

Electronic Theses and Dissertations, 2004-2019

2013

Formative Assessment: Benefit For All

William Wallace
University of Central Florida

 Part of the [Science and Mathematics Education Commons](#)
Find similar works at: <https://stars.library.ucf.edu/etd>
University of Central Florida Libraries <http://library.ucf.edu>

This Masters Thesis (Open Access) is brought to you for free and open access by STARS. It has been accepted for inclusion in Electronic Theses and Dissertations, 2004-2019 by an authorized administrator of STARS. For more information, please contact STARS@ucf.edu.

STARS Citation

Wallace, William, "Formative Assessment: Benefit For All" (2013). *Electronic Theses and Dissertations, 2004-2019*. 2702.
<https://stars.library.ucf.edu/etd/2702>

FORMATIVE ASSESSMENT: BENEFIT FOR ALL

by

WILLIAM V. WALLACE
B.S. LeMoyne College 2003

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Education
in the School of Teaching, Learning and Leadership
in the College of Education
at the University of Central Florida
Orlando, Florida

Summer Term
2013

Major Professor: Juli K. Dixon

©2013 William V. Wallace

ABSTRACT

This study investigated how formative assessment implemented in a fifth grade mathematics classroom with a student response system and a student self-evaluative tool affected student self-assessment. Data were collected through individual student and focus group interviews, self-assessment sheets, and teacher reflections.

Formative assessment is a low stakes classroom assessment that is an assessment for learning. This study used a student response system to convey feedback from the formative assessment to both students and teacher during instruction. The student self-assessment sheet was implemented to provide a more dynamic level of feedback for students than what could be provided through the student response system alone.

To the teacher who has had the greatest impact on me as a learner, as well as the best teacher I have ever seen, who inspires me to always improve my craft.

CJW

ACKNOWLEDGMENTS

Liam and Myra, your patience has helped me be a better father and educator, for that I am forever thankful. My parents, Fran and Maryellen, your patience has always given me a strong sense of self that has allowed me the confidence to achieve goals that I never imagined attainable. Every positive impact I have made and will ever make in this world is because of the two of you.

Dr. Juli K. Dixon, your patience gave me the guidance to finally find my way. Thank you for pushing the right buttons, at the right time, and igniting an empty page into a study that will hopefully influence educators to come. Thank you Marie Pecoraro for always being eager to lend a hand. Thank you to Dr. Lisa A. Dieker and Dr. Janet B. Andreasen for serving on my committee.

Warm or Cold.

TABLE OF CONTENTS

LIST OF FIGURES	ix
LIST OF TABLES	xi
INTRODUCTION	1
LITERATURE REVIEW	3
Assessments	3
Formative Assessment	6
Student Response Systems.....	8
Feedback	9
Self-Assessment	11
METHODOLOGY	13
Introduction.....	13
Setting	13
Study Procedures	15
Student Self-Assessment Methods.....	15
Formative Assessment: SMART Notebook.....	16
Student Response System	21
SMART Teacher Tools.....	22

SMART Notebook	23
SMART Receiver and SMART Clickers.....	26
Student Procedures.....	27
MO Self-Assessment Sheets	27
SMART Clickers	28
Teacher Procedures	29
Data Collection	34
DATA ANALYSIS.....	36
Self-Assessment Tool: The Modus Operandi (MO).....	37
Focus Group & Individual Student Interviews	43
Teacher Reflections	48
CONCLUSION.....	51
Introduction.....	51
Results.....	51
Implications.....	52
Limitations	55
Recommendations.....	55
Summary	56

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER.....	58
APPENDIX B: PARENT CONSENT FORM.....	60
APPENDIX C: TEACHER EXPLANATION OF RESEARCH	65
APPENDIX D: MODUS OPERANDI (SELF-ASSESSMENT SHEET).....	68
APPENDIX E: MODUS OPERANDI (SELF-ASSESSMENT SHEET) ASSESSMENT CRITERIA WITH STUDENT EXAMPLES	70
APPENDIX F: EXPORTING FORMATIVE ASSESSMENT DATA TO MICROSOFT EXCEL	72
APPENDIX G: FOCUS GROUP INTERVIEW QUESTIONS.....	74
APPENDIX H: TEACHER REFLECTION QUESTIONS & RESPONSES	76
APPENDIX I: STUDENT INTERVIEW QUESTIONS.....	84
REFERENCES	86

LIST OF FIGURES

Figure 1: Example of a question that could be used for any assessment.	5
Figure 2: An empty SMART Notebook File	18
Figure 3: A screen capture of the digital student edition into SMART Notebook.	18
Figure 4: An example of one type of formative assessment questions chosen from the teacher edition.	19
Figure 5: Example of a common error question with its description taken from the teacher edition.	20
Figure 6: The example of a common error question with the use of a pull tab to give feedback to the teacher and students.	21
Figure 7: The fictitious class and students listed within SMART Teacher Tools. The bottom portion of the figure displays specific student information and you can see that this student has been tagged as a non-FRL, Free and Reduce Lunch, student.	23
Figure 8: The title page within a SMART Notebook file. On the bottom right shows delivery mode and feedback.	25
Figure 9: The choices of types of questions on the left. On the right at the top where you type in your question if needed and below the Common Core Standard is tagged for this question.	26
Figure 10: The progression of a student signing in, inputting their answers, and the feedback sent through a SMART Clicker.	29
Figure 11: SMART Notebook file shows the pie graph of the data for student responses.	31
Figure 12: Specific student data from formative assessment within SMART Notebook file.	33

Figure 13: Triangulated design for data collection, adapted from Oliver-Hoyo & Allen, 2006. . 36

Figure 14: Student work from MO sheet. 39

LIST OF TABLES

Table 1: MO student response of twelve with high scale choice, but incorrect solution.	41
Table 2: Student Interview 1.....	45
Table 3: Student Interview 2.....	46

INTRODUCTION

Formative assessment gives teachers useful information to proactively guide their instruction ("Intelligent Uses for ARRA Funding: Technology Based Formative Assessment," n.d.). However, are we missing opportunities to develop student use of this information? Teachers are increasing technology integration into assessment with student response systems such as SMART Clickers ("SMART Technologies Research," n.d.). A student response system is a wireless system that allows teachers to request information or ask questions which students can digitally respond to using a hand-held device and send their information through a receiver ("What is a Student Response System," n.d.). A benefit of implementing a student response system is that it provides real time data for teachers and students. These data can be disseminated and displayed immediately to improve student performance, guide the teacher to a new direction during a lesson, and create a culture of student self-critique or self-assessment. However, current trends in the literature indicate that while these systems provide helpful feedback for the teacher, this is not the case for students.

Literature indicates that formative assessment is correlated with increased student achievement (Black & Wiliam, 1998). Research also indicates that self-assessment can be used as a vehicle for academic success (Bercher, 2012). This study attempted to do both.

The goal of this research was to use the instructional method of formative assessment and a student self-assessment tool to inform a teacher of student learning and improve student ownership of learning. This study focused on my practice of creating and implementing, with the participating teacher, a self-assessment tool for fifth grade students and to use in conjunction

with a student response system for providing formative assessment feedback to students and their teacher. The need for this study stems from two parts. The first is geared toward the teacher to defeat the uncertainty of where students are in their learning, thus the need to implement formative assessments. The second part of this study centers on the student. My goal was to create a student self-assessment tool to use in conjunction with formative assessments. Through this study I aimed to provide the teacher access to information regarding where her students were in their learning on a given set of tasks so that the teacher could use this knowledge in her instruction and the students could use it to guide their own learning. Specifically, I investigated the question: How does my practice of facilitating formative assessments using a student response system with a fifth grade teacher and students impact student assessment of learning?

LITERATURE REVIEW

Support from the literature for exploration of student involvement in the assessment process comes from two general areas: formative assessment and student self-evaluation of learning. In addition to these areas I also examined student response systems and how they influenced formative assessment, and how through developing and implementing the self-assessment tool students can create their own descriptive feedback. This chapter includes research and literature describing and connecting these areas.

Assessments

Popham (2005) defines assessment as, “a formal attempt to determine students’ status with respect to educational variables of interest” (p. 6). Within assessment, there are specific types of assessment that are conducted in different ways and serve different purposes; they are formative assessment, summative assessment, and diagnostic assessment. This chapter describes these different forms of assessment and the educational variables of interest vested in each.

Formative assessment is an assessment *for* learning (Leahy, Lyon, Thompson, & Wiliam, 2005). A purpose of formative assessment is for teachers to gain a clear portrayal of where their students are in their learning (Black & Wiliam, 2004b). Formative assessment is different from summative or diagnostic assessment. Formative assessment gives the teacher a cloudless view into the erudition of each student.

Summative assessment measures what the student has learned after instruction has taken place, an assessment *of* learning (Danielson, 2008). Stereotypically summative assessments have little impact on learning as it is happening, as the measurement results are commonly seen well

after the learning process, and the class has moved on to a new topic of learning. Leahy et al. (2005) described summative assessment as “information (that) arrived too late to be useful” (p. 19). Summative assessments are used as a main source for grades. Examples of summative assessment are: end of chapter or unit exams and high stakes testing typically conducted by state departments of education. The No Child Left Behind Act of 2002 aggrandized high-stakes summative assessment and amplified its influence in education. Test scores were now the business of learning, but increased test scores have not always paralleled with student learning.

Research conducted by Pedulla et al. (2003) reported that approximately 40% of teachers sought out ways to raise test scores on high-stakes state tests without improving student learning. Correspondingly a research study by Hoffman, Assaf, and Paris (2001) whose sample consisted of over 200 educators reported that, “half of the respondents did not believe that the increases in TAAS (Texas high-stake summative assessment) scores were the result of higher levels of student learning” (P. 488). There is hope, Abrams (2007) believes that it is possible for formative assessment and summative assessment to coexist, but this will only take place when student achievement is viewed as student learning, not an increase in test scores. Abrams continues in her literature by stating, “Greater use of formative assessments will enable teachers to work toward achieving the policy aims of test-based accountability (high-stakes summative testing) while also engaging in thoughtful, effective learning” (2007, p. 94). This perspective exhibits using formative assessment in the classroom for productive learning, and will drive the need for summative assessment to ensure responsibility of student achievement.

Another form of assessment is diagnostic assessment which is to, “determine individuals’ strengths and weaknesses” (Popham, 2005, p.8). An affirming quality of diagnostic assessment is that it does provide teachers information on which student weaknesses to address and can inform their lesson plans (Brookhart, 2010). A downfall to diagnostic assessments is that the majority of benchmarks or standards that are assessed are not the current standards the students are working on in the classroom, which can mean the information may not influence current classroom instruction. Brookhart goes further in stating, “an important aspect of formative assessment is that teachers and students use the information” (p. 4). In differentiating between diagnostic assessment and formative assessment; diagnostic assessment teachers are given information on student weaknesses that they may utilize or not. In formative assessment both teachers and students are given the information and use it to modify immediate learning. A diagnostic assessment is used in schools when placing students in a remedial or accelerated program. Both summative and diagnostic assessments have been used for evaluative purposes. Using these assessments in this way gives teachers and administrators the ability to evaluate and rank students.


7.  **PARCC Test Prep** Albert’s photograph has an area of 80 square inches. The length of the photo is $1\frac{1}{4}$ the width. Which of the following could be the dimensions of the photograph?
- (A) 5 inches by 16 inches
 - (B) 12 inches by 10 inches
 - (C) 6 inches by 5 inches
 - (D) 10 inches by 8 inches

Figure 1: Example of a question that could be used for any assessment.

A teacher can utilize any type of assessment necessary for their needs. I will show how a single question could be used for summative, diagnostic, and formative assessments individually. The question from Figure 1 could be used for summative assessment, after learning has taken place, if the teacher wants to assess what the student has learned. The question from Figure 1 could be exemplified for diagnostic assessment if the teacher uses it in a pre-test to see student strengths and weaknesses and the teacher can customize instruction based on the results. The question from Figure 1 could be used in formative assessment during instruction. The teacher will be able to see which students are having trouble in their learning and can assist them at that moment and adjust instruction as it is happening. Formative assessment also gives the student access to the data which can be used to guide their learning. It is not necessarily the type of questions that set these assessments apart, but how the assessment is purposed.

Each assessment type has its place in education, but summative and diagnostic tests have impacted teaching methods by reducing the use of assessment to help learning (Harlen, 2009). The forthcoming discussion of the literature will highlight the benefits of formative assessments and its potential to impact classroom learning.

Formative Assessment

Teachers use formative assessments to make decisions “intended to improve unsuccessful yet still modifiable instruction” (Popham, 2005, p.8). Formative assessment is an assessment that supports learning (William & Thompson, 2008) in that the teacher has built in time to adapt instruction if needed based on information from the formative assessment. Formative

assessment for learning is used to adapt, modify, and direct instruction (Larson, et al. 2012).

With formative assessment, the assessment is integrated “as an extension of the learning process rather than an add-on, or an end to the endeavor” (LeMathieu & Reilly, 2004, p. 193). Formative assessment is used immediately to make adjustments so as to form new learning (Shepard, 2008).

An example, or strategy, of using assessments instantly is a teacher utilizing student whiteboards after they have worked through a problem. Students would hold up their whiteboards with their answer showing the teacher. The purpose of this is for a teacher to get a sense of where her students are in their learning. Now based on this informal observation the teacher can adjust the direction of the lesson based on the student responses.

The concept of formative assessment has been turbulent. According to Black and Wiliam (2004a) “many teachers and researchers have misunderstood the term.” (p. 22). A common misconception is that testing more frequently makes that testing formative (Wiliam & Thompson, 2008). The term formative assessment is often misused in the United States and used within school districts for high stakes testing predictions that are really “early-warning summative” (Wiliam & Thompson, 2008, p. 60). Wiliam and Thompson (2008) continue to argue that, “the uses of assessment to support learning and to certify the achievements of individuals are so fundamentally in tension that the same assessments cannot serve both functions adequately” (p. 59).

Formative assessment is an instructional method that allows teachers to monitor learning progress of students that is or is not taking place (Popham, 2005). Formative assessment gives the teacher an evidence capture of where in the learning process a student is (McLaren, 2012).

Through this student monitoring using formative assessment, teachers have invaluable opportunities to modify and differentiate their teaching strategies to best fit student needs during instruction.

Paul Black and Dylan Wiliam are notable researchers on formative assessment. In 1998, Black & Wiliam found that “studies show that innovations that include strengthening the practice of formative assessment produce significant and often substantial learning gains” (p. 140). Black and Wiliam (1998) go on to conclude that “formative assessment helps low achievers more than other students and so reduces the range of achievement while raising achievement overall” (p. 141). In this study, teachers used formative assessment data to monitor student learning on a day-to-day basis, or within the time span of a unit (Black and Wiliam, 1998).

