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ABSTRACT

North Carolina adopted the North Carolina Common Core State Standards (NCCCSS) in K-12 Mathematics and K-12 English Language Arts on June 2, 2010 that were released by the National Governors Association Center for Best Practices and the Council of Chief State School Officers. With the adoption of these state-led education standards, North Carolina is in the first group of states to embrace clear and consistent goals for learning to prepare children for success in college and work. Under the Mathematics Standards, Math I, commonly known as Algebra I, is considered the gatekeeper for students who are college or career ready. There is a significant need to encourage and prepare a higher percentage of minority and non-traditional high school students to pursue careers in the areas of science, technology, engineering and mathematics (STEM) on a national level. High school freshman from schools the twenty-one county region that falls under the school divisions assigned to Elizabeth City State University (ECSU) consistently perform poorly in Math I on the End of Course (EOC) state test annually. This team will seek to examine the challenges to be overcome by eighth grade students to be successful on the Math I state assessment taken at the conclusion of their first semester in five high schools located in three selected school divisions that are in close proximity to ECSU. The Math Team will focus on the skills of North Carolina students that are required to successfully transition from Math 8 to Math I in the North Carolina Common Core Standards for Mathematics.

Key Words: North Carolina Common Core State Standards for Mathematics (NCCCSS), End of Course Tests, STEM

PURPOSE

The research purpose to find the best practices considered as solutions to meet the challenges of preparing Math I students from Pasquotank, Perquimans, and Washington County School districts to enhance the teaching strategies that enabled student success on the end of course state test. Understanding the factors that influence student success in Math I enhances opportunities for college entrance and career goals that tend to potentially increase participation in science, technology, engineering, and mathematics (STEM).



SAMPLE AND PARTICIPANTS

The data collected and analyzed in this study comes from 27 mathematics teachers from three counties in northeastern North Carolina; Pasquotank, Perquimans and Washington during the spring of 2014 school year. 44% of the teachers taught Math 8 and 56% of the teachers taught Math I. From the group of teachers 30% were male and 70% were female also 63% of the teachers had been teaching for ten or more years. 37% taught for ten or less years. Members of the ECSU CERSER Mathematics team collected the survey and interview responses from a majority of the teachers personally.

TABLE I. Frequency Distribution for Participant Demographics

Mathematics Teachers from Pasquotank, Perquimans, & Washington County Schools		
	Math I	Math 8
Pasquotank County	4	
Northeastern High		
Pasquotank High	3	
Elizabeth City Middle		3
River Road Middle		2
Perquimans County		
Perquimans Middle		3
Perquimans High	2	
Washington County		
Creswell High	2	
Plymouth High	4	
Washington County Union		7

FOCUS QUESTIONS

Does an effective teacher philosophy of teaching and learning enhance student learning?
How does understanding student knowledge of math content impact student success?
What professional development activities assist in building student test taking skills

SURVEY INSTRUMENT

The information gained from the survey instrument was used to observe teacher best practices for Math I in North Carolina to improve student achievement on the EOC. The math team designed a 20-item survey instrument (*figure 1*) used for data collection with mathematics teachers from three counties in northeastern North Carolina with low EOC Math I scores for 2010 and 2012. The survey instrument consists of five sections; Understanding Student Culture, Formal and Informal Staff Development Participation, Student Response to Classroom Instruction, the last two sections both focused on Formal Staff Development. The math team used a 5-Likert scale for the survey participants were asked to select their level of agreement with each of the statements with 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

BEST PRACTICES

Common Core State Standards (CCSS) are changing the educational system throughout the United States and are designed to improve student achievement, teachers need to find ways to provide instruction that keeps math scores high and still follow the CCSS standards.

Best Practice #1: Selecting and using meaningful algebraic tasks

Best Practice #2: Stimulating classroom discourse

Best Practice #3: Creating a positive algebraic learning environment

Best Practice #4: Analyzing teaching and learning in algebra Best Practice #5: Prioritize Classroom Information

Best Practice #6: Discuss Lesson Plans with Other Teachers

Best Practice #7: Provide Creative Educational Solutions

Figure 1: Survey Instrument

Algebra I Teacher Survey

This questionnaire is designed to assess challenges your students faced to obtain a level of success in Algebra I. Completion of this survey should require about 5 minutes of your time. Please give each statement relevant thought in your response. Your responses will remain confidential.
Gender: M F
Number of Years Teaching: _____

Indicate the extent to which you agree or disagree by filling in the appropriate bubble. Please address your response based on the statements which range from "1" Strongly Disagree to "5" Strongly Agree as they are represented across the row.

