

# *Implementation & Documentation of Technology Training for Seniors and the PiMERS Middle School Program*

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**Purpose-** The Pathways in Mathematics Education and Remote Sensing (PiMERS) program is a part of a STEM (science, technology, engineering and mathematics) based initiative that is the result of the joint effort of Elizabeth City State University (ECSU) and NASA Langley Research Center (LaRC). The Association of Computer and Information Science/Engineering Departments at Minority Institutions (ADMI) also supported this contribution to the NASA national efforts for achieving excellent education. The goal of PiMERS is to foster and nurture the interest of minority students in STEM-related fields, specifically mathematics and remote sensing. The REU Outreach program worked underneath the PiMERS grant to host two events- the 2016 PiMERS Middle School Program and the 2016 PiMERS Senior Computer Training Camp at Zion Baptist Church. The PiMERS Middle School program allowed the student-researchers opportunities to engage in other related fields such as computational chemistry and aviation, computer science, hydrology, robotics and engineering. During the span of this program, the researchers partook in seminars that were created to induce interest in STEM related fields. Students also partook in math and robotics seminars that were intended to gauge their knowledge based off the Common Core standards implemented by the North Carolina school system. The PiMERS Senior Computer Training program was intended to provide basic computer and internet training for senior citizens. The PiMERS Senior Computer Training Camp consisted of biweekly training sessions that ran for five consecutive weeks. Each session was formulated to cover different aspects of modern technology in order to instill basic computer skills in the participants. The training camp was a continuation of the 2015 Senior Computer Training Camp at Zion Baptist and was held at Zion Baptist Church in Portsmouth, Virginia. The program was started by Dr. Hayden and is facilitated by the Zion Baptist Outreach team whose members consisted of Dr. Johnson, Mr. Lee Hayden and Steffi Walthall, an REU student intern. The program ran for a span of five weeks starting on the 28th of June 2016 and ending on the 28th of July 2016 and it consisted of ten training sessions. The students met biweekly on Tuesdays and Thursdays from 10 am to 12 pm for each training session.

**Keywords—** outreach, seniors, remote sensing, robotics, technology training, STEM, NASA

## *I. PiMERS MIDDLE SCHOOL PROGRAM*

### *A. Preparation and Materials*

PiMERS program staff consisted of Dr. Linda Hayden, the principal investigator and the director of ECSU's PiMERS program, Dr. Darnell Johnson, Mr. Jeff Wood, the program's multimedia trainer, and Mr. Joal Hathway, administrative and technology outreach manager along with members of the Math Outreach Team. The Math Outreach team consisted of one graduate and one undergraduate student that were involved in CERSER's (Center of Excellence in Remote Sensing Education and Research) Research Experience for Undergraduates (REU) program, Derek Morris from (ECSU) and Steffi Walthall from Savannah College of Art and Design (SCAD). The program was set to run for two weeks for six hours each day. At the completion of the program, the students would each receive a certificate of completion and a stipend for one hundred dollars. Students involved in the PiMERS program were recommended from surrounding middle schools in the Elizabeth City/Camden area. The students selected were either rising 7th or 8th graders. Teachers from the middle schools were asked to select the most qualified minority students for this program from their classes based on the criteria of overall academic standing, student awards, and pre-established interest in STEM fields. From over twenty applicants for the program, only eleven student-researchers were chosen. At the beginning of the program, each student received a PiMERS binder and bag, a task sheet of every assignment that they had to complete before the end of the program, a schedule of every event that would happen during the program, a flash drive, a pen, and pamphlets that contained extraneous information concerning different programs that were related to STEM fields. The assignments on the task sheets were all related to the events that the students would participate in during the span of the PiMERS program. Each assignment was required to be completed before the end of the program in order for the students to receive their stipend.