Student Response Systems

This study looked to improve upon using formative assessment not just from day to day, but actually having the ability to access where students are in their learning the very moment it is taking place during a lesson. A student response system provides a teacher that insight into student learning during current instruction in real time while the learning is happening, rather than after the lesson, or through indirect observations. Student response systems have added a new dimension to student learning that improves student achievement through the vehicle of formative assessment (Hepplestone, 2011). The teacher now has easily readable data to show how the class scored on a formative assessment as well as how each individual student scored. The teacher can adapt instruction in real time during the learning process. Leahy et al use the

term “hinge point” (2005, p.22) because the teacher can direct the lesson in a number of paths based on student learning.

Some researchers believe that these processes are already taking place in a classroom that uses student response systems, however many teachers are not implementing corrective formative strategies to use the system to its potential (Waters, 2012). Many teachers may use it when asking questions during a lesson but the students do not have to sign in and they enter their answers in “Anonymous Mode”. This does not give the teacher detailed information for each student. Anonymous Mode provides a basic polling feature for the teacher, meaning the teacher can see class data. This does not give the teacher the full benefit or insight of the data to see precisely each individual student answer. Student response systems may also be only used as a tool for summative assessments. A teacher has the ability to use this tool with summative assessment. When used this way the students input their answers and the student response system software will grade the assessment for the teacher, as well as generate reports.

Feedback

A downfall to the current student response system is the level of feedback. Student response systems do provide instantaneous feedback which is a characteristic of instructional best practices (Barker, 2011). However, the feedback from student response systems only provides students with a right or wrong answer. Literature shows that feedback of just right or wrong answers is insufficient. Feedback on formative assessment can be more effective as it shows a student his or her strengths, weaknesses, and next steps. (Larson et al. 2012). Formative assessments require descriptive narrative feedback (LeMathieu & Reilly, 2004). This descriptive

feedback can take place in a variety of forms such as oral feedback or written comments.

“Formative assessments provide specific standards-based feedback that leads to improved student achievement” (Burke, 2010, p. 119). Feedback is most effective when it helps move the student forward in their learning (Shepard, 2005).

Most student response systems provide a low level of feedback for students. Many systems provide the student information if his or her answer was correct or incorrect. In some cases student response systems will provide the student who answered incorrectly, with the correct answer. For students receiving knowledge that their answer was correct or incorrect is ineffective feedback (Sadler, 1989). Robust, descriptive feedback does impact student learning. “Feedback enables learning by providing information that can be used to improve and enhance future performance.” (Hepplestone, 2011, p. 117). In summative assessments feedback provided by the teacher can be descriptive through comments, but does it impact immediate student learning? The answer is no, the data or information from summative assessments are attained by the student well after the learning of that topic has ceased. If a teacher could give immediate, descriptive feedback during a lesson while the student is in the midst of learning it would be an amazing feat. The issue is that for one teacher with an average of 20 students per classroom, there just is not enough time to give that robust, descriptive feedback to all students. But what if we could instill in our students ways to assess and reflect on their learning and thus create feedback for themselves?

Student response systems provide valuable data for teachers during formative assessments, but bestow lackluster feedback for students. This study combats the formidable

dilemma of poor feedback from student response systems by developing student self-assessment which could be the authentic feedback vessel for students.

Self-Assessment

Self-assessment refers to the involvement of learners in making judgments about their own learning (Boud & Falchikov, 1989). By embedding self-assessment into instruction, students evaluate and monitor their own learning; students become custodians of their learning experience (Danielson, 2008). Brew (2009) states, “through self-assessment students benefit by becoming more confident, independent and reflective learners, and they obtain a deeper understanding of the required learning” (p. 642). Teachers that enacted a self-assessment method in their classroom showed greater learning gains (Shepard, 2005).

Student self-assessment is within the Common Core State Standards (CCSS) of Mathematics. The CCSS deliver Standards for Mathematical Practice, which describe to educators at all grade levels to develop in their students an assortment of proficiency in mathematics (“Common Core State Standards Initiative” n.d.). For example in Standard for Mathematical Practice One: Make sense of problems and persevere in solving them, students showing expertise with this Standard for Mathematical Practice will, “...monitor and evaluate their progress...Mathematically proficient students check their answers to problems...and continually ask themselves, “Does this make sense?” (“Common Core State Standards Initiative” n.d.).

Formative assessment strategies provide teachers with advantageous information or feedback. By tying formative assessment with current technology, a student response system,

that information can be accessed instantly by the teacher and student. With these data the teacher can adjust instruction as needed, and students can use these data and their student self-assessment strategies to monitor and adjust their learning as needed.

METHODOLOGY

Introduction

The focus of this study was on my practice of creating a self-assessment tool for fifth grade students, to use in conjunction with a student response system and their teacher for providing formative assessment feedback. By students having access to formative assessment data through the student response system and their own descriptive feedback through their self-assessment tool, the goal was for students to develop an ownership of their learning.

In this study qualitative research was conducted. Instructional methods were scrutinized through the use of formative assessments by the teacher. The teacher and I collaborated on the self-assessment tool that gave students a greater stake in their learning process that fit well with formative assessments. Data were collected from formative assessments, teacher reflections, the student self-assessment tool, and student and focus group interviews. All research activities (teacher reflections, student and focus group interviews, and self-assessment sheets) were voluntary, and the students had the choice to not answer while participating in research activities.

Setting

The school setting in which this research took place was an urban public elementary school in central Florida. The demographics of the school were 61% White- Non Hispanic, 27% Hispanic, 4% Black, and 8% Other. The demographics of the students that participated in this study were similar. The percentage of the student population qualifying for free and reduced lunch was 56%.

The participating teacher had eight years of experience in education. She was certified in elementary education kindergarten to sixth grade. The teacher was also certified in English for Speakers of Other Languages. All eight years have been in a fifth grade classroom, and she had taught mathematics for all eight years.

The human research was conducted in a fifth grade classroom that was comprised of 12 male and 8 female students. The grade level was departmentalized and this fifth grade class was shared between two teachers, their homeroom teacher specializing in mathematics and science, while the other specialized in language arts and social studies. All academics were taught to the same group of students.

This study focused on the area of mathematics and the following descriptions are for the mathematics classroom. The technology in the classroom was made up of one teacher laptop, five student desktops, one Elmo document camera, one SMART interactive whiteboard 600 series, and a SMART Student Response System, which included a SMART Receiver and 24 SMART Clickers. The seating in the classroom invited cooperative learning and discussion as they were formed in groups of three to five.

This study was reviewed and approved (Appendix A) by the Institutional Review Board (IRB) of the University. The principal of the school approved the study. Parental consent forms (Appendix B) were signed and returned for all students participating in the study. The student assent letter was read aloud, examined, and student questions were encouraged. The participating teacher also received an Explanation of Research document, see Appendix C. All documents were kept in a secure location consistent with IRB requirements.

Study Procedures

This was a minimal to no risk study; the participants were under age 18. This study took place over a five-week period, from May 2013 to June 2013. A sample of five students was chosen to participate in the interviews and focus groups of the study. The sample was chosen based on the students' differing mathematics abilities, and chosen by the teacher. The students in this study were instructed for 60 minutes of mathematics daily. The curriculum was based on Common Core State Standards. The resource used for general instruction was Chapter 7 in Go Math! Florida Common Core (Houghton Mifflin Harcourt, 2013).

Student Self-Assessment Methods

The student self-assessment tool was used during mathematics instruction for all students. The student self-assessment tool was called the “modus operandi” or MO sheet. The self-assessment tool took no longer than ten minutes to complete during mathematics class time, and as with all research activities was voluntary. An example of the front of the MO, the self-assessment section is provided in Appendix D. Appendix E represents the assessment criteria with student examples of best practices after the creation of the assessment criteria. Each student had a fresh copy of the MO for every mathematics lesson. This fresh copy for each lesson consisted of the front of the MO which included the self-assessment and on the back were the assessment criteria and student examples of best practices when answering a mathematics question.

The MO was two-sided and was divided into two sections on the front, one for each formative assessment question, and consisted of assessment criteria on the back. I created the

MO sheet with the goal of having students self-assess their learning process. Input and modifications from the participating teacher weighed in on the final creation of the MO sheet. There were two formative assessment questions for each mathematics lesson.

The teacher spent approximately 45 minutes outside of mathematics instruction to construct and practice using the MO self-assessment tool with students before actual implementation during the mathematics lessons. This was a collaborative process as students discussed with peers and evaluated and modified parts of the MO. At the same time it was a teacher guided process but emphasis was placed on insuring the instrument was student created, to hopefully lead to greater ownership. After creating the self-assessment portion of the instrument, assessment criteria were built on the back of the page for continuity of what constituted an acceptable mathematics solution of best practice. This performance criterion was modeled after 5th Grade Math Journals (“5th Grade Math Journals” n.d.). Once assessment criteria were confirmed between the teacher and students, the student examples of mathematics best practices were captured into one cohesive example and became part of the MO sheet that students used on a daily basis.

Formative Assessment: SMART Notebook

Before each lesson I prepared two formative assessment multiple choice questions within SMART Notebook software. These questions were word problems that aligned with the lesson the students and teacher were working on that day. The use of the SMART Notebook software, SMART Student Response System, and SMART Interactive Whiteboard were chosen because the school district where this study took place transitioned, approximately 5 years ago, to

standardize these tools across all schools within the district. SMART Notebook is software that contains many tools and features for teachers to create and deliver engaging interactive lessons (“SMART Technologies Education Solutions”, n.d.). Some tools within the SMART Notebook software are: multiple pen tools, highlighter, shapes, ruler, text, capturing tool, and a multitude of interactive tools to manipulate content. SMART Notebook allows the teacher to save all files created within SMART Notebook. An empty Notebook page is shown in Figure 2.

The Notebook file I created for the participating teacher contained two formative assessment questions per lesson, with ten lessons in the Chapter 7 Go Math! Common Core curriculum. Multiplying fractions and mixed numbers was the skills implemented in chapter 7. The formative assessment questions were used with the Student Response System and the digital pages of the Student Edition. The capturing tool within SMART Notebook was used to capture the student pages from the publisher’s website, Thinkcentral.com, as shown in Figure 3. This was constructed for the teacher to be able to digitally manipulate the file on the SMARTboard using the tools within SMART Notebook software. The teacher had displayed through the SMARTboard exactly what the students were manipulating through their hard copy text that was right in front of them. The teacher had the ability to write, highlight, add textboxes, add new pages, erase, and save the digital file using the tools within SMART Notebook software. If the teacher had used the publisher’s digital student edition pages through a web browser, she would not have had the ability to save or add new pages as in SMART Notebook.

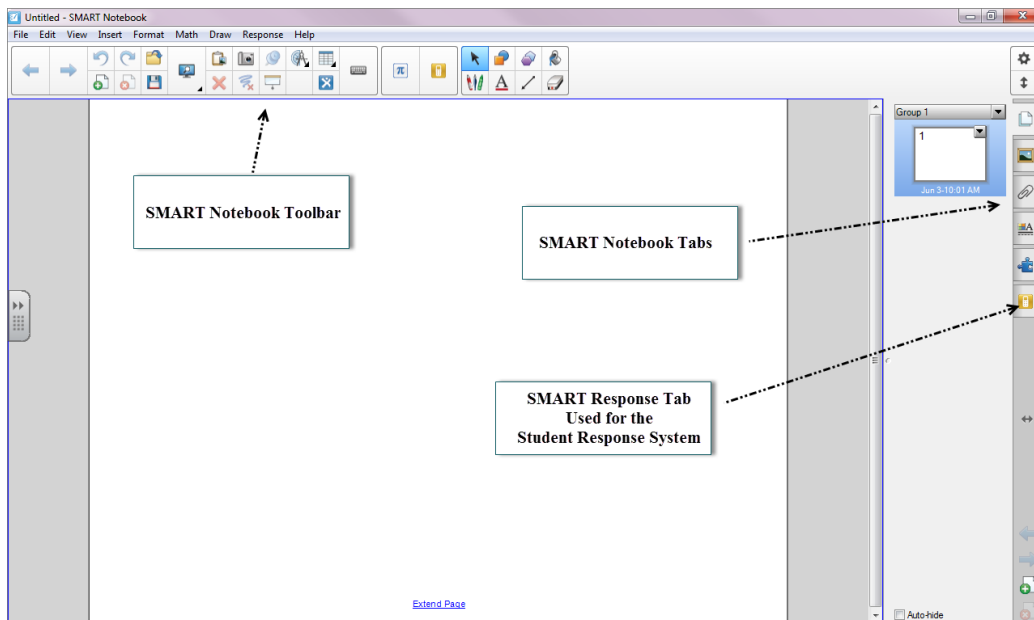


Figure 2: An empty SMART Notebook File

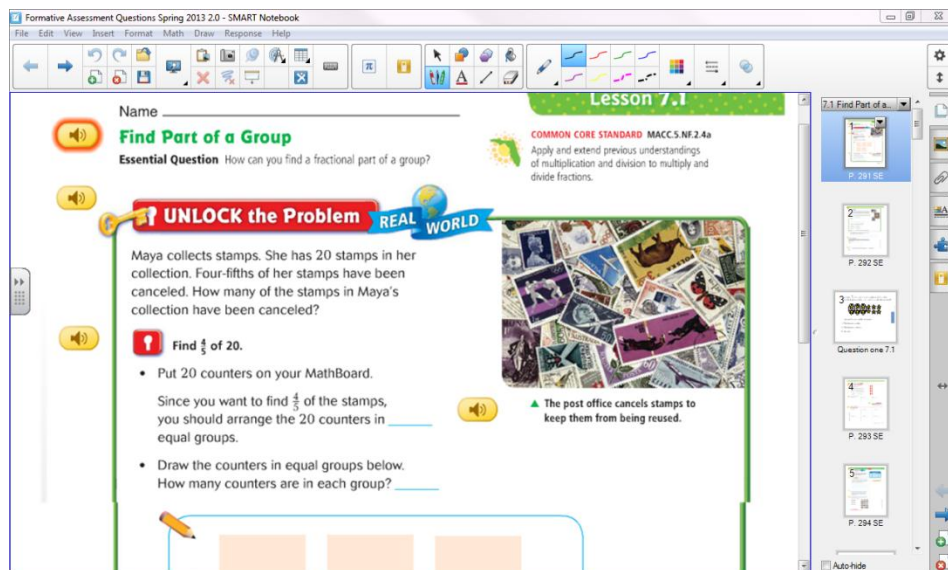


Figure 3: A screen capture of the digital student edition into SMART Notebook.

The capturing of the student edition pages was a two-step process, as I had to capture the two halves of the page separately for best fit. Within SMART Notebook software the teacher

also had the option to add new pages if needed. Using the Elmo document camera the teacher had the availability to capture student work and place it directly into the SMART Notebook file to manipulate, and display through the SMARTboard.

There were two formative assessment questions within each mathematics lesson, for ten lessons during this study. The formative assessment questions used were based off of the “common errors” or PARCC Test Prep Coach sections within the teachers’ edition of the Go Math! series. The common errors gave insight to teachers student mistakes that will most likely occur with that particular skill. In each Go Math lesson there were one or two questions based on addressing common errors and PARCC Test Prep questions. When there was only one common error or Test Prep Coach question, I created the second question. See figures 4 and 5 to show examples of the common error or Test Prep Coach sections from the teacher edition or that I created.