	1	2	3	4	5
<i>Please indicate the extent to which you agree or disagree with the following statements.</i>					
Have an awareness of previous knowledge level before working with a new group of students.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Students are expected master the content before moving on to new topics.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Frequently collaborated with my students' former math teachers about teaching strategies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Know that other math teachers are working with students at the same level of achievement and using similar teaching methods to cover the same content.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teachers of former students easily assess student learning from my classes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>To what extent do you agree with the following statements on both formal (staff development) and informal (confering with a colleague)?</i>					
Provided me with knowledge that was useful in the classroom to enhance student learning.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Workshop sessions were coherently related to each other.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focused on too many topics.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provided me with useful feedback about my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Led me to try new things in the classroom that led to student success.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>My Algebra I students targeted class instruction by...</i>					
Assessing a problem and choosing a method to use from those already introduced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performing tasks requiring methods or ideas not already introduced.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Explaining an answer or a solution method for a particular problem.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Analyzing similarities and differences among representations, solutions, or methods.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working on mathematics textbook, worksheet, or board work exercises for practice or review.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Indicate your level of agreement with professional development sessions you participated in this school year that focused on the following topics:</i>					
Student assessment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curriculum materials or frameworks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Use of technology in instruction.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multicultural or diversity issues that affect student learning outcomes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Parent involvement that enhance student performance in Algebra I.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Considering professional development opportunities you experienced in mathematics this past year, time and effort was devoted to the following...</i>					
Analyzing Algebra I curriculum materials.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improving student skills at designing mathematics tasks for individual students.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improving student understanding of knowledge of patterns, functions, or algebra.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extending student knowledge of different representations for number concepts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extending student knowledge of different representations for operations or computation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table II. Understanding Student Culture

	Strongly Agree/Agree	Neutral	Strongly Disagree/Disagree
Have an awareness of previous knowledge level before working with a new group of students.	20	6	1
Students are expected master the content before moving on to new topics.	18	6	3
Frequently collaborated with my students' former math teachers about teaching strategies.	15	3	9
Know that other math teachers are working with students at the same level of achievement and using similar teaching methods to cover the same content.	19	5	3
Teachers of former students easily assess student learning from my classes.	19	5	3

Table III: Formal and Informal Staff Development Participation

	Strongly Agree/Agree	Neutral	Strongly Disagree/Disagree
Provided me with knowledge that was useful in the classroom to enhance student learning.	22	3	2
Workshop sessions were coherently related to each other.	14	11	2
Focused on too many topics.	16	6	5
Provided me with useful feedback about my teaching.	16	4	7
Led me to try new things in the classroom that led to student success.	19	5	3

Table IV: Student Response to Classroom Instruction

	Strongly Agree/Agree	Neutral	Strongly Disagree/Disagree
Assessing a problem and choosing a method to use from those already introduced.	19	5	3
Performing tasks requiring methods or ideas not already introduced.	14	8	5
Explaining an answer or a solution method for a particular problem.	19	5	3
Analyzing similarities and differences among representations, solutions, or methods.	20	4	3
Working on mathematics textbook, worksheet, or board work exercises for practice or review.	18	6	3

Table V: Formal Staff Development

	Strongly Agree/Agree	Neutral	Strongly Disagree/Disagree
Student assessment.	16	3	8
Curriculum materials or frameworks.	16	5	6
Use of technology in instruction.	16	8	3
Multicultural or diversity issues that affect student learning outcomes.	11	6	10
Parent involvement that enhance student performance in Algebra I.	7	10	10

Table VI: Formal Staff Development

	Strongly Agree/Agree	Neutral	Strongly Disagree/Disagree
Analyzing Algebra I curriculum materials.	16	4	7
Improving student skills at designing mathematics tasks for individual students.	16	4	7
Improving student understanding of knowledge of patterns, functions, or algebra.	18	2	7
Extending student knowledge of different representations for number concepts	15	5	7
Extending student knowledge of different representations for operations or computation	16	3	6