## *B. PiMERS OPENING*

The opening ceremony for the PiMERS Middle School Program was initiated with a greeting from Dr. Hayden to the researchers and their families and introduced the staff that would be working with them for the next two weeks. She then spoke on the many opportunities that this program would open up for the students later on in their educational careers. There was a strong emphasis placed on the importance of STEM fields and the impact that it is having in the current track that society is on. She noted the importance of the research that the CERSER programs have done and how the students are now a part of the growing legacy that the university has established. Dr. Hayden continued opening the program by going over the events in which students would be involved for the next two weeks. She then had two surrogate speakers relate on the behalf the experiences of the robotic engineers and programmers. Afterwards she invited Dr. Johnson, the program director to speak about the program schedule. Dr. Johnson spoke heavily about the importance of this opportunity that the students had because of their status as minority students. He spoke in depth about the different activities in which students would participate, such as how during the span of the program the students would participate in thirteen various instructional sessions, six lunch seminars, and two field trips. Dr. Johnson specifically placed emphasis on the robotics and mathematics sessions that the students would be involved in later on in the program. He also noted how this program would give them an advantage during the following academic year as well as during their college careers.

## *C. PiMERS Program Sessions*

After the opening of the program, the parents departed and the students had their first lunch seminar. Each student was required to take notes on each lunch seminar so that they could eventually compile them into research papers as required by their task sheet. Andrew Brumfield, a graduate assistant from ECSU, spoke to the students about remote sensing and satellites. During his lecture, he talked about the first satellites created, how there are different types of satellites, and the importance of remote sensing when it comes to researching the effects of climate change globally. He also discussed what sensing is in a way that was relatable to the students and how remote sensing is an extension of human senses that is meant to analyze data unobtrusively. Following the lunch seminar, the students had a digital camera lab with Mr. Jeff Wood. The students were given Coolpix™ digital cameras as Mr. Wood gave a presentation on digital cameras. During his presentation, Mr. Wood taught the students about light waves and how they translate to pixels through binary code, the measurements of pixels and bytes, different types of cameras and the basic controls for cameras. He also spoke about different types of shooting techniques for camera beginners such as the Fibonacci sequence and the rule of thirds. After his presentation, Mr. Wood took the students to the outdoor classroom where they shot their own pictures using the digital cameras provided. Three of the students also directed several group shots, utilizing the information given to them by Mr. Wood.

The second day of the program opened with another presentation by Mr. Wood in PowerPoint training. During this session, the students were taught how to use Open Office in conjunction with Powerpoint to create a presentation on themselves. Mr. Wood taught them how to change their slide formats, designs, and fonts as well as how to insert images into a PowerPoint presentation. He also taught them about general formatting and etiquette when creating and presenting a presentation. Afterwards the students presented their PowerPoints. The students were instructed to create presentations about themselves, including topics such as their hometowns, education, hobbies, and future colleges and career plans. Each student was subjected to a constructive group critique in which the students and staff gave their opinions on the presentation's strengths and weaknesses. Cornelius Holness, an REU student intern, presented the students' second lunch seminar. His presentation was on unmanned aerial vehicles (UAV), otherwise known as UAVs. During his lecture, he spoke about the first unmanned aerial vehicles and how they are instrumental when it comes to the process of remote sensing because they can be controlled remotely. Mr. Holness's presentation contained a video that showed different types of unmanned aerial vehicles and how they have been used for military and research purposes. After the UAV presentation, the students had their first math application session which was facilitated by the Outreach team. The members of the team first discussed the Common Core State Standards that are required by the North Carolina Public school system for their academic year. The Common Core State Standards Initiative is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. Forty-two states, the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have voluntarily adopted and are moving forward with the Common Core. The Common Core Standards Initiative was fully implemented in North Carolina during the 2012/2013 school year [1]. The students were then allotted an hour and a thirty minutes to complete a thirty question exam comprised of various math equations. The purpose of the exam was to gauge the collective standing of the researchers in comparison to the Common Core Standards. The Common Core Standards for mathematics education for the seventh and eighth grades require students to be able to [2]:

- Analyze proportional relationships and use them to solve real-world and mathematical problems
- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers
- Use properties of operations to generate equivalent expressions.
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

- Draw, construct, and describe geometrical figures and describe the relationships between them.
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.
- Use random sampling to draw inferences about a population.
- Draw informal comparative inferences about two populations
- Investigate chance processes and develop, use, and evaluate probability models
- Know that there are numbers that are not rational, and approximate them by rational numbers.
- Work with radicals and integer exponents
- Understand the connections between proportional relationships, lines and linear equations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.
- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities
- Understand congruence and similarity using physical models, transparencies, or geometry software
- Understand and apply the Pythagorean Theorem
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.
- Investigate patterns of Association in bivariate data.