★ **PARCC Test Prep** Rochelle saves $\frac{1}{4}$ of her allowance. If she decides to start saving $\frac{1}{2}$ as much, which statement below is true?

(A) She will be saving the same amount. (C) She will be saving less.

(B) She will be saving more. (D) She will be saving twice as much.

★ **PARCC Test Prep Coach**

In Exercise 14, if students selected:

A They don't understand the concept.

B They interpreted the problem as saving $\frac{1}{2}$ of her allowance rather than $\frac{1}{2}$ of $\frac{1}{4}$.

D They relate $\frac{1}{2}$ to $\frac{1}{4}$ rather than finding $\frac{1}{2}$ of $\frac{1}{4}$.

Figure 4: An example of one type of formative assessment questions chosen from the teacher edition.

! COMMON ERRORS

Error When multiplying a whole number and a fraction, students may multiply the whole number by the denominator of the fraction.

Example $6 \times \frac{2}{3} = \frac{2}{6 \times 3} = \frac{2}{18} = \frac{1}{9}$

Springboard to Learning Be sure students write the whole number in fraction form with 1 as the denominator before they multiply: $6 \times \frac{2}{3} = \frac{6}{1} \times \frac{2}{3} = \frac{12}{3} = 4$.

Have students draw arrows to connect the numerators and other arrows to connect the denominators to reinforce that, when multiplying, numerator \times numerator = numerator and denominator \times denominator = denominator. Encourage students to always use estimation to check the reasonableness of their answers.

Figure 5: Example of a common error question with its description taken from the teacher edition.

The common errors and PARCC Test Prep questions were chosen based on the information the teacher edition provided for teachers. For example, in figure 4 the PARCC Test Prep question gives the teacher valuable information if the student answered the formative assessment incorrectly. It provides the teacher information on what most likely was the cause of the student mistake.

A detailed view of a formative assessment question is in Figure 6. Figure 6 shows the use of a pull tab within the SMART Notebook file. I created an interactive pull tab for each formative assessment question that would hide outside of view until needed, after the students completed their answer. The teacher is able to manipulate the pull tab into view using the SMARTboard and the touch of a finger. The pull tab housed the information of what most likely was the cause for an incorrect answer for the teacher and students.

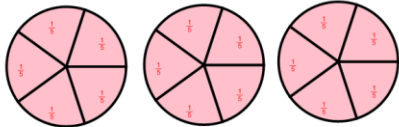
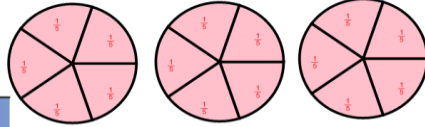
<p>Silas decides to eat $\frac{3}{5}$ of the 3 pizzas that were purchased for the party. How much pizza was left after Silas took his slices?</p> <p>A. $1\frac{1}{5}$ B. $\frac{2}{5}$ C. $1\frac{4}{5}$ D. $\frac{9}{5}$</p> 	<p>Silas decides to eat $\frac{3}{5}$ of the 3 pizzas that were purchased for the party. How much pizza was left after Silas took his slices?</p> <p>A. $1\frac{1}{5}$ B. $\frac{2}{5}$ C. $1\frac{4}{5}$ D. $\frac{9}{5}$</p>  <p>B. Left after one pizza C. Amount Silas ate simplified, but not leftover amount D. Amount Silas ate unsimplified, but not leftover amount</p>
--	--

Figure 6: The example of a common error question with the use of a pull tab to give feedback to the teacher and students.

By giving the teacher the information as to why students most likely got the answer incorrect the intent was to front load the teacher with knowledge as to best prepare for student responses. The goal was to remove the guesswork regarding what exactly the student did incorrectly so the teacher could focus on how to best assist in student learning through modifying her current instruction if needed.

Student Response System

In this study the SMART Student Response System was utilized for formative assessment questions and used with the student self-assessment tool. The SMART Student Response System was chosen because the teacher had easy access and familiarity to these tools. The SMART Student Response System consists of a set (24) of SMART Clickers, a SMART Receiver, SMART Teacher Tools software that works with the SMART Notebook software, which was the vessel for the mathematics lesson and formative assessment, and the SMARTboard for visual display. For this student response system to work and collect the points

of data needed, you must have all components listed above. The SMART Clickers were used for the students to have the ability to join a class, sign in, input their answers, and get feedback as to if their answers were correct or incorrect. The SMART Receiver is the communication link between the SMART Clickers and Teacher Tools software. The SMART Receiver accepts the student input of information from the Clickers and passes it on to the SMART Teacher Tools. The SMART Teacher Tools then collects the data and also displays it within SMART Notebook for viewing. The next sections describe the SMART components and how they were implemented.

SMART Teacher Tools

SMART teacher tools was the component that recorded and housed the data during formative assessments. Within teacher tools you have the ability to tag students as well. This way through teacher tools you can generate reports based on the tags you have created. An example of the layout of teacher tools, student information, and the use of tags is shown in Figure 7. The example shown is a fictional class used for demonstrative purposes.

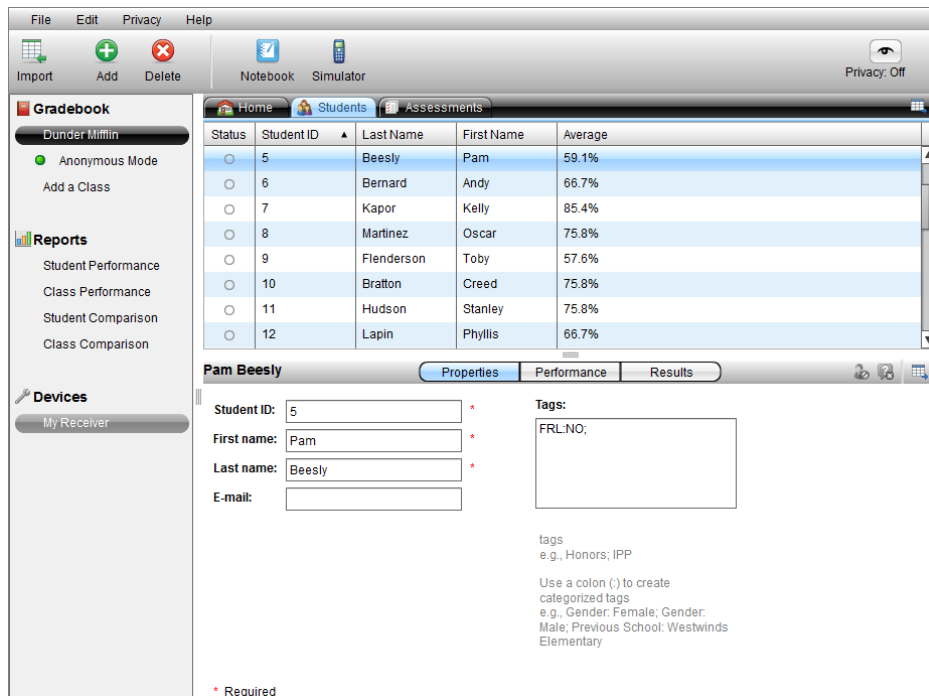


Figure 7: The fictitious class and students listed within SMART Teacher Tools. The bottom portion of the figure displays specific student information and you can see that this student has been tagged as a non-FRL, Free and Reduce Lunch, student.

SMART Notebook

The SMART Notebook component within the student response system is the driving enterprise for the questions of the formative assessment. Earlier in this chapter I discussed the process of the formative assessment questions and how they were built and displayed for student and teacher view. This section focuses on how the formative assessment questions within the SMART Notebook file were tied in with SMART Teacher Tools to collect data with the goal of providing student and teacher feedback to improve student-assessment of learning.

Within each lesson I had to add the formative assessment questions to the Notebook file. I began by creating a title page for the two formative assessment questions, and then I created the formative assessment questions. I accomplished this task by accessing the SMART Response tab within the Notebook file (Figure 2). A title page was added for each lesson and tied the two formative assessment questions together as one assessment. The title page (Figure 8) listed the topic of study in the mathematics lesson, the section of the chapter, and page number to access the beginning of that section. On the title page within the SMART Response Tab, there were options to select. I selected to show results to students (through the SMART Clickers) after the teacher stopped collecting results. I also chose to allow students to answer questions at their own pace, knowing that the pace would be as a group based on teacher instruction. Through the title page is also where the teacher could begin or end the formative assessment.

After the title page was created I added a question to a page, and chose Multiple Choice type question for all formative assessment questions, as in Figure 9. In some cases I would type in the question. In other cases, I created the question using a screen capture from the publisher's digital website; I would not have to type in the question. In this section I would also tag the question with the Common Core Standard we were assessing as shown in Figure 9. With the questions being tagged the teacher had the opportunity to generate student and class data based on the specific standard if desired, but was not an implementation within this study.

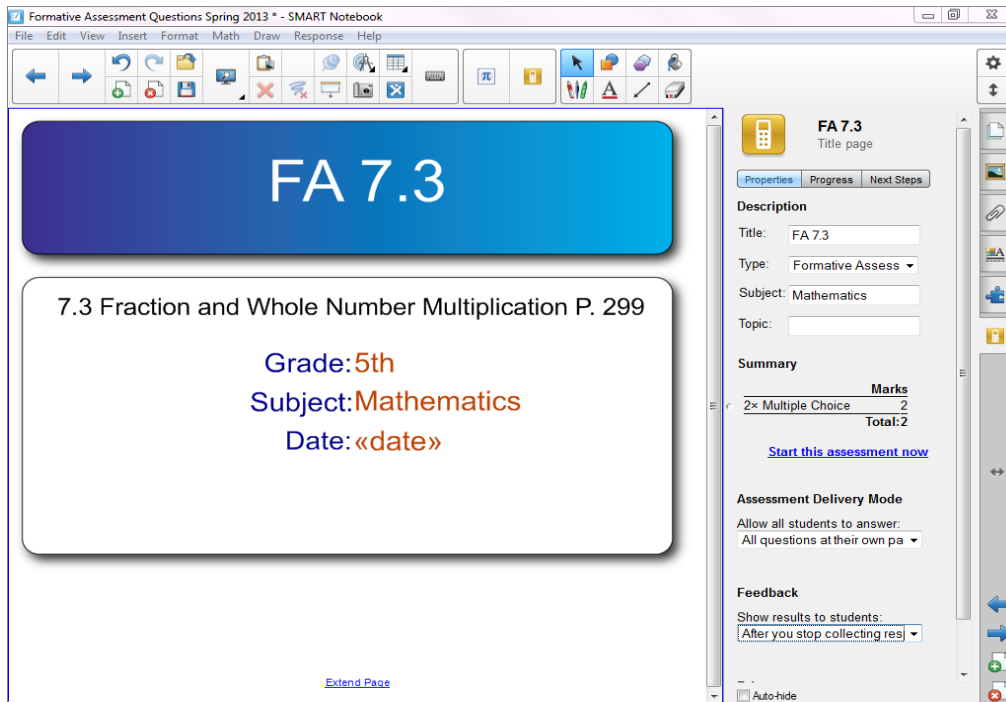


Figure 8: The title page within a SMART Notebook file. On the bottom right shows delivery mode and feedback.

The next step in creating a Multiple Choice question within SMART Notebook, to work with the student response system, was to select how many choices for the question. In my study the number of choices for each question ranged between two and four. Next, using radio buttons, I selected the correct answer and pressed finished to complete the question.

Once the question has been created the teacher can now see the properties of the question and the answer key. The teacher can now choose to show or hide the answer key. If the teacher chooses to show the answer key, the answer is displayed as well as the Common Core Standard that was tagged to that question. Once the questions are created within the SMART Response tab, they are automatically tied into the SMART Teacher Tools software.

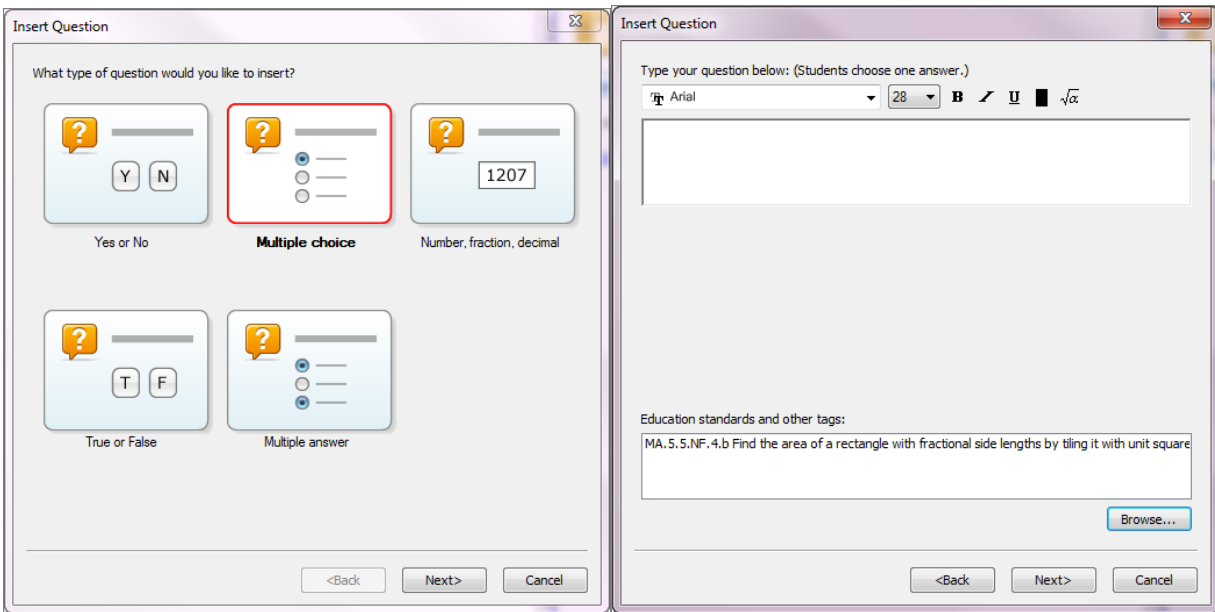


Figure 9: The choices of types of questions on the left. On the right at the top where you type in your question if needed and below the Common Core Standard is tagged for this question.

I created the formative assessment questions to be built for display through the SMARTboard, plus tied into SMART Response. The students were now able to use their clickers to respond to the formative assessment questions and the data were sent to SMART Teacher Tools.

SMART Receiver and SMART Clickers

The SMART Clickers are a wireless remote and used for students to input their answers as part of the formative assessment process. The teacher had the SMART Receiver in place to accept their responses. The SMART Receiver was plugged into the teacher laptop through a USB connection. The SMART Receiver linked directly to the SMART Notebook file that the formative assessment was on and Teacher Tools. Through these connections is how the student responses were recorded for the formative assessment.