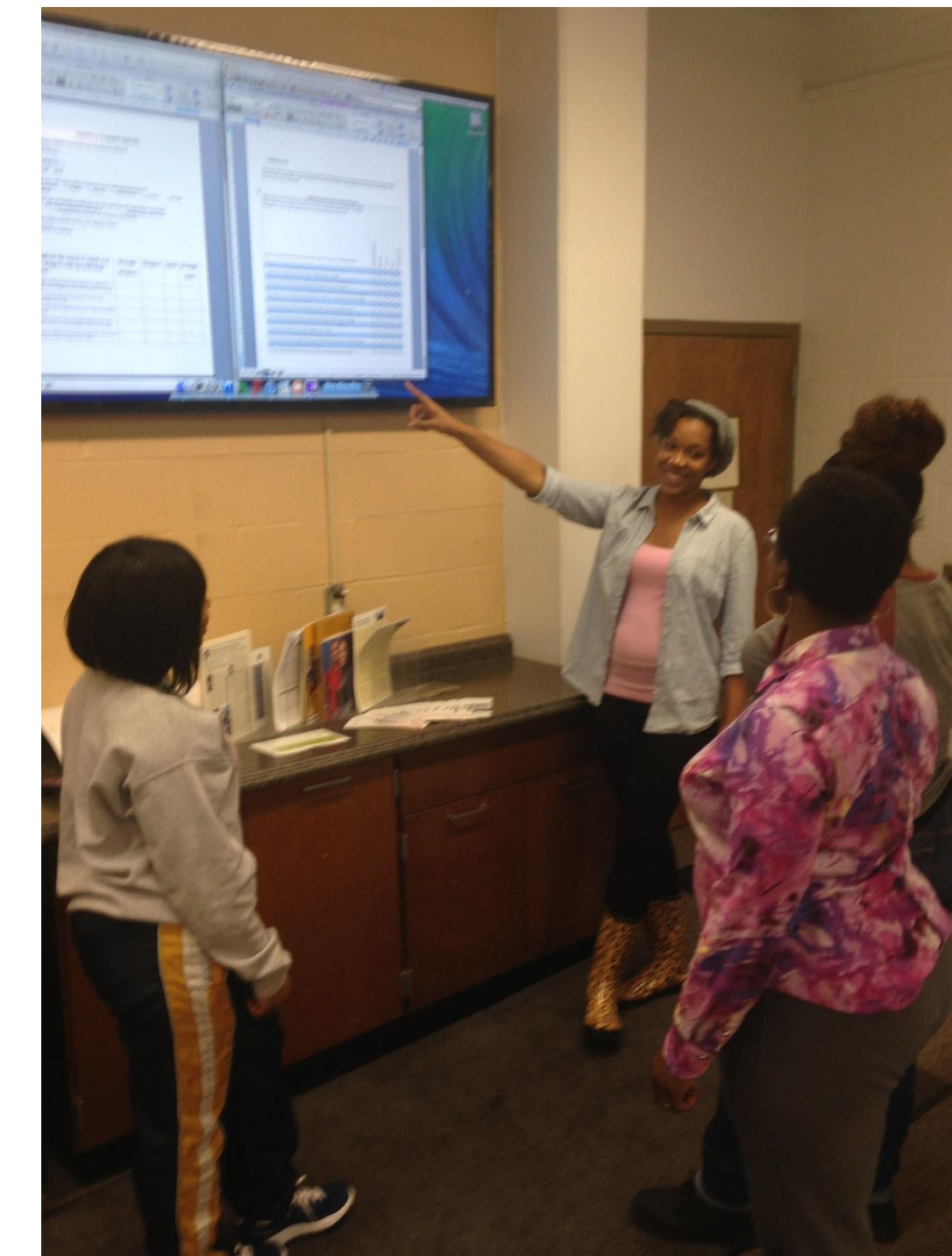
Figure 2: Questionnaire Instrument



Algebra I Teachers

Interview Question Prompts:

- What is your teaching philosophy?
- What five words would you use to describe yourself as a teacher?
- Describe your teaching style?
- What type of classroom management structure do you implement?
- What technology is used to support your teaching?
- How do you communicate student progress to parents?
- Tell me how you develop your daily lesson plan and what do you include?
- What is your system for evaluating student work?
- What do you do if a lesson doesn't work well?
- Could a student of low academic ability receive a high grade in your classes?