As the students finished a Pre-Test, the members of the Outreach team collected and graded the exams. The incorrect scores were tallied and later on Dr. Johnson performed a review of the incorrect questions. The results of the Pre-Test showed that a majority of the class marked seventy percent of the answers wrong. However, when questioning the students, it was made clear that the students' teachers did not cover some of the material on the test.

Dr. Johnson took the students on a fieldtrip to the Virginia Air and Space Center. Students interacted with exhibits concerning aviation and robotics on the third day of the program. They also saw exhibits on spacecraft and satellites. The students also saw an IMAX film on ROBOTICS 3D. Prior to this trip, the students wrote a two-and-a-half-page essay on what they expected to see on their trip to the Virginia Air and Space Center and what they expected to learn [3] [4].

The fourth day of the program began with the beginning of a Hydrology training lab conducted by Ms. Sheryl Bradford. Ms. Bradford started the lab by informing the students that they would be conducting an investigation on the origins of a fish that had been rescued from a creek on ECSU's campus. The students were taken outside, retrieved water samples from the creek, and moved on to a lab within the Pharmacy building. Students were then broken into teams of two and tested the

water to determine its various qualities, such as salinity and oxidation.

After discussing the results of the water testing, students participated in a lunch seminar given by Mr. Derek Morris, an REU graduate student intern and a member of the REU Math Outreach team. Mr. Morris's presentation covered computer science. During his presentation, Mr. Morris covered the importance of computer science in today's modern economy, the benefits of a computer science degree, and the different types of jobs that computer science degrees can fill. At the end of the presentation, the students returned to the lab. They were divided into teams and played a memorization/recollection exercise that required them to match the terms that they had learned during the hydrology lab to their respective definitions. Following the exercise, Ms. Bradford directed the students in making their own "lava lamps" using vegetable oil, water, food coloring, glitter and effervescent tablets.

The fifth day of the program started with the second and final math application session. The students continued their review of the exam from the first math application session with Dr. Johnson and they were given two math worksheets that were to be completed by the end of the program. During the lunch seminar, Mr. Orestes Gooden, an instructor in ECSU's Aviation Science program, spoke to the students about the first African American female pilot, Elizabeth "Bessie" Coleman. Mr. Gooden introduced the students to ECSU's own Bessie Coleman, Dominique Vaughn, a pilot and flight specialist at ECSU. Ms. Vaughn spoke to the students about her beginnings as a pilot and the different plans that her licenses allowed her to fly. The lunch seminar continued as the students were taken to the aviation wing in Dixon hall. The students interacted with two different flight simulators as well as the air traffic control lab. In that particular lab, they learned about the military alphabet that the pilots and air traffic controllers use to communicate with each other. The students were led into the technology lab where they saw the university's technological resources, such as ECSU's 3-D printers, UAVs, and drones. During this time, the students were introduced to Dr. Kuldeep Rawat, the chairperson of the Technology Department at ECSU. Dr. Rawat spoke to them briefly about the resources that the department has and how the university uses these resources for testing.

The sixth day of the program began with a tour of the campus. Derek Morris and Steffi Walthall, guided the students on a campus tour to the Marion D. Thorpe, Sr. Administration building, Information Technology Center, Willie and Jacqueline Gilchrist Education and Psychology Complex, Mickey L. Burnim Fine Arts Center, Melvyn N. Vonda Reed Riley Wellness Center, and Walter N. and Henrietta B. Ridley Student Complex/University Center before returning to Dixon Hall for lunch. Kevin Benton, an REU student intern, on networking, gave the lunch seminar for that day. The lunch seminar was followed by GPS training conducted by Cornelius Holness. The students were taken outside and learned how to plot and edit points into a GPS. Later they went to an open field near the Administration building where they participated in exercises to promote an understanding of the equipment.