Student Procedures

MO Self-Assessment Sheets

In this study we integrated technology use and a self-assessment tool into the mathematics classroom. Prior to this implementation I worked with the participating teacher to set up procedures on how students would proceed with both components of this study. Earlier in this chapter it was detailed how the MO was created and introduced. The next sections will focus on how it was implemented during mathematics class time.

At the start of each mathematics lesson students received a copy of the MO sheet, adding their name and date once received. The students used the MO sheets when completing the formative assessment questions only, with the aim being to impact student self-assessment of learning. Students first began working out the formative assessment problem either within their textbook or on a separate sheet of paper using a pencil. Once students decided on their best solution to the formative assessment question, using justification and explaining in detail they began the top portion of the MO sheet (Appendix D).

The first part of the MO sheet focused on what the student is most confident about. As discussed with the teacher prior to this study she had worked with her mathematics class for students to find information in the word problem that is absolute. The next step in the MO sheet was a simple reminder list asking students to check if their answer makes sense, if they showed their work, and if they checked their work. Next students had a four point likert scale that referenced the assessment criteria on the back of the MO sheet. The likert scale measured one to four, with four meaning that their answer met all aspects of the assessment criteria, and one

being that their answer met few aspects of the assessment criteria on the back of their MO sheet (Appendix E).

Students next inputted their answers using SMART Clickers. Once all students have answered the teacher stopped the question and the students received their results. Using their MO sheets the students check if they scored incorrect or correct. From there they completed the “Marvelous/Misconception” section of the MO sheet. This had students evaluate their work to look for things they did well and search for their mistakes or misconceptions. Lastly, the students completed the bottom question on what they learned for “future math awesomeness”. This process was completed once for each of the two formative assessment questions for that lesson.

SMART Clickers

Students would join the class and sign in using the SMART Clickers when mathematics class time began. The SMART Clickers would stay on and signed in throughout the mathematics lesson. The students would use the SMART Clickers to input their answers to the formative assessment questions. When the teacher stopped the assessment the students received the data if their answer choices were correct or incorrect. The SMART Clickers also showed a “Grade”. It was discussed and made clear to the students by the teacher that the formative assessment questions were not taken for a grade.



Figure 10: The progression of a student signing in, inputting their answers, and the feedback sent through a SMART Clicker.

Teacher Procedures

The teacher procedures centered on the two question formative assessment, student response system, and providing time for the students to complete the MO sheet. The first formative assessment question occurred around the mid-point of the lesson and the second formative assessment question towards the end. For the student response system the teacher needed to start and stop each assessment. Also, the timing of the feedback from the student response system was critical because the students needed to complete the top portion of the MO sheet and then receive the feedback from the student response system. The formative assessment gave both teacher and student the opportunity to adjust and evaluate student learning. The

student can use the data from the student response systems and their reflection within their MO sheets as well as using their assessment criteria examples to adjust their learning.

The goal of formative assessment is to provide an enlightened determination of student learning as it is happening. The benefit is that this occurs as instruction is taking place, and can be modified to best meet the needs of the student at that juncture based on the formative assessment data. When a teacher and class use a student response system the teacher holds that data at their fingertips. The smart response system provided feedback to both student and teacher. For the student the feedback from the student response system was minimal and for students to move forward in their learning they needed more, in this study we used a self-assessment tool. The information for each formative assessment that was housed in the pull tab, gave teacher information to best prepare for student incorrect responses. With that information prior to teaching a lesson and the feedback from the student response system for the formative assessment questions the teacher now has options to remediate or excel in real time during instruction.

The component driving the feedback for a teacher in the student response system was SMART Notebook. It was found after completing lesson one in this study that the formative assessment needed to be modified. By including a Title Page for the formative assessment questions, in the SMART Notebook file, the two questions were tied together. The problem that arose from this set up was that to get feedback for question one in the formative assessment you had to complete both questions in the student response system. This clearly was a conflict within our procedures for completing the student self-assessment MO sheet, as the feedback from the

student response system needed to take place for each question at a specific time. The conflict was remedied by deleting the Title Page. Now the two formative assessment questions were independent of each other within the lesson.

With the formative assessment questions corrected and independent of one another the students could get the data they needed, and the teacher could access the data as well. The SMART Response tab gives the teacher the feature to access data for the class or for individual students. Figure 11 shows how class data can look while students are inputting their answers, as well as when they are finished. The teacher has the option to show the class data in a pie graph or bar graph. This is a quick reference for a teacher to see, as a class, where her students are in their learning.

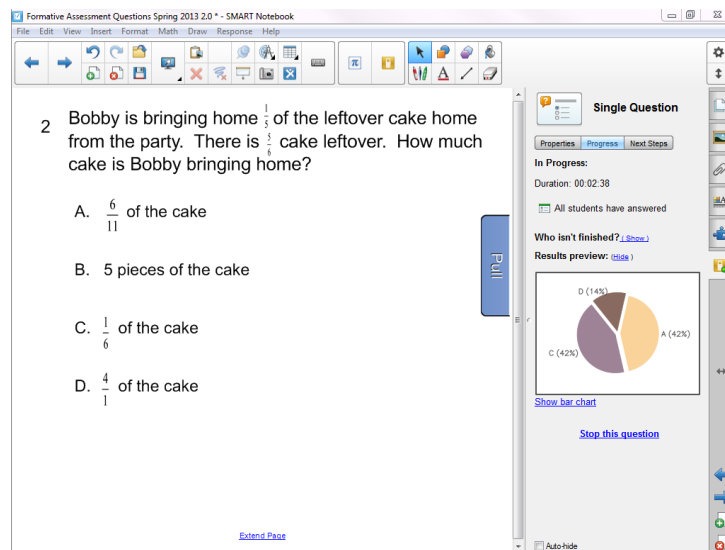


Figure 11: SMART Notebook file shows the pie graph of the data for student responses.

Through the formative assessment utilizing the SMART response system the teacher had access to specific student data. Figure 12 shows an example of student data the teacher can view

once they stop the question through the smart response system in the SMART Notebook file. The “Details” provide the name of the student their answer choice and the duration of time spent on the question. In this study “Duration” of time was insignificant because when the teacher started the question, the student most likely had their answer ready to input. The teacher also had the option to export the results of both questions from the formative assessment into one excel file with the question data stored on two separate sheets within the same file. Exporting to Excel allows the teacher the ability to save that data. Exporting the data was not part of the study, but the teacher did have prior knowledge of that feature before the study began. Appendix F demonstrates an example of what the data would look like if exported to excel.

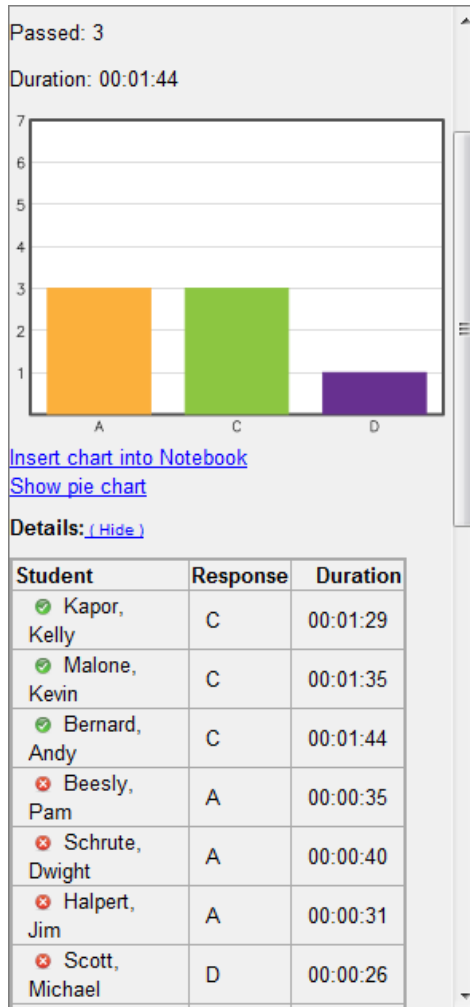


Figure 12: Specific student data from formative assessment within SMART Notebook file.

This study integrated technology with formative assessment methods and a student self-assessment tool. The MO student self-assessment tool was built to be the driving force for student evaluation of learning through the instructional method of formative classroom assessment. The goal of these interconnected components was to work in unison to influence student assessment of learning.

Data Collection

Data were collected from formative assessments, teacher reflections, student MO sheets, and student and focus group interviews. During data collection all materials were kept locked and secured. The data were stored in the fifth grade classroom. The only persons to have access were myself, and the classroom teacher through collection of the data. All data were destroyed at the end of the study. The same students participated in the focus group and student interviews. The sample of five students was chosen by the teacher.

Within this study there were two focus group interviews. The focus group sessions were recorded through a video recording device. The focus group consisted of all five students from our sample concurrently. Each focus group session was planned for three to five questions, but as the sessions transpired other questions were posed based on student answers. A list of guiding questions for the focus groups is provided in Appendix G. The focus group sessions were study related and optional for the participant; they extended beyond regular classroom expectations. The setting for the focus group interviews was in a fifth grade science lab classroom. The focus group interviews took place during Special Area time (Physical Education, Music, Art etc.). The time designated for the focus group sessions were no longer than 45 minutes.

The teacher was responsible for completing three reflections. This reflection piece was given at the beginning, middle, and end of the study. The time to complete each individual reflection prompt was no longer than one hour. These reflections were voluntary for the teacher. A list of the teacher reflection questions is provided in Appendix H.

The student MO sheets were collected at the end of each mathematics lesson and kept in a three-ring binder using tabs for organization of each section of the Go Math! Common Core chapter. The formative assessment questions for each section of the chapter plus the publisher's digital screen capture pages were located within one SMART Notebook file. Once the teacher completed the last lesson the SMART Notebook file with all of her modifications it was returned to me for data.

Within this study there were two student interview sessions. The student interviews were recorded through my laptop using Audacity software. The student interviews consisted of all five students from our sample individually. Each student interview was planned for three to five questions, but as the session transpired more questions were posed based on student answers. The questions are provided in Appendix I. The student interviews were study related and optional for the participant; they extended beyond regular classroom expectations. The setting for the student interview one was in the participating teacher's fifth grade classroom. The other setting used for student interview two was in a fifth grade science lab classroom. The student interviews took place during Special Area time (Physical Education, Music, Art etc.). The time designated for each student interview was no longer than eight minutes.

DATA ANALYSIS

This study focused on the use of formative assessment in the classroom. I enhanced the existing formative assessment instructional method by integrating a student response system, and used a student self-assessment tool with formative assessments. The goal of this study was to examine the above components to see how they might affect student self-assessment of learning.

For this study three sets of data were analyzed. I used focus group and individual student interviews, teacher reflections, and the actual student self-assessment tool (MO sheet) to gather data. The hope was for these three types of data, collected through qualitative methods, to provide triangulation to determine confirmation of an impact on student self-assessment. I adapted a figure from Oliver-Hoyo & Allen (2006) as seen in Figure 13. This visual assisted me with understanding the concept of triangulated design.

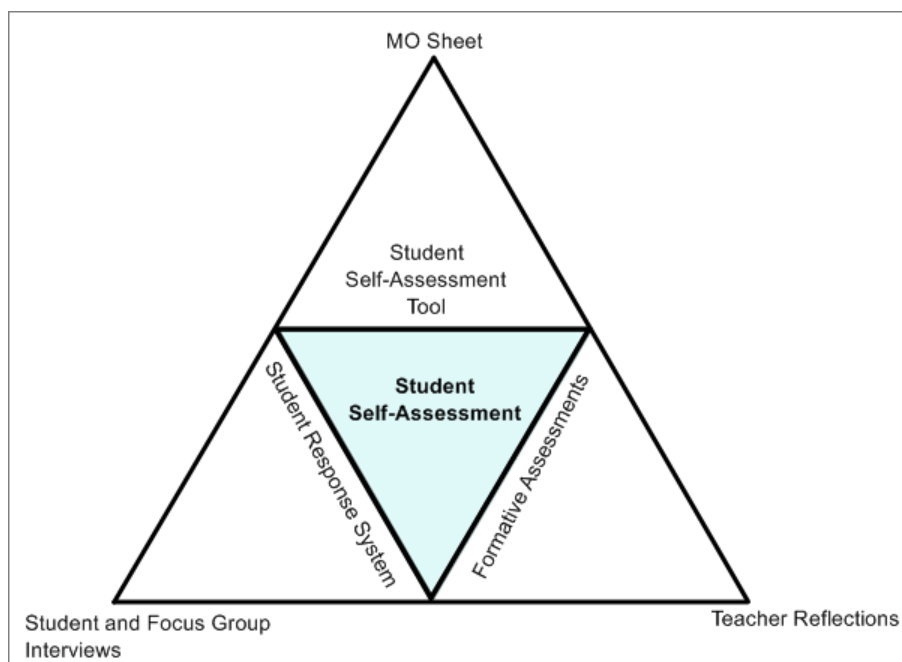


Figure 13: Triangulated design for data collection, adapted from Oliver-Hoyo & Allen, 2006.

On the outer vertices of the large triangle lay the three modes of data collection: student and focus group interviews, teacher reflections, and the MO sheet. These three modes of data collection exhibited how the different components implemented in this study, and along the edges of the blue triangle, possibly influenced student self-assessment, our driving question in this study.

Self-Assessment Tool: The Modus Operandi (MO)

The MO sheet was the self-assessment tool the students used in this study, and is provided in Appendix D and E. The self-assessment tool was generated because of the need to create valuable feedback from formative assessments, since the feedback from the student response system of a right or wrong answer was insufficient. I modeled the construction of the MO sheet after the research conducted by Fastre, van der Klink, Sluijsmans, and van Merriënboer (2012). The first step for student self-assessment is selecting relevant performance criteria. In this study the assessment criteria was designed between the teacher and I, based off of 5th Grade Math Journals. The time spent working with the assessment criteria as a class at the beginning of the study provided clear performance criteria for the students as described in chapter three. Step two of student self-assessment is judging the extent to which performance of learning tasks meets relevant criteria. In this study the MO sheet consisted of a four point scale to give clear direction of the assessment criteria that described a high level of performance (Marzano, 2007). This scale was completed prior to students attaining knowledge of if their solution was correct or incorrect. The students also completed a marvelous/misconception section on the MO describing what they did well, and where their possible faults may have been.

The marvelous section consisted of students finding aspects of their work or thought process that they did well. The students wrote down these marvelous items, with the purpose of showing that even if their answer was incorrect there were still parts of their solution that they did well. The misconception section had students focus on where they may have made their mistake if incorrect. The final step of student self-assessment is identifying areas for improvement that are to be addressed in future learning tasks. In this study the students completed the “What did you learn for future math awesomeness?” section. The students were directed to complete this section whether their answer was correct or incorrect.

