflections demonstrated that she gained a real interest in measuring and felt empowered to measure herself and others. Notice how all three responses in the student reflections related to her identity as a child who sees herself as being competent to measure.

What would you tell a friend about measurement?

NB: I would say we could measure each other. We could weigh ourselves and find out how tall we are.

What would you like to keep doing with measurement?

NB: I'd like to measure myself to see how tall I am or how much I weigh.

What are you still wondering about measurement?




NB: I was wondering what number a yardstick went up to, but then I found I could find out easily by looking at a yardstick.”

Using Digital Photographs for Assessment and Teaching

The digital photographs became both a tool to extend learning for the students and a way to enhance evaluation and assessment for the teachers. The teachers gave students the photographs from their field experiences to help them represent what they saw and learned on their trips. Using the digital photographs, students carefully tried to match their representations to the pictures. The digital camera was a new purchase this year. The teachers suspected that not only did students mature in their ability to represent their ideas over the year, but that the digital photographs greatly improved their attention to details and their ability to make more realistic and accurate representations in the measurement project.

BH's (5yr) Growth in Representing - Simple to Complex

BH was self motivated and worked independently on his three-dimensional representations. Over the months he demonstrated his increased attention to detail as he covered the boxes with paper and paint to transform them to model the objects that he was representing.

Digital Documentation of Process	Teacher's Comment
	In September, during the fall project on <i>Keeping our Environment Healthy</i> , BH chose to make a simple three-dimensional construction out of cardboard.
	In October, BH had big plans for his three-dimensional work and would return to it over several project/activity time periods.
	He made a series of boats with construction paper taped to cover the words of the box. He was proud that his boats did not dump garbage into the water, but rather reduced, recycled, and reused.



Throughout November, he continued to paint his series of boats to make them look complete.




By December, BH's three-dimensional construction of a ship has many details and a coat of paint to give it a more finished appearance. He returned to his project over several days and worked diligently until completion.



2/29/02
BH used clay at the beginning of the measurement project. He misnamed the ruler a scale.




In the measurement project BH worked collaboratively with two other children on making a money counter. Working as a team was a new experience for BH. Even though it appeared that he knew that the money counter was not red, he didn't object and helped paint it. Afterward he reported, "We needed to repaint it, because the color we used in the beginning wasn't good."

	<p>BH embellished his ideas on the second topic web by explaining how he could measure or predict the height of flowers.</p> <p>BH: You can measure how tall flowers are with a ruler. You could go outside into your garden to see how tall the plants are if you feel like it. You could also predict how tall the plants are going to be, so you can think where you want to plant them. You can measure all kinds of plants.</p> <p>The statement infers that he conceptually understands how to measure with a ruler. However, because he placed the numerals on the ruler with 1 on the top, he may have misconceptions about how to use the tool for measuring, or he may not have paid attention when he was making his drawing.</p>
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The documentation often provides evidence that students have shown discrepancies in their understanding. Teachers need to plan additional activities to teach and further assess students' knowledge. In this case, BH performed other measuring activities satisfactorily in class.

MB's (6 yr) Growth in Representing, Greater Engagement and Persistence

The teachers watched the ways that students chose to represent their ideas. Teachers probed students' thinking by asking questions. MB grew in his disposition to attend to details and to independently stay engaged for longer periods of time.

Digital Documentation of Process	Teacher's comment
	<p>In September, MB's representation of the garbage truck during the fall project is simply made. There are few details and no attempt to make it look finished.</p>



In late April, MB and JK worked as a team to find the right material to make a coil representation. They discussed and tried out materials in answer to the teacher's question, "What materials do you think would work best in making your representation?" They tried clay and were unhappy with the results. The photograph shows that in the first week of May, they are working with paper shreds.






As MB contemplates how to make the thin pieces of paper roll like a coil, JK puts the shreds on his head. MB is frustrated by the thin pieces of paper tearing and JK not contributing. MB & JK decide to work on separate representations.



Looking at the digital photograph, MB thinks about his options.




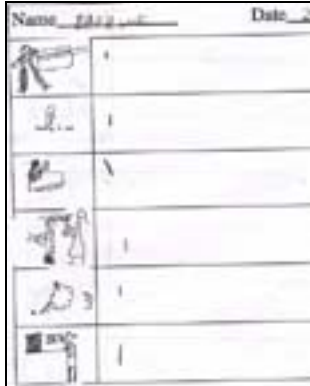


5/13
MB tries cardboard cylinders in answer to the teacher's question, "What other materials could you use?"



	<p>5/16</p> <p>MB solicits help in holding and taping the tubes to make the coil representation. MB worked diligently on getting the coil to look the way he wanted.</p>
	<p>5/23</p> <p>The coil had many numbers on it. MB's idea was to write numbers around the coil with a pen. He found this to be tedious work so he decided to write on a third of the coil each day.</p>
	<p>5/30</p> <p>This is the Open House display of MB's coil representation next to the digital picture.</p>


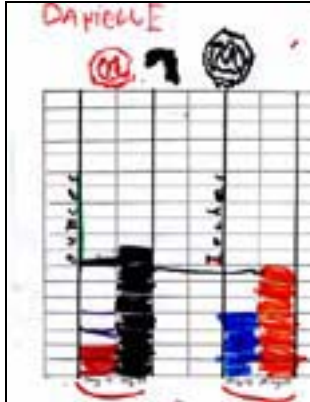
DM's (6 yrs) Growth in Thinking and Reflecting on Her Past Experiences and Data Collecting - Simple to Complex

DM had experience with project work in her previous class. Her academic skills were on par with typical kindergartners, but she was less accomplished in social skills and expressive vocabulary. DM was able to formulate questions but self-evaluating and reflecting on her own work was difficult for her.