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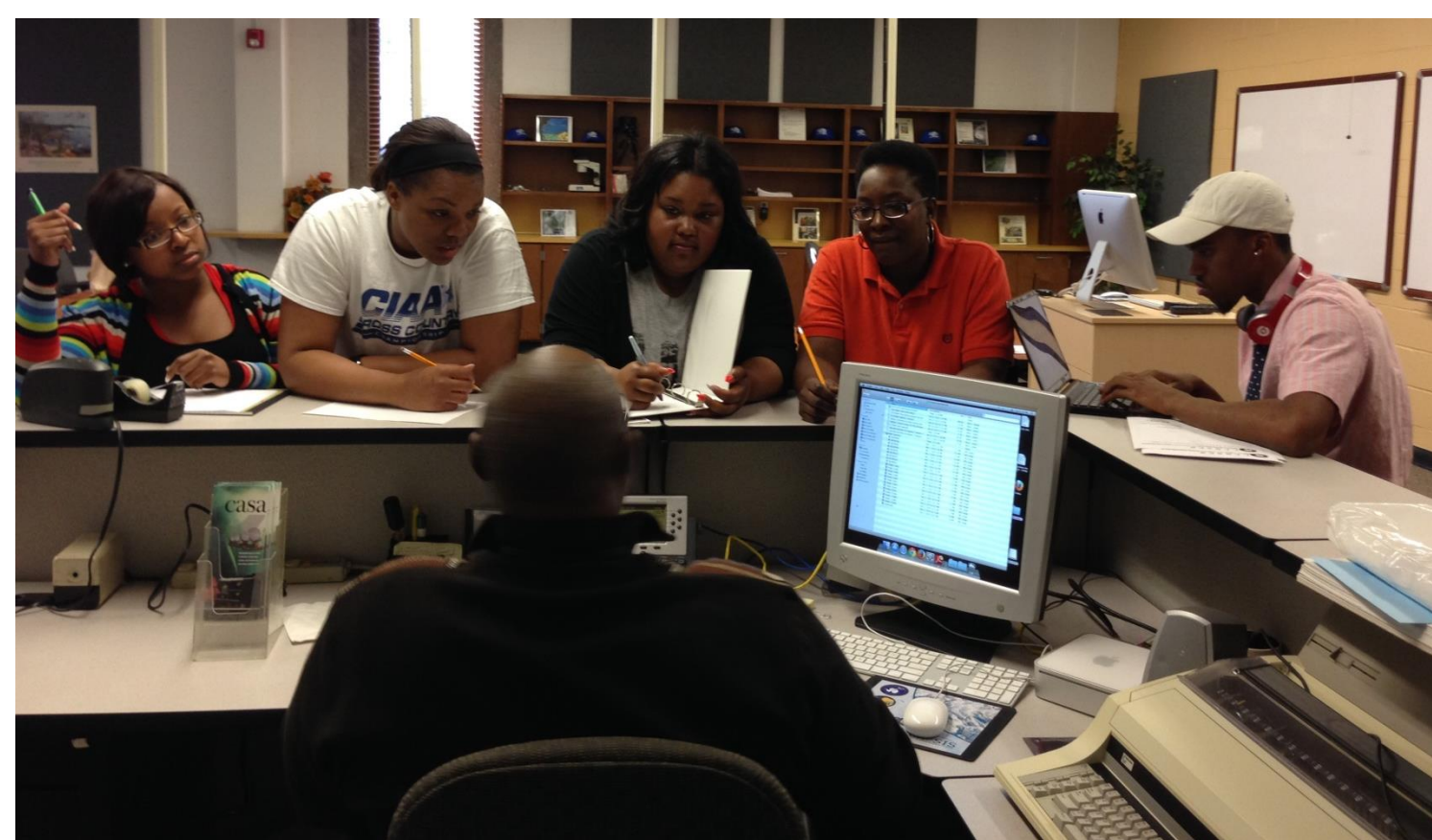


Figure 3

$$\text{Chi-square} = \text{Sum of } \frac{(\text{observed} \times \text{frequency} - \text{expected} \times \text{frequency})^2}{(\text{expected} \times \text{frequency})}$$

Table VI: Chi Square Results

0.999194862	0.999194862	0.97554228	0.731567852	0.621609236
0.960882861	0.953565985	0.810123571	0.810123571	0.688696651
0.541697187	0.931269327	0.982111252	0.926092519	0.699588245
0.980090409	0.909082926	0.98725212	0.302065874	0.688696651
0.957334132	0.964217731	0.97554228	0.135024234	0.772231645

CHI-SQUARE STATISTIC

The The Chi-Square Test showed a comparison of observed and expected values the results are shown in the table above. From the results it can be shown that the survey instrument overall received close to the expected value for a majority of the responses. Of the 25 questions 60% were in the 90% range for expected response which is a high yielding result.

FUTURE WORK

The 2014 math research team plans to present findings of this research at local, regional, and state mathematics education conferences and submit this manuscripts for IEEE publication. Two goals came to play a central role, first identifying ways in which mathematics teachers use professional development in a specific academic and social context to assist their students. And second by identifying the knowledge, resources, experiences, and rationales mathematics teachers draw on to assist students in becoming successful on state assessments.

CONCLUSION

The results of the questionnaire and survey concluded that math teacher effectiveness demonstrated contributions to growth in student learning. Good middle and high school teachers accomplish other things, including motivating and engaging students, acquiring new knowledge and skills, and collaborating with colleagues. But those accomplishments best serve their purpose when they lead teachers to improve student achievement. Professional development lead effective teachers to administer pretests at the beginning of the year or the start of a unit and then administer a post-test at the end, measuring students' growth in learning along the way. They also provided richer information on what skills or topics students are or are not mastering. Formative assessments added the benefit of being tied directly to individual teachers and their classroom practice Most education reformers agree that improving student learning defines effective teaching. The best way to improve teacher effectiveness is to provide teachers with support and guidance that are grounded in effectiveness—that is, which uses effectiveness data to enhance professional development, teacher education, and encourage student learning.

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