An area that some students showed possession of careful thinking was the top section of the MO for “what are some things you know for sure?” My goal for this section was for the students to dissect the mathematics problem they were working on. By focusing on what the students knew for sure in the problem, the goal would be that it would be easier for them to see what they had to solve. In this section I saw strategies being used of taking facts directly from the question and using that text to build their knowledge of the question. Some students just went straight to creating an equation. A few students showed a level of understanding by discussing if their answer was greater or less than the use of a benchmark mixed number.

An affirmation of student self-assessment being influenced came from analyzing the relationships within the MO sheet. I was especially interested in the students that chose a 3 (met most aspects of assessment criteria) or a 4 (met all aspects) but ended up getting the formative assessment question incorrect. This occurred only twelve times out of approximately 200 opportunities throughout the study. This shows a level of soundness in judgment of the

assessment criteria on the part of the students, meaning that the students judged fairly if they met the aspects of the assessment criteria or not. After being fairly confident in their answer, were these students able to see their misconception? And did they learn anything for future math awesomeness? By looking into these aspects I am examined how the students evaluated where they made their mistakes, and what they learned for future learning. Figure 14 shows student work from an MO sheet. In this example you notice that the student was having trouble in question one, but she gets specific in her misconception in that she is confused as to what the question is asking.

Rate your performance using assessment criteria on back		Rate your performance using assessment criteria on back	
1	2	3	4
few aspects	Met some aspects	Met most aspects	Met all aspects
Was your answer <input checked="" type="checkbox"/> Correct <input type="checkbox"/> Incorrect		Was your answer <input checked="" type="checkbox"/> Correct <input type="checkbox"/> Incorrect	
Marvelous	Misconception(s)	Marvelous	Misconception(s)
<ul style="list-style-type: none"> I showed my work used <u>key words</u> 	<ul style="list-style-type: none"> I put 6 goes into 20 4 times! 	<ul style="list-style-type: none"> I checked my work read key words used key words 	<ul style="list-style-type: none"> None
What did you learn for future math awesomeness?		What did you learn for future math awesomeness?	
<ul style="list-style-type: none"> ★ That you can sometimes improper fractions help you get the answer 		<ul style="list-style-type: none"> that I'm really really good at this and I love this lesson! 	

Figure 14: Student work from MO sheet.

This student was able to pinpoint her problem, not just saying, “I don’t get it.” This student has found her misconception and judging by her attitude in question two was able to remedy her trouble.

Table 1 displays the twelve MO sheet responses that indicated that the students were confident that they met the assessment criteria but their solution was incorrect. Students C, D, F, G, H, I, and J demonstrated specific misconceptions, in their work. In the future math awesomeness section, Student A showed that the student was using part of the Remainder from the MO of, “Does your answer make sense?” Student E, noticed that it wasn’t quite a mathematics mistake that gave her an incorrect answer.

Table 1: MO student response of twelve with high scale choice, but incorrect solution.

Student	Misconception	What did you learn for future math awesomeness?
A	I misunderstood the Q (question) but I know now what it means and the answer.	To always use reasoning along with your answers.
B	The half wasn't half they didn't overlap.	(Blank)
C	I made my picture the wrong way.	Fraction are easy if you try
D	Got it wrong I circled $\frac{2}{3}$ instead of 2 wholes	I had to circle 2 bars
E	I didn't ready the answers carefully enough	I have to look more carefully at questions and answers
F	I multiplied wrong	That there are many ways that you can do fractions
G	I did the work wrong	I leamed
H	Didn't show the work the right way	I do the right equation.
I	I made the wrong improper fraction	Put the right improper fraction.
J	I divided wrong	I leamed you need everything to complete the problem
K	I was not reading the problem correctly and I got rid of B, C.	To read the problem slower, and that maybe I should do some practice over the summer.
L	Didn't understand the problem, confused on what the question was asking	That this I don't understand

Data from the MO sheet also showed some clear examples of students referring to the assessment criteria. In one student's marvelous section she wrote, "I met all aspects." This student was referring to meeting all aspects of the assessment criteria. Another student for future math awesomeness wrote, "Check my work and use AC (assessment criteria) to help."

Within the MO sheets there was what I refer to as commonplace thoughts. Students writing a general response on what they will work on for future math awesomeness, at times

responded with commonplace thoughts. Some commonplace thoughts would be: show my work, read carefully, check my work, stay focused, pay attention, work harder, and take my time. Most commonplace thoughts occurred with students who had correct answers. It is logical that if your answer was correct, you most likely did not have any misconceptions so it would be tough to have a specific response for future math awesomeness. Commonplace thoughts did not get specific on correcting any misconceptions.

Some students showed clear thoughtfulness on how they could improve for future math awesomeness. The list below refers to students responses for future math awesomeness. Not all of these from the list are necessarily task specific, but it does give a sense of moving their learning forward.

That making mistakes is okay.

A new method of math!!

I learn for future math by doing easy steps for the future.

You can listen to your classmates too, not just your teacher.

How to multiply fractions, I can be confident with this.

Don't look at the answers before your done work it out first.

That sometimes improper fractions help you get the answer.

I learned a new way to figure it out

I learned to follow all steps

Always check your work. You might find a mess up.

A new way of learning.

That you can use models and no models for the same problems.

Focus Group & Individual Student Interviews

The second aspect of data chosen to provide triangulation in this qualitative research study was individual student and focus group interviews. This study used a sample of five students to partake in the focus group and student interviews. I used interviews to, “gain insight into lived experiences, learn the perspectives of individuals participating in a study and discover the nuance in stories” (Jacob & Ferguson, 2012, p. 1). The student interviews were used as a way to attain the students’ opinions on what was happening in their classroom throughout the study, Table 2 below, shows the responses of the first individual student interview and Table 3 shows responses from the second individual student interview. The first interview took place at the beginning of the study, and the second interview was towards the end of the study. In certain cells of the table there is text that says *Follow Up:* and then lists a question. In these instances I asked a follow up question to that student. The follow up question occurred if I felt the student had more to say but maybe holding back, or for clarification of his or her original response.

There was correlation from the student interviews showing students able to improve for future learning tasks. When Student A was asked question two for student interview 1 (Table 2), if she had been active in her learning and if she thought it was better to do problems and find out if the answer was correct or incorrect, she responded, “...if you explain how you got it wrong you will know what you need to fix next time.” This was an example of how using formative assessments paired with the MO sheet and student response system affected student self-assessment of learning. Also from student interview 1 Student B responded that using the

Clickers in formative assessment will help her see what she needs to work on. From the student interviews there was evidence that students were able to ascertain their areas for improvement through identifying their misconceptions. During student interview 2, in question 1 Student A responded by, "...once I saw what I got wrong, it helped me." Student C in question 1 student interview 1 described that it helped her understand more when she focused in on the mistakes she made. Student B in student interview 2, question 1, described that she just needs a "list of stuff to do". The assessment criterion on the MO sheet had guidelines for targeted performance best mathematics practice (McMillan & Hearn, 2008). I asked Student B if the list she was referring to would be the assessment criteria and she confirmed yes. By using the assessment criteria students were evaluating their own solutions to a common ideal of a best mathematics answer.

During student interviews some students stated that they could now mentally remember to do steps within the MO sheet, specifically from the Reminder Box of does your answer make sense?, did you show your work?, and lastly did you check your work?. This deliberate practice of self-assessment transitioning to an intrinsic alertness of student best practices corroborates an influence on student self-assessment.

Table 2: Student Interview 1

Question	Student Responses	Student
<p>1 Has math changed in your classroom this week at all? In what ways, explain.</p>	With the MO I have gotten confused and like once I started I didn't really understand it but it got easier for me.	A
	Use Clicker to put in the answer in the middle and end. <i>Follow Up: Is that valuable?</i> Will help teacher <i>Follow Up: Has it helped you so far?</i> Yeah going to help me study and see what I need to work on.	B
	We have to do the MO in the middle and the end that's different. <i>Follow Up: How has that been going?</i> It helps me a little bit, like understand like in case something that we like at one point what you have done you think is good or what mistakes you have done, we usually just talk about it instead of writing it down that actually kind of helped me out. <i>Follow Up: Has it been good to see the mistakes you made?</i> Yeah, because I think it helped me understand more.	C
	Circles, now math problems	D
	No not really.	E
<p>2 So far in this study have you been less active or more active in your learning? Explain.</p>	More active because, I have gotten the question right and wrong and I understand what I got wrong and how I got it right <i>Follow Up: What helped you figure out what you got wrong?</i> I guess I did not read it correctly <i>Follow Up: Do you think that it is better than doing problems and not knowing if you got it correct or incorrect?</i> I think it's a lot better because if you explain how you got it wrong you will know what you need to fix next time, but if you don't it's just like, "oops! I got it wrong, oh well."	A
	Not more than usual	B
	Yes, we can explain what we think is important in what it is, we get to do that more, we can say like yes we checked over our work we did our work, it does seem easy.	C
	No	D
	Same	E
<p>3 If you could make modifications to the MO in any way to help you learn, what would you change and why?</p>	I like the whole entire sheet, its helped me, it's like a checklist for me because I have a disability. So it's a lot easier for me to be like, "Oh I got to do that not this, don't get unfocused do that."	A
	We could have others instead of us reading what we have as like a 1, 2, 3, or 4 having other rare us on what we are doing and we can put it on our paper so we can and put a reason why you got a 1, 2, 3, or 4 <i>Follow Up: Why would it be valuable to get someone else's eyes on it?</i> Having somebody else look at it, you can see things that you didn't put before.	B
	(did not answer)	C
	I would change my thinking skills, it's good	D
	I would change it to where we could have vocabulary sentences.	E

Table 3: Student Interview 2

Question	Student Responses	Student
1 Do you think you still need to be using the MO? Why or why not?	The MO is really helpful. So, yeah I think I still need it because most of the time, "I am like yeah I get this." But I think last week or last week I didn't really get one of the questions so I was like, "Whoa!" <i>Follow Up: How did the MO help you when you didn't get the question?</i> Just thinking with the misconceptions, once I saw what I got wrong, it helped me.	A
	The MO is helpful in ways I can check to see if I have done everything, so in case I missed something but I don't get the question wrong because I didn't fill something out. I don't know, we could just have a list of stuff to do. <i>Follow up: Like the assessment criteria?</i> Yes	B
	Not really because I can mentally remember already, "did I check my work? Is my work reasonable?" And if I have my answer and I already checked my work, then I can do that, if I got the question wrong I can mentally do like, "what did I do wrong?"	C
	Yes go back and check your work, did you do work?	D
	No, I remember what I check over.	E
2 Have you seen any changes in your teacher now that you are using the Clickers during your mathematics	No	A
	No	B
	No	C
	No	D
	No	E
3 If you were a 5th grade teacher, how would you help your students become owners of their	Over the weekend, just write down the steps at lease once a day.	A
	Not sure	B
	If they did their work, explain their work.	C
	No	D
	Do the question over again.	E
4 Tell me something that you have been working on with this study that you plan to use in future of your	(No Response)	A
	Many ways to do something	B
	Making sure I check my work, usually I forget to do that, but when I started using the MO sheet then I started remembering to check my work.	C
	(No Response)	D
	Reminder Box, because I can do a checklist in my head.	E

In this research study interviews were also utilized in a focus group setting. The focus groups consisted of all five students from the student interviews but in one collective interview session. The focus group was a good switch from the individual student interview because the students' thoughts could be engaged by what other students shared in the discussion. In this study there were two focus group sessions. These focus group sessions occurred within the first and last quarter of the study. A focus group session lasted no more than 45 minutes and had three to five questions. A list of the focus group questions is in Appendix G.

During the focus group sessions, student discussions brought up the use of feedback and how it was provided during the formative assessment. The main points of discussion for feedback were:

they (students) could see where they made mistakes quicker, without waiting a week

if we (students) took a quiz it (feedback) would take longer to get back and you forget what you were working on

would not remember what we were thinking that day when answering the questions.

The students seemed to feel that to best impact self-assessment students need immediate feedback.

Another unifying motif that rang out during the focus group sessions was the use of the assessment criteria on the back of the MO sheet. Students were asked if the examples for the assessment criteria helped when using the MO. Some student responses were: *yes gives you the idea of what you can do, I would look on the back and see, "oh I need to do that, not this." telling you what to do on the back (the list of best math practices), above the ways to figure it out, helps me because I can see if I did everything and if I didn't do everything I can do it to get*

the answer correct This discussion shows that students were using the assessment criteria to judge if their learning met mathematical best practices discussed as a class at the beginning of the study. Some students used the examples of other students that showed mathematical best practices. Another student was able to evaluate her work based off of the list of evidence of understanding the mathematics concept. These student responses display how students were able to evaluate how their performance met the assessment criteria. The interview process, both individual and focus group, gave insight into what the students were thinking and how they felt about the components used in this study. The process provided invaluable data from the perspectives of the students, which were important to see.

Teacher Reflections

The student interviews provided information from the student perspective. The purpose of the teacher reflection was to get an idea of the study from an educator's perspective. A list of the teacher reflection questions and responses can be found in Appendix H. There were three teacher reflections conducted at the beginning, middle, and end of the study. The teacher reflections consisted of three to five questions and should not take longer than 45 minutes to complete.

Within reflection 1 the teacher described her definition of student self-assessment. To her student self-assessment was: *if students are given the time, the modeling and the practice opportunities to develop their own ability to thoughtfully question how they are doing, and what they can do to improve.* The teacher went on to describe that if done correctly she believes that it will lead to further success with content and self-motivation. As the students continually

implemented the MO sheet the teacher noticed that the students were: talking more about their learning, students with lower mathematics ability felt more confident, and students with lower mathematics ability were able to pinpoint where they had their misconception. The teacher described a moment in class when a student shared his response to what they would learn for future math awesomeness? The teacher's description of the student response was (student dialogue) *using a model was really more helpful than he ever thought, and that he will use them more often in the future for solving multiplying fractions.* The student had been in the teacher's mathematics class all year, and never had this thought process until working with the MO sheet.

In using the student response system the teacher communicated that it increased engagement and integrating the technology led to student buy in of the task. The teacher communicated that in using the student response system students wanted to know why they got the answer wrong paired with a desire to address an incorrect answer which was not evident previously. The teacher described when students saw that they missed a question through the student response system, they started flipping through their notes to check their work to try and figure out why their answer was incorrect.

The teacher reflections also depicted implementing formative assessments. The teacher described formative assessment as a non-threatening, non-graded assessment that took pressure off of students. The teacher explained what she meant by taking pressure off of students, as the teacher having the knowledge of student results on formative assessments, this took the pressure off of students to speak up or ask questions if they had an incorrect solution. With the teacher knowing how each student answered, students who scored wrong actually expected the teacher to

check in with them and were more open to discussion. The teacher described her mini assessments during a lesson as *being a mind reader*. Through the design of formative assessment within this study the teacher can see which students need attending to without a crystal ball. As described in chapter three, the formative assessment questions stemmed from the common error or PARCC Test Prep Coach questions. The teacher described that before this study she was reluctant to implement these types of questions and when students usually got to them at the end of the lesson many ran into trouble. Her reasoning is that throughout a lesson before the study she was unable to notice that the students were having trouble. By the time they got to a challenging question, the frustration from students was clear. Through using the formative assessment question I set up, which gave feedback from the pull-tab for both teacher and student, the teacher now meets these questions head on with confidence because she is able to see where her students are in their learning.