Date	Child's Comment	Context for Documentation	Teacher's Comment
1/7	First comment: You have to measure wells – you know, water. Second comment: You measure basketball hoops.	This is a whole group brainstorming session.	At this meeting, children reflected on what they knew about measurement. Many of the students brainstormed about experiences that they had. DM had difficulty reflecting on her past. After a child remembered about measuring the depth of swimming pools, DM offered measuring wells. Again, a child brainstormed, “You measure to have the right size bat.” DM suggested, “You measure basketball hoops.” DM didn’t appear to recall her own experiences, however when she listened to peers’ comments she offered something similar.
1/16		Memory drawing saying: “My Auntie measured me for a dress.”	DM drew a long measuring tape with no numbers on it.
1/24	Answered a sign-in question under “yes” that measuring a baby’s weight is the same as measuring the inside of a clubhouse.	After the students grouped their memory drawings by similarities, she responded to the sign-in question.	In the discussion on 1/22, DM talked about an experience that she now remembered - that her baby brother got weighed but she did not differentiate in the discussion or on the sign-in question between types of measurement (linear or weight).
1/28	DM: You can measure the lake. This is a ruler measuring into a swimming pool.	DM joined the group discussing difficulties that they had in measuring liquids.	DM joined a group of friends. She had brainstormed about measuring water. However, she had not measured wells in the past. She had experiences with liquids in pouring drinks, but she did not mention it.
2/15	DM: I think we’ll see people measuring wells for water.	Students predicted all the ways they thought people measured in and around the school building.	All the predictions except DM’s were based on previous experiences. DM did not make a prediction that was linked to her past experiences in the school.

2/19	<p>One tally mark in each category.</p> 	Data collecting on a field site visit to the offices in our school building during math time.	DM did not appear to understand data gathering or connect marking a tally behind a picture after seeing a measuring device or someone measuring. When the teacher had a conference with her, she said she had seen all those things one time. This did not agree with the data collected by the rest of class.
2/21		Data collected is translated to a bar graph during math time.	DM translated the data to the bar graph correctly.
3/8	DM: We learned about measuring stuff. I love measuring water.	DM's entry for the K/1 classroom newsletter, <u>February issue</u> .	Since beginning the project, DM has commented about water. This entry in the February newsletter is a realistic reflection on her experiences.
3/11		During journal writing time, DM draws and questions, "Why do you measure with the ruler?"	DM sincerely wondered why people measured with rulers. This drawing is the first piece of evidence that she was beginning to reflect on what she wanted to know.

3/14	DM works with AC on painting a box white.	The work is to represent the kiln that she saw with a small group on a field visit to the Ceramics studio on 3/13. She painted the box during project/activity time.	Three girls decided to work together to make a kiln representation. They planned what materials they needed. DM contributed by painting for a short while.
3/15	DM scribbled in round black circles over the white paint.	During project/activity time, a digital photo was placed so DM could see the black straight lines that looked like bricks.	The other two girls, NO and AC, decided that DM was tired of working on that representation and that was the reason she was not being careful. They were upset at their work having to be redone. The thin straight lines may have been a manual dexterity challenge for DM.
4/2		DM chooses to measure around the room during project choice time.	DM made a choice of something that interested her and worked collaboratively with someone else on a common task.
4/17		DM painted on one side of the fire truck during project/activity time.	DM positively contributed to a shared group representation. She was successful partly because she was alone on that side with her own brush and it was not delicate work.
5/14	DM: I didn't know that kids can measure with a ruler or tape measure; I didn't know that you measure tables and carpets; I didn't know that you can measure seats.	End of the project brainstorming session during a whole group meeting where students shared what they learned about measurement.	DM comments are directly related to some of her chosen classroom experiences that involved linear measurement. The average age of conservation for number and linear measurement is 6 – 8 years. She had a clear understanding between linear and weight measurement.

5/21		Illustration of what she now knows about measurement.	The drawing showed that DM had put numbers on the ruler realizing how important numbers are in measuring. In her memory drawing in January, she did not draw numbers.
5/24	DM: People measure other people with a tape measure to see how tall they are. They can measure bricks with a tape measure to find out how big they are and you could use them for buildings. Measuring is important for making a map of the world because you have to measure how big is the world.	Students generated four themes of "What's Important about Measuring." They worked in groups planning and making murals to be displayed at the Open House.	DM chose to work with the group on the mural, "Measuring is Important for Good Health." She was uncooperative with the group and the group asked her not to work with them. DM decided to work alone on a poster. She dictated what she was illustrating. She talked about three of the four themes all in one.
5/28	<u>DM PowerPoint presentation.</u>	DM chose to make a PowerPoint presentation.	The PowerPoint presentation shows an increased ability to reflect on her experiences.
5/30	DM took data from measuring and weighing chicks. 	The data was placed on a graph.	DM grew in her ability to gather data. She was able to gather data, graphically organize it, and communicate the findings.

Although DM made positive contributions on shared group tasks at times during the project, improving her social skills remained a target goal. DM showed gains in her ability to think about measurement and reflect upon her past experiences. She also grew in her ability to gather data and organize it meaningfully.