All three forms of data provided insight to how formative assessment, student response system, and a student self-assessment tool affected a teacher and her students. Students gave opinions and insight of the three components using their MO sheets, as well as during individual student and focus group interviews. Teacher reflections added to the wealth of data by weighing in from an educators point of view on how this study impacted her students as well as her instruction. The goal of this study was to see if implementing formative assessment with a student response system and student self-assessment tool had an effect on student self-assessment.

CONCLUSION

Introduction

In this action research study I worked to answer the question, “How does my practice of facilitating formative assessments using a student response system with a fifth grade teacher and students affect student assessment of learning?” This study implemented formative assessments with a student response system and a student self-assessment tool into one cohesive experience for teacher and student. In this chapter I will examine the results, consider possible implications, and give advisement to future study.

Results

I found that student self-assessment was impacted by the implementation of formative assessment with a student response system. In this study both teacher and students benefited. The participating teacher was able to modify her instruction to best meet the needs of her students based on the data displayed from using the student response system with the formative assessment questions. In the beginning of the study, the participating teacher did not have a clear understanding of the value of the student data during instruction. After the first lesson the teacher did not use formative assessments to adjust instruction. Instead the teacher waited until after school to print out the excel spreadsheet to view the class data. From this spreadsheet she highlighted and worked planned on checking in with a few students the next day. The concept of being able to use that data during instruction took deliberate practice. Through more discussions

she quickly caught on and implemented formative assessments using the student response data to adjust instruction as needed.

The participating teacher noticed when using the self-assessment tool there was an increase in students talking about their learning, students were able to pinpoint their mistakes, and had an increased desire to fix incorrect responses. These aspects all influenced student-assessment of learning. The desire to fix incorrect responses impacts student motivation, as they are striving to do their best, not because of an abstract grade but for learning.

Just a simple reminder box, is that all they need? Through the student and focus group interviews it became evident that for many of the students a valuable part of the MO sheet was the reminder box that asked: Does your answer make sense? Did you show your work? Did you check your work? This may have influenced students by slowing them down and reminding them to check their work to make sure they met the assessment criteria to the best of their ability. Another insight gained from the interviews was that students were able to implement the reminder box mentally or independently.

Implications

Literature has revealed that formative assessments can impact student learning (Black and Wiliam, 1998). For formative assessment to best be implemented students need instantaneous feedback (Barker, 2011), a tool that can provide such feedback is a student response system. Literature also shows that a student self-assessment tool is used for students to evaluate their own leaning and can lead to academic success (Bercher, 2012).

The self-assessment tool (MO sheet) used in this study was created to provide student feedback, that enhanced the feedback provided through the student response system and helped move student learning forward while also judging performance to set criteria. The MO sheet was developed for students to provoke thought and directives of action during their formative assessment. Self-assessment brings forth a movement to transition a wrong answer from just another red mark on a paper to an opportunity for learning and growth. As educators we want our students to be independent self-evaluative learners, but what steps do we take to get the students to that point? This study has shown that in the case of students in this fifth grade class, a student's ability to self-assess their learning in a meaningful way takes practice, and practice takes time. The participating teacher described that during the beginning of the implementation of the student self-assessment tool it took a great deal of time to work through it, but the benefit paid off as students aptitude at finding their misconceptions became easier and their desire to fix their mistakes improved.

What do the results mean for assessment? This study took formative assessment and blended it with technology and a student self-assessment tool thus creating a classroom atmosphere of using assessment for the purpose of learning. The assessment components in this study were assessments that involved active participation from the student. Formative assessment is a low stakes assessment with its root goal for students and teacher to use the data to modify learning (Brookhart, 2010). In formative assessment there was no concern by the student participants of how their grade might be affected, no concern that if they didn't do well they may have to be in an afterschool remedial program. The participating teacher described that

formative assessment gave the students in this study the comfort and freedom to take risks, because it was non-threatening and non-graded. In education there is always a need to assess learning, but how we assess and what we do with that data needs the student to be a full participant (Brookhart, 2010)

There are many student implications, but a teacher implication is continuous professional development on the instructional method of formative assessment. A greater knowledge of any skill will only lead to better understanding of how to use it. As described earlier the teacher had confusion on how to utilize the tools to best achieve instant formative assessment. Through our discussions we were able to remedy this quickly.

Different variables had an acting influence on the research of this study. A variable of influence would be students' mathematics ability. Some students consistently got answers correct, the self-assessment sheet had finding misconceptions and reflecting on what you learned from fixing them at its core. But what if the students didn't have any misconceptions? What if there was consistently nothing to fix? Would the students learn anything for future math awesomeness? Research connected to this aspect of this study is still needed. For those students in this study described above, it was a challenge to make the MO sheet relevant. The participating teacher explained how with those students she would lead them to contend with the mathematics problem in a different way. For example if those students were using representational models, she would challenge them to move to an abstract algorithm to solve the problem. This strategy pushed students out of their comfort zones to take risks in their mathematics learning.

Limitations

A limitation in this study was the time of year this study took place. This study took place in May and June of 2013, towards the end of the school year. The use of the MO sheet may have brought different results if this study had taken place at the beginning of the school year. At the point of year that this study had taken place social norms and mathematical norms had already been established. The students understood their teacher's expectations, and the teacher had already earned their trust, which made for an easy transition to using the MO sheet. On the other hand implementing the components of this study from the beginning of the year could likely have a greater effect on student self-assessment.

A problem that I encountered in this study was the error in creating the formative assessment questions within the SMART Notebook file for the teacher to have the ability to see student answer choices immediately during the formative assessment. This issue only occurred for one lesson, and was a learning experience for both myself and the teacher. Once corrected the teacher had access to the student data and could now use it to differentiate to best address student needs at that moment in the lesson.

Recommendations

“Self-assessment is a key element in formative assessment because it involves students in thinking about the quality of their own work” (Andrade and Valcheva, 2009, p. 12). Results showed an increase in students' ability to pinpoint where their misconception laid, their ability to use the assessment criteria, as well as an increased desire to want to know why they got an

answer wrong. Some recommendations for future research would be when and how long to implement this type of study as well as the evolution of student self-assessment.

For future research I suggest starting the self-assessment process at the beginning of the school year. I also suggest implementing a study of this nature over a longer duration of time, instead of just a five week period. For example after using a self-assessment tool over a three month period of time, what does the self-assessment tool look like? Have students developed any changes or modifications after using it for that long of a period? Is there a point where students are ready to wean off of having to complete their self-assessment sheet and those skills and thought processes have become intrinsic?

This study focused on student self-assessment, but within the right classroom culture it may be able to evolve into peer-assessment. If a study begins with self-assessment is it a natural occurrence to progress to peer-assessment or will the teacher have to implement some sort of deliberate practice for that transition?

How do the components (formative assessment, student response system, self-assessment tool) of this study influence summative assessment? This study looked at how assessment for learning paired with a student response system and student self-assessment tool can impact a classroom, but does this instructional method using these three components impact the measurement of student achievement?

Summary

Formative assessment was the driving force within this study and students and teacher both benefited. According to the data the student response system was an effective tool to use in

conjunction with formative assessment to provide instant feedback for teacher and students.

Student self-assessment is a powerful skill and has been the tool that has influenced student self-assessment during formative assessments. All three components are employable individually but when implemented together as seen in this study, each component complements the others to improve students' self-assessment of their learning. Is that not something we should be striving for in our classrooms, to benefit all?

APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **William V. Wallace**

Date: **May 09, 2013**

Dear Researcher:

On 5/9/2013 the IRB approved the following human participant research until 5/8/2014 inclusive:

Type of Review: Submission Correction for UCF Initial Review Submission Form
Expedited Review Category # 7
Project Title: Formative Assessment: Benefits for All
Investigator: William V. Wallace
IRB Number: SBE-13-09368
Funding Agency:
Grant Title:
Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form cannot be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 5/8/2014, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Patria Davis on 05/09/2013 08:19:47 AM EDT

IRB Coordinator

APPENDIX B: PARENT CONSENT FORM



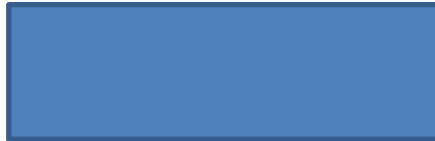
Formative Assessment: Benefit for All

Informed Consent

Principal Investigator: William V. Wallace

Faculty Supervisor: Juli K. Dixon, PhD

Investigational Site:



How to Return this Consent Form:

To return this consent form please have your child turn it in to



Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include about 25 people. Your child is being invited to take part in this research study because he or she is a 5th grade student at [redacted] Elementary School in [redacted] Mathematics classroom. [redacted] administrator, and [redacted] classroom teacher, have given permission for this research study to be conducted.

The person doing this research is William V. Wallace of the UCF Department of Education, Lockheed Martin Academy. Because the researcher is a Masters student he is being guided by Dr. Juli Dixon a UCF faculty supervisor in the Department of Education.

What you should know about a research study:



- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should allow your child to take part in this study only because you want to.

- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you or your child.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this study is to fill in the gap of formative assessment and its impact on instruction and to develop student ownership of learning by implementing a student self-assessment tool.

What your child will be asked to do in the study: Your child will be asked to complete a “modus operandi” self-assessment sheet. The goal of the “modus operandi” is to develop skills for your child to evaluate their own learning. Some examples of these skills are: a student identifying their weak points, checking they did their very best to answer all parts of the math question. The time it would take to complete the “modus operandi” should not be longer than ten minutes.

Additionally your child may be asked to be part of a select group to take part in three interview sessions and two focus group question sessions. These sessions will be no longer than 45 minutes. This study will not have an impact on your child’s grades or their amount of time on academic tasks. Your child does not have to answer every question or complete every task. You or your child will not lose any benefits if your child skips questions or tasks.

Location: The location of this study is in your child’s 5th grade classroom at 


Time required: We expect that your child will be in this research study for no longer than 5 weeks from May – June 2013.

Audio or video recording:

Your child may be audio or video recorded during this study. If you do not want your child to be recorded, your child will not be recorded and will not be part of the interviews or focus groups. If your child is recorded, the recordings will be kept in a locked, safe place. The recordings will be erased or destroyed when the study has been concluded.

Risks:

There are no expected risks for taking part in this study. There are no reasonably foreseeable risks or discomforts involved in taking part in this study.

Benefits: There are no expected benefits to your child for taking part in this study.

Compensation or payment:

There is no compensation, payment or extra credit for your child's part in this study.

Confidentiality: We will limit your personal data collected in this study. Efforts will be made to limit your child's personal information by using pseudonyms when disseminating the data and to people who have a need to review this information. The only organizations that may inspect and copy your information include the IRB and other representatives of UCF.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt your child talk to William V. Wallace, Graduate Student, College of Education, Lockheed Martin Academy, (407) 870-4669 or Dr. Juli Dixon, Faculty Supervisor (407) 823-4140, Department of Health Professions at (407) 823-2233 or by email at healthpro@ucf.edu.

IRB contact about you and your child's rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Your signature below indicates your permission for the child named below to take part in this research.

**DO NOT SIGN THIS FORM AFTER THE IRB EXPIRATION DATE
BELOW**

Name of participant

Signature of parent or guardian

Date

Printed name of parent or guardian

- Parent
- Guardian (See note below)

Assent

- Obtained

Note on permission by guardians: An individual may provide permission for a child only if that individual can provide a written document indicating that he or she is legally authorized to consent to the child's general medical care. Attach the documentation to the signed document.

APPENDIX C: TEACHER EXPLANATION OF RESEARCH



EXPLANATION OF RESEARCH

Title of Project: *Formative Assessment: Benefit for All*

Principal Investigator: William V. Wallace

Other Investigators:

Faculty Supervisor: Juli K. Dixon, PhD

You are being invited to take part in a research study. Whether you take part is up to you.

- The purpose of this study is to fill in the gap of formative assessment and its impact on instruction and to develop student ownership of learning by implementing a student self-assessment tool.
- You will be asked to complete three separate written reflections responding to set questions related the research design. The reflections will be spread out throughout the research study. You do not have to answer every question or complete every task. You will not lose any benefits if you skip questions or tasks.
- We expect that the time required in this research study for no longer than 5 weeks from May – June 2013. The expected time needed to complete the three reflection prompts should be no longer than 60 minutes per reflection prompt.

Study contact for questions about the study or to report a problem

If you have questions, concerns, or complaints, you may talk to William V. Wallace, Graduate Student, College of Education, Lockheed Martin Academy, (407) 870-4669 or Dr. Juli Dixon,

Faculty Supervisor (407) 823-4140, Department of Health Professions at (407) 823-2233 or by email at healthpro@ucf.edu.

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901.

APPENDIX D: MODUS OPERANDI (SELF-ASSESSMENT SHEET)

Modus Operandi

Date: _____

Name _____

Big Idea:

Learning Target:

Question 1

From the Math problem what are some things you know for sure?

Reminder

Does your answer make sense?
Did you show your work?
Did you check your work?

Rate your performance using
assessment criteria on back

1 2 3 4

Met few aspects Met some aspects Met most aspects Met all aspects

Was your answer

___ Correct ___ Incorrect

Marvelous

Misconception(s)

What did you learn for future math awesomeness?

Question 2

From the Math problem what are some things you know for sure?

Reminder

Does your answer make sense?
Did you show your work?
Did you check your work?

Rate your performance using
assessment criteria on back

1 2 3 4

Met few aspects Met some aspects Met most aspects Met all aspects

Was your answer

___ Correct ___ Incorrect

Marvelous

Misconception(s)

What did you learn for future math awesomeness?

**APPENDIX E: MODUS OPERANDI (SELF-ASSESSMENT SHEET)
ASSESSMENT CRITERIA WITH STUDENT EXAMPLES**

Assessment Criteria

Evidence that I have a thorough understanding of this math concept!

- I used an efficient strategy
- I modeled the problem using a very clear drawing or diagram, chart, graph, or equation.
- My explanation is clear and accurate.
- I used precise math vocabulary
- I supported my conclusions with proof—>“because”
- I evaluated the reasonableness of my solutions

Used details from the problem in explanation! Helps to make sure answer makes sense!

Detailed! Guess, Check, Revise

Detailed Common Algorithm

Explanation!

I got my answer by dividing 34 by 2 for because this side is half of a normal of dye and 34 give you 17 which is half of 34.

Alex uses non-toxic soy dye for creating T-shirts at her company. In a normal order of T-Shirts she uses 34 cups of soy dye. The current T-shirt order Alex is working on is for half of a normal order. What is the amount of dye Alex needs for the T-Shirt order?

Using Pictures to solve

non-toxic soy dye

Singapore Style

Alex used 17 cups of Soy dye to make company T-Shirts.

Full Sentence Answering Question.

APPENDIX F: EXPORTING FORMATIVE ASSESSMENT DATA TO MICROSOFT EXCEL

Formative Assessment 7.4

		Quest		
Name	ID	Q1	Correct	Grade
Kevin Malone	4	C	1	100%
Kelly Kapoor	7	C	1	100%
Andy Bernard	6	C	1	100%
Pam Beesly	5	A	0	0%
Michael Scott	1	D	0	0%
Jim Halpert	2	A	0	0%
Dwight Schrute	3	A	0	0%
Number Correct / Class Average		3	0.4	42.90%
		Answer Key	C	
Questions				
Q1				

		Quest		
Name	ID	Q1	Correct	Grade
Pam Beesly	5	A	1	100%
Michael Scott	1	A	1	100%
Dwight Schrute	3	A	1	100%
Kevin Malone	4	C	0	0%
Kelly Kapoor	7	C	0	0%
Jim Halpert	2	C	0	0%
Andy Bernard	6	C	0	0%
Number Correct / Class Average		3	0.4	42.90%
		Answer Key	A	
Questions				
Q2				

APPENDIX G: FOCUS GROUP INTERVIEW QUESTIONS

Focus Group 1 Questions:

What has been easy when using the MO? Why do you think that is?

Does the AC (assessment criteria) make the expectations clearer for math best practices? Explain.

Have you used some of the skills from the MO in other subject areas?

Focus Group 2 Questions:

How has your learning changed since participating in this study?

Getting the data from formative assessments was that more important than the MO?

Did having your examples for the assessment criteria help when using the MO?

If you could talk to a 4th grade student about mathematics in Mrs. W's class what would you tell them?

Last thoughts?

APPENDIX H: TEACHER REFLECTION QUESTIONS & RESPONSES

Reflection One Question & Responses:

Have you used assessments as a student learning tool? Why or why not?

Yes, I have used assessments as a student learning tool, but not to the extent that I am using it during this study. In the past, students have taken pre and post tests and kept track of their data, growth (or lack thereof), and then used that to help themselves with what chapters they needed extra practice on. This year, I have used a great majority of my assessments in the sentsos, and have noticed students taking much more ownership of their work. They are trying harder to get a better grade (so they can see a good grade on their clickers). As a class, they are looking at the results of the class average as an unofficial contest between their class and the other group. Together, we look at which problems were the most missed, and find patterns in our data. We get to go over what they missed right away while their thinking is fresh in their minds, and students are the ones who lead us to the right answer. When they get a problem wrong, they have to mark it themselves on their test, which has made them much more inquisitive as to why they got the question wrong, and what the right answer is. I have found that if I give students a few minutes to talk about their results with their table, that those missing one in common will try to figure out why together, and those who got it right will try to help them. Using assessments as a learning tool for the student is a FANTASTIC idea, but I know I could be doing more with it to drive student achievement...if only I had a little more time in the day to create the assessments that I want for EVERY lesson, for EVERY class, for EVERY day. What Mr. Wallace created for us to use has been a blessing of time. It is very easy to manipulate to meet the needs of my students on a whim, while giving me all of the tools I would normally use all in one place at my fingertips.

If you could adjust instruction during a lesson based on student data, describe what that would look like.

In my mind, if through discussion, or really, really bad formative assessment results from the first question on the clickers, I realize that they aren't "getting it," I would be able to adjust my instruction to stop and go back to fix any misconceptions students are having. Through the clicker results, I would also use those students who did "get it" as teachers for those who didn't (not a permanent thing, just a temporary for this problem only length of time. I don't think it is right to always turn the smartest into the teachers...which doesn't always give them a chance to grow as math learners and be challenged themselves.) If, after changing my instruction due to most students not "getting it," I still have a group struggling, then I would have the other students go on to a more challenging task (which would be part of our class routine already...similar to a station or challenge problem of the week) I would pull those kids and continue to work with them until they "got it." On the other hand...if the data shows that most students did "get it," I could use that information to push them farther, pulling the challenge questions for them to work on. That may mean that I would have to alter my plans for the rest of the week because they have already mastered it before coming to me.

What does student self-assessment mean to you?

To me, student self-assessment means that students are given the time, the modeling, and the practice opportunities to develop their own ability to thoughtfully question how they are doing, and what they can do to improve. If done correctly, this ability to reflect on their learning will lead to further success with content, and an enriched sense of accomplishment and self-motivation. I think that time, along with thoughtful and consistent modeling is the key.

Reflection Two Question & Responses:

Now that you are able to see specifically the students answer choice immediately during the lesson while instruction is still modifiable, has this led to any changes during your lesson? Has it changed how you have prepared for your mathematics lessons?

Yes! Now that I can see immediately who has it and who doesn't, I am able to see a few things: 1. How many kids "have it." If a majority does, I can move on and focus my attention on those few who "don't have it" when we have some independent or partner practice time. I can see who needs the help right away. Before, it was like being a mind reader. I would have to rely on reading faces. Even when utilizing the student white boards...a student can still peek at another student's work, and just copy it, making it appear that they do have it, when they don't. I might have missed helping that kid. Then, in all likelihood, they wouldn't ask me for help on their own, either...next thing you know, they're failing the test, and I could be confused, because they had the right answers in class on their boards. Now, I can see who doesn't have it, and go right to them to see how things are going. It kind of takes the pressure off those kids who, no matter how much you try to tell them its okay to ask questions, are just too shy to do it. Eventually, I believe they will start asking the questions on their own, because they are so used to talking with you about it, that they will now have the comfort level to know it is okay to ask. 2. If a majority of the class "doesn't have it," I can now see that before I have gotten all the way through the lesson, and don't know exactly where or why they are still getting it wrong. Now, before I am halfway through, I can see EXACTLY how well we are doing, and modify accordingly. It has changed how I am preparing for a lesson, because I am now taking more time to really know all of the word problems and questions in the book before I teach it. I know that sounds like something that I should be doing already, but what I mean is this- If kids seem like they are getting it right away, I can jump right into clicker question #1. If they get that...I now know which more challenging problem I think is appropriate for them, and we can try it out, and from there, move on to the last question. I can also choose the problems that I know to be trickier, or ones that I know will challenge them with a common error, and really check for mastery of content. On the other hand, if kids aren't getting it, and they are now more clearly voicing what it is that they don't understand, then I can go to a different word problem that I have looked at already to help change the perspective on the skill at hand. Knowing exactly where students are getting it or not has helped me to modify instruction on the spot. In the past, I might have studied the first three word problems ahead of time, but then just gone right into independent practice with little thought of how we can challenge them even more, or how to alter those who aren't getting it. (That would be saved for center time when I could work more independently with smaller groups.) I would have to wait until I was walking around and checking things out, at which point it might be too late. Having the entire lesson done in Notebook software has also really helped me. I have saved the original chapter file, and then a separate file for each of my two classes. The next day, or at any point during the unit where I want to re-address something we had done already, or challenge them to use a previous question to help them solve the current one, we can go back and actually look at what they had done. The Elmo being utilized with the Smart Ink has been so cool for us all, and really enhanced the level of learning in my room.

How do you think learning BEST occurs: by a students' desire to get a good grade, or the desire to improve their body of knowledge? Based on your answer, explain how the classroom culture you create helps to cultivate that desire.

Well, this is a super tough question. I would have to say both. I know that my fifth graders are very motivated by using the clickers. They have told me that they want to see that they got a good grade on them after taking a test or doing one of the daily questions on them. Using the clickers has driven them to study more, because again, the payoff for them is seeing that A or B score on their clickers. The funny thing is, though, that now, when they see that they missed a question, they start flipping immediately to the page where they showed their work, and try to figure out why they got it wrong. In the past, when students had to wait for me to grade their papers, by the time they got their graded paper back, they didn't have the same drive to see what question they missed, or even more importantly, WHY they missed it. With the clickers, as soon as they get their score, they openly start sharing their scores with each other, comparing to see which ones they missed, and then start to help each other figure out why they missed it. The ones who got it correct will help those who missed it...an instant teachable moment done by the students themselves. I just have to stand back and give them about 3 minutes to let them have their moments. It is truly empowering for the students, and for me. After they have had some time, they immediately look to the board to see what their average was as a class. They even started (totally on their own) a little competition between my homeroom and my other class to see who's class had the higher average. After we look at the average of the class, and based on how much time we have left, we will look to see which questions we missed the most as a class. I find that this instant feedback really helps to bond the class together. It gives some sort of validation to my low kids that they aren't alone with missing questions, because a lot of others missed that, too. Suddenly they don't feel as bad about their score as they had before, not knowing how they compared to everyone else...they just always learned to assume that they were the worst, even though that may not have been the case. Plus, if someone gets a question correct that they now see most others missed, they are beaming with pride to come and show off how they came to the correct conclusion, totally increasing their confidence level, which is priceless. This drive for students to get a good grade immediately leads to the desire to improve their body of knowledge. As I said before, now when using the clickers, students want to know WHY they got it wrong...therein showing the desire to increase their body of knowledge. Previously, they didn't always have that desire when we weren't using the clickers. As the teacher, I am doing my best to make sure that we have created a classroom culture where it is OKAY to be wrong, as long as they are trying and they can provide evidence for their train of thought. I have taught them to say: Teacher: If we get it wrong... Students choral response: So what? Teacher: As long as we... Students choral response: try and learn from it. I also believe that it is the simple logistical things that help establish this close community of learning, which is essential for cultivating those desires, like the layout of the classroom. Students are invited to sit on the floor with a pillow where they can see the board comfortably (as long as they are focused and working). Some choose to sit close to the front in the desks. I try to play relaxing music low in the background while working independently or with a partner, just to create a more laid back atmosphere that is conducive to conversations about math, rather than a lecture about math. Everyday isn't like that, though, it depends on the mood of the class. There are some days where they can't handle it, and other days where I need them at their seats in order to work with manipulatives better. I think that the comfortable lighting we have plays a big role, and the friendly competition thrown in increases students engagement in the lesson.

How would you modify the Modus Operandi activity? Why?

There isn't anything that I would change about the Modus Operandi activity after having implemented it for seven lessons. At first, like anything, it was time consuming to model it correctly. After seven lessons, though, I am starting to get quality work in a faster time. My students have told me on several occasions that they've gone back to check their work after reading the reminder section. I have told numerous colleagues about it, because I think it is truly helpful. It integrates the best of things we always teach and preach, but sometimes don't have time for or rush through. I think that the marvelous/misconception section has opened up the door to several conversations about where they have made their mistakes, and what they could do next time to fix them. I think that the marvelous section also gives students who are low or struggling a chance to see that just because they don't always get the correct answer doesn't mean that they aren't successful math problem solvers. I think it is boosting their confidence to help them see that they are doing something correctly, whether it is that they picked the correct key words, came up with the correct expression or equation, or even that their strategy was a good one, even if it didn't work out due to a computational error or a common mistake. I think it is helping students to see where they can make a small fix, instead of feeling like they are helpless in math. I even had one student tell me (after answering the last question, "What did you learn for future math awesomeness?") that using a model was really more helpful than he ever thought, and that he will use them more often in the future for solving multiplying fractions. It was a great moment!

Open thoughts?

Thought #1: Parents! One thing I will change for next year is preparing a parent night for math early on, and a letter to go home about math instruction during the upcoming year. I was so very frustrated when my kids came back to me with their homework after the first Chapter 7 lesson, and said, "Mrs. Wallace...my mom taught me a trick that is waaaay easier than this model stuff, and it gets me the right answer every time! They said they didn't understand our models and that this works better." When I asked them why their method works, or how it works, they just looked stunned and said, "I don't know....but it works every time!" Trying to impress upon a fifth grader the importance of correctly modeling multiplication of fractions (at the end of the school year) has been a challenging task. Trying to communicate that to parents is even harder. I was talking with some colleagues about it, and they offered two trains of thought: 1. Don't send home homework with the kids for fear of parents just teaching them the "trick." 2. We need to get together and have a parent night at the beginning of the year and "hope" that parents will care enough to show up, and then care even more to truly listen to what we have to say, and follow our requests. Thought #2: In order to use the Modus Operandi effectively, you really need to have established a sense of community and safety in your classroom. Students need to feel that all answers are welcome, and that math is not a scary thing, but something that we will all try to make sense of together. That there are numerous ways to solve a problem, and all of those ways can be correct. I would like to say that my classroom is like that. I feel that my students have a great sense of caring about the success of others, and try to help each other when they don't understand something. The Modus Operandi really just helped to continue that line of thinking, and even take it to the next level, because they are now able to pinpoint successes and errors more easily, and with great care for the feelings of others. It is definitely helping them to be more self aware of their learning, but also allowing them to then communicate that to others more openly. When I tried to explain the Modus Operandi to another colleague of mine, whose classroom doesn't always share that same sense, he just nodded quickly and said that it's the same thing he does already. He then asked if I would show it to him, and in my head, I'm still trying to find a way to tell him that the classroom environment has to be established first. I think that the Modus Operandi will help him to be a better math teacher, but only if the kids are willing to offer their thoughts on their own.

Reflection Three Questions & Responses:

Do you think this study affected your students self-assessment of learning? Explain.

I absolutely do! I would like to think that before this study, I had created a pretty open environment about math, where kids felt safe to try new things and share new solutions. However, after implementing this study, I found that the kids were talking more about their learning than they ever have...and with each other. They were more aware of where they were going wrong, and they weren't afraid to share it. They cared a lot more if they got it wrong, and were trying to figure out why...and again...if not from me, then from each other. The time that they took to write down their feelings helped them to "get it out" of their system, and you could tell it was a relief for some, who might have felt unheard before (this study). Before this study, I know that there were days when they had lots of questions, and time wasn't always on our side, and I simply couldn't get to them all. Looking back, I might have spent too much time covering something they got, and instead, didn't have as much time in the end to cover questions on the more challenging material, which could have left some feeling frustrated. I don't face this problem nearly as much, with this new process. Basically, this process has helped them to see something that I have been trying to do all year...get them to understand that solving math is a process that we can tackle together, and that it is okay to try something new and not be successful right away, as long as you learn from it. Trying something new can pay off, and give them the math confidence that they crave and need to be successful in math.

What was the hardest thing for you as a teacher when implementing and using the MO sheet?

First of all, implementing the MO sheet wasn't too difficult for my class, because most of the things on it we had done at some point or during most of the year. It was just incorporating all of those things at once, and tying them all together. Probably the toughest part for me was simply when we did this study. After FCAT is over, the closer you get to the end of the year, the harder it is to keep students engaged. We began this with about 5 weeks to go, when most other classes start doing "fluff." So, to keep them operating at peak performance, and asking them to put more effort into math was a little challenging. However, it should speak to how engaging and effective the study was, that students were working up until the second to last day of school on multiplying fractions, and did so with almost no complaining, and with a high level of success. The one thing I would say to anyone else starting to do this would be to be consistent. Always hold students to the high level expected on the MO sheet (with the examples on the back). If they start to slack, you need to point it out, and get them back up to that level. I would also say that being consistent helped to head off lots of repetitive questions that I got the first couple of days...like, "Do I turn the clicker on now? Do I sign in now? Do I hit finished now?" Being consistent provided the routine that let them focus on what they were supposed to be learning, not worrying about technicalities.

Thinking of the range of students' mathematics ability in your classroom, high, medium, low, which type of student do you think benefited most from this study?

This is a really tough question, because I think that all benefited from it. However, if I had to pick just one, I would say it would be the low group of students. First of all, the technology integration into DAILY math instruction already increased their engagement with the lessons. They wanted to pay attention more so that they would have an increased chance at answering the questions correctly. Also, the formative questions allowed me the ability to see when those low kids are "getting it," I can run over to them and give them some positive praise, because I know how excited they are that they got a clicker question right. It also saves me and them from continually bugging them about how they are doing. On the days when they get it, I can praise them and move on. On days when they don't get it, they know I will see that and be there to help, so they don't have to be so worried that they don't get it yet. The MO guide has been great for them because my low kids have learned from experience that if they get it wrong...that's it...they're just wrong. That's all they see, and they hate it, and it lowers their confidence. With the MO guide, they have a place to point out all the good things that they did, and then a spot to point out where they went wrong. In most cases, they usually did a lot of the work right, but made a small mistake at the end. The MO guide has helped them to see that they were on the right track, and helps boost morale even if they get an answer incorrect. Typically, when we are working on one skill, they tend to make that mistake over and over until I can work with them to fix it(usually towards the middle to end of the lesson), so the MO guide has also helped my low kids to pinpoint what it is that they are getting incorrect, as opposed to them just thinking that they got the whole problem wrong. This has also been helped by Mr. Wallace incorporating the common error alerts from the textbook into the formative questions. As a class, we can hit those problem areas head on, instead of waiting to throw them in afterwards to see how they do on them. I also think that the whole process has helped give them the confidence to voice their feelings about math more, especially when they don't understand something, because now they know what they don't get, and when they don't get it. That information is much more useful to them than just being lost at the end when they are finally asked to try a problem on their own. My high kids really liked the process because it gave them a chance to show off what they know, and feel confident in what they know through validation of the correct clicker responses. The MO guide, again, let them show off what they know through the use of the best vocabulary, different strategy to solve the problem, and way of explaining how they did it. Sometimes with the highest ability math kids the problem isn't in solving, it's in explaining what they did. I think the MO guide really makes them slow down a bit and work on that weakness for them. My middle kids really benefited because it helped them to see their strengths and weaknesses more. Sometimes in the middle, it is like a yoyo. On some days you get it, other days you don't, and often, I think, those days can correlate with effort. With this process, it really does help to create the environment where, if you start to slack, it is easily noticeable in your responses on the MO guide, and in your success at the questions. It helps the middle kids strive for some regularity with their ability to adjust their efforts as needed.

Would you implement these instructional methods used in this study again next year (formative assessment, student response system during instruction, and self-assessment tool)? Why or why not? Of the three which do you think was most beneficial to your students? Why?

I would most definitely integrate these methods into my instruction next year. In fact, I've already asked Mr. Wallace when we can start sharing this with other teachers. I've told so many people about it, and how it really does integrate so much of what we try to teach our students, but does it in a concise, easy to use format that engages the students. I have some very anxious teachers waiting for the green light for me to share the MO guide and Smart Notebook files with the questions built in with them! The formative assessment is such a big thing that, I feel, is being thrown around in our lesson planning for next year by teachers, but without them really understanding how it is used or its true value. Currently, our administration is making the staff undergo a new math training, where the teachers must pick a common formative assessment to use for each new common core math standard. I think that it's great...but am waiting to see that it is being utilized as they say. My fear is that it becomes what it has been in the past, for example, like fluency in reading...you have to check student fluency levels, their score gets written down in a file, maybe they are grouped differently in class, but most likely it stops there and nothing more gets done about it. Whenever the topic has come up at the end of the year...I keep speaking up about how Mr. Wallace's daily formative assessments have been awesome, because this helps me to see on the spot how they are doing, and change my instruction accordingly...way before the mini-assessment I would give them at the end of the standard being covered. It is so hard to decide which part was most beneficial. The formative assessment really helped them to see how they were truly doing (not just..."Oh yeah...I think I get this.") Those that did get it got a confidence booster, and those who didn't had a safe, non-threatening, non-graded (in the gradebook) way to see that they still need some help, and specifically at which point they still need help (not just at the end when most teachers generally stop and ask if there are questions, to which they usually respond..."I just don't get any of it.") The ability for me to use the formative assessment questions to monitor class progress during the lesson helped me to change my instruction to be the best it can be, so that in itself is beneficial to the students. It helped me not waste their time with instruction that wasn't useful to them. The student response system itself is really engaging to the students. They became pros at using it within a few days, and when I say pros, I don't mean logging in and answering the questions...I mean successfully troubleshooting issues with the clickers and the program. Without the student response system, I don't know that the kids would be as vested in the whole system Mr. Wallace has put in place (formative, clickers, and MO guide). The technology integration, I think, is crucial to kids buying into the process, and part of their desire to be better learners. The self-assessment tool has been amazing, because as most kids put it, it helped them to make sure they really went back and checked their work, and didn't let them get away with not doing it. I also think that by Mr. Wallace taking the extra time to put their best student examples on the back for the assessment criteria, was a great reminder for them of what is expected each time. When they see their work, it is motivation to want to do it as good as, if not better than, what is already there. I think the last question on the MO guide is critical...what did you learn for future math awesomeness? It has FORCED them to really STOP and THINK...what did I just learn? And how is this information going to be useful in the future? I think this is usually a missed opportunity for many teachers...they are just happy that their students got it...but don't give them time to really process what it is they just got. That process time, to me, is the difference between a kid really understanding what they learned and retaining it, and just recalling it until the end of class, but losing it when they get home. So, I realize that I haven't picked just one, but I don't think there is one part...I think they all work together to create one cohesive useful tool for both teacher and students.

If you were to do the instructional aspects of this study all over again what would you do differently? Please be specific.

If I were to do this all over again, the only thing that I would wish would be that we had started this at the beginning of the year, and had more time to show its full potential. (Although, having experience without the MO did help them to see the benefits of using it, I think) If I had more time in my math block, I would like to utilize the MO guide more by having them use various Kagan Cooperative Learning strategies to share with each other their thoughts. Perhaps it can be integrated into writing time, somehow, with my partner teacher.

APPENDIX I: STUDENT INTERVIEW QUESTIONS

Student Interview 1:

Has math changed in your classroom this week? In what ways, explain.

So far in this study have you been less active or more active in your learning? Explain.

If you could make modifications to the MO (Student Self-Assessment) in any way to help you learn, what would you change and why?

Student Interview 2

Do you think you still need to be using the MO? Why or why not?

Have you seen any changes in your teacher now that you are using the Clickers during your mathematics Lesson?

If you were a 5th grade teacher, how would you help your students become owners of their learning?

Tell me something that you have been working on with this study that you plan to use in the future of your learning.

REFERENCES

- 5th Grade Math Journals Retrieved June 23, 2013, from <http://www.k-5mathteachingresources.com/support-files/5th-Gd-MJv.2-Preview.pdf>
- Abrams, L. (2007). Implications of High-Stakes Testing for the Use of Formative Classroom Assessment. In J.H. McMillan (Ed.) *Formative Classroom Assessment* (pp. 79-98). New York: Teachers College Press.
- Andrade, H., & Valtcheva, A. (2009). Promoting Learning and Achievement Through Self-Assessment. *Theory Into Practice*, 48, 12-19.
- Barker, T. (2011). An Automated Individual Feedback and Marking System: An Empirical Study. *Electronic Journal of e-Learning*, 9 (1), 1-14. Retrieved from <http://www.eric.ed.gov/PDFS/EJ930249.pdf>
- Bercher, D. A. (2012). Self-Monitoring Tools and Student Academic Success: When Perception Matches Reality. *Journal of College Science Teaching*, 41 (5), 26-32. Retrieved from <http://web.ebscohost.com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?vid=33&sid=fe264527-c844-492c-a1b8-d355f7f05be%40sessionmgr113&hid=125>
- Black, P., & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment*. London: School of Education, King's College London.
- Black, P., & Wiliam, D. (2004a). The Formative Purpose: Assessment Must First Promote Learning. In M. Wilson (Ed.) *Towards Coherence Between Classroom Assessment and Accountability* (pp. 20-50). Chicago: University of Chicago Press.
- Black, P., & Wiliam, D. (2004b). Classroom Assessment is Not (Necessarily) Formative Assessment (and Vice-versa). In M. Wilson (Ed.) *Towards Coherence Between Classroom Assessment and Accountability* (pp. 183-188). Chicago: University of Chicago Press.
- Boud, D. & Falchikov, N. (1989). Quantitative Studies of Student Self-Assessment in Higher Education: A Critical Analysis of Findings. *Higher Education*, 18 (5), 529-549.

- Brew, C., Riley, P., & Walta, C. (2009). Education Students and Their Teachers: Comparing Views on Participative Assessment Practices. *Assessment & Evaluation in Higher Education*, 34 (6), 641-657. Retrieved from <http://web.ebscohost.com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?sid=fe264527-c844-492c-a1b8-fd355f7f05be%40sessionmgr113&vid=29&hid=125>
- Brookhart, S. M. (2010). *Formative Assessment Strategies for Every Classroom-2nd Edition*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Burke, K. (2010). *Balanced Assessment from Formative to Summative*. Bloomington, IN: Solution Tree Press.
- Common Core State Standards Initiative. Retrieved on June 3, 2013 from: <http://www.corestandards.org/>
- Danielson, C. (2008). Assessment for Learning-For Teachers as Well as Students. In C.A. Dwyer (Ed.) *The Future of Assessment Shaping Teaching and Learning* (pp. 191-214). New York: Lawrence Erlbaum Associates.
- Fastre, G., van der Klink, M., Sluijsmans, D., Merrienboer, J. (2012). Drawing Students' Attention to Relevant Assessment Criteria: Effects on Self-Assessment Skills and Performance. *Journal of Vocational Education and Training*, 64 (2), 185-198.
- Harlen, W. (2009). Improving Assessment of Learning and for Learning. *Education 3-13: International Journal of Primary, Elementary and Early Years Education*, 37 (3), 247-257.
- Hepplestone, S., Holden, G., Irwin, B., Parking, H.J., & Thorpe, L. (2011). Using Technology to Encourage Student Engagement with Feedback: A Literature Review. *Research in Learning Technology*, 19 (2). 116-127. Retrieved from <http://www.researchinlearningtechnology.net/index.php/rlt/article/view/10347>
- Hoffman, J., Assaf, L., & Paris, S. (2001). High-stakes Testing in Reading: Today in Texas, Tomorrow? *The Reading Teacher*, 54(5). 482-494.
- Intelligent Uses of ARRA Funding: Technology Bases Formative Assessment. (n.d.). *State Educational Technology Directors Association*. Retrieved on May 23, 2013 from: http://www.setda.org/c/document_library/get_file?folderId=281&name=DLFE-427.pdf.

- Jacob, S.A., & Furgerson, S.P. (2012) Writing Interview Protocols and Conducting Interviews: Tips for Students New to the Field of Qualitative Research. *Qualitative Report* 17. Retrieved from <http://www.nova.edu/ssss/QR/QR17/jacob.pdf>
- Larson, M., Fennell, F., Adams, T. L., Dixon, J.K., Kobett, B.M., & Wray, J.A. (2012). Common Core in Mathematics in a PLC as Work. T.D. Kanold (Ed.). Bloomington, IN: Solution Tree Press.
- Leahy, S., Lyon, C., Thompson, M., & Wiliam, D. (2005). Classroom Assessment: Minute by Minute, Day by Day. *Educational Leadership*, 63 (3), 18-24.
- LeMahieu, P.G., & Reilly, E.C. (2004). Systems of Coherence and Resonance: Assessment for Education and Assessment of Education. In M. Wilson (Ed.) *Towards Coherence Between Classroom Assessment and Accountability* (pp. 189-202). Chicago: University of Chicago Press.
- Marzano, R.J. (2007). *The Art and Science of Teaching: A Comprehensive Framework for Effective Instruction*. Alexandria, VA: Association for Supervision and Curriculum Development.
- McLaren, S.V. (2012). Assessment is for Learning: Supporting Feedback. *International Journal of Technology & Design Education*, 22, Retrieved from <http://web.ebscohost.com.ezproxy.net.ucf.edu/ehost/pdfviewer/pdfviewer?sid=fe64527-c844-492c-a1b8-fd355f7f05be%40sessionmgr113&vid=14&hid=125>
- McMillan, J.H., Hearn, J. (2008) Student Self-Assessment: The Key to Stronger Student Motivation and Higher Achievement. *Educational Horizons*, 87 (1), 40-49
- Oliver-Hoyo, M., Allen, D. (2006). The Use of Triangulation Methods in Qualitative Educational Research. *Journal of College Science Teaching*, 35 (4), 42-47.
- Pedulla, J., Abrams, L., Maduas, G., Russell, M., Ramos, M., & Miao, J. (2003). *Perceived effects of state-mandated testing programs on teaching and learning: Findings from a national survey of teachers*. Chestnut Hill, MA: Boston College, National Board on Educational Testing and Public Policy.
- Popham, W. J. (2005). *Classroom Assessment: What Teachers Need to Know*. Boston: Pearson.
- Sadler, D.R. (1989). Formative Assessment and the Design of Instructional Systems. *Instructional Science*, 18 (2), 119-144.

Shepard, L. A. (2005). Linking Formative Assessment to Scaffolding. *Education Leadership*, 63 (3), 66-70.

Shepard, L. A. (2008). Formative Assessment: *Caveat Emptor*. In C.A. Dwyer (Ed.) *The Future of Assessment Shaping Teaching and Learning* (pp. 279-303). New York: Lawrence Erlbaum Associates.

SMART Technologies Education Solutions Retrieved June 3, 2013, from <http://smarttech.com/Home+Page/Solutions/Education+Solutions/Products+for+education/Software/SMART+Notebook+collaborative+learning+software/SMART+Notebook+collaborative+learning+software>

SMART Technologies Research Retrieved June 2, 2013, from <http://downloads01.smarttech.com/media/research/smartresponseresearchsummary.pdf>

Waters, J. (2012). Resolving the Formative Assessment Catch-22. *T.H.E. Journal*, 39 (7), 8-14. Retrieved From <http://online.qmags.com/TJL0912?fs=2&pg=8&mode=1#pg10&mode1>

What is a Student Response System (SRS) Clicker? Retrieved May 19, 2013, from <http://www4.uwmedu/lrc/srs/students/docs/StudentFAQs.pdf>

William, D., & Thompson, M. (2008). Integrating Assessment with Learning: What Will it Take to Make it Work? In C.A. Dwyer (Ed.) *The Future of Assessment Shaping Teaching and Learning* (pp. 53-82). New York: Lawrence Erlbaum Associates.