The seventh day consisted of a field trip to ECPI University where the students went on a tour of some of the different STEM-related research labs that the university had to offer. They first visited an engineering lab where they saw different types of technology that used sensors to complete tasks. The students then went to the Hydraulics lab where the guide spoke about the different applications of hydraulics that are used in everyday engineering jobs. Afterwards, the students were led to a computer science lab where they saw a breadboard, which is the main brain of a computer. After lunch, the guide spoke to the students about what they believe their role will be on the corporate ladder as well as their career goals. Afterwards, the students went to the cybersecurity lab where they saw different cyberattacks taking place in real time and learned how to make their internet passwords stronger. The students were guided to the game development lab of the university where the game design professor spoke to them about different game engines that they could develop in free. Finally, the students were led to the Criminal Justice lab where a few of the students interacted with a crime simulation and had to gauge the threat level of the situation [5].

The eighth and ninth days of the program were dedicated specifically to robotics. Dr. Johnson and the REU student interns of the Math Outreach team presented information on the robotics kits that the students would be using to build and program their own robots that would eventually race during the last robotics session. For the PiMERS Middle School Program, the students were presented Lego® Mindstorms® robotics kits that featured a programmable “brain” and sensors that could be used in conjunction with the brain to enable the robots to avoid obstacles [6] [7]. Students were divided into teams of two with an exception of one team that had three members. Each team was given one Lego® Mindstorms® robotics kit and both members had to work together to sort all of the pieces into like groups before actually building their robots. The process of building the robots was at sometimes frustrating for the students because of the detail-oriented structure required by the instructions. Some of the teams had to restart in making their robots because of a previous mistake in placing the wrong piece in a certain area. During lunch of the first day of robotics training, the students listened to a lecture given by student intern Kamberlin King on Remote Sensing and TeraScan, a program that ECSU is specifically involved in. On the second day of the robotics lab the students were introduced to the software that they would be using to program their robots with (NXT 2.0) as well as the obstacle course that their robots would need to be programmed to complete. The REU Math Outreach team members placed a strong emphasis on trial and error thought processes for this session as well as logical thinking and teamwork. It was heavily encouraged that while one team member tested out the robot the other team member who was not actively interacting with the robot would take notes. The race was scored by which team best completed the race and within what time. At the end of the competition, each team was given trophies or medals depending on their placement in the overall race.

#### *D. Closing Ceremony*

The final day of the program began with the students coming in, completing their final assignments for their task sheets, and preparing for the closing ceremony. Before the closing ceremony, each of the students handed in their completed work from the program along with their task sheets to Dr. Johnson. The parents were invited to attend the closing ceremony. Dr. Hayden congratulated the students on their accomplishments and told the parents about some of the events that happened during the two-week program. She then thanked Dr. Johnson for all of his hard work and invited him to speak to the students. He also spoke about the students’ achievements and discussed their schedule with the parents. Dr. Johnson then invited one of the students to give her presentation on her experience in the program. Afterwards, Dr. Hayden invited several other guest speakers to the podium- Dr. Georges a professor from UK, Roger Hathaway, the former director of Education at NASA-Langley Research Center and Ms. Dana Chandler, a parent of one of the students involved in the program. The former director of NASA-Langley and the professor both encouraged the students to keep working in STEM related fields and to keep aspiring to higher goals. Ms. Chandler spoke directly to the parents about the change and the excitement for learning that she saw in her child as he went through this program. She thanked Dr. Hayden and Dr. Johnson for dedicating their time and energy towards the program and for investing in the students. Finally, the students were awarded their stipends, a certificate of completion and a medal of achievement for their work in the program.

## II. PiMERS SENIOR COMPUTER CAMP AT ZION BAPTIST CHURCH

### *A. Introduction*

The PiMERS Senior Computer Training Camp at Zion Baptist Church was initiated during the second week of July and was renewed for a second session four-week session that took place during the month of August. The first session ran was facilitated by the Zion Baptist Outreach team members Dr. Darnell Johnson (ECSU), Mr. Lee Hayden (ECSU) and Steffi Walthall (SCAD) and they were joined by Maeah Walthall (GMU) at the initiation of the second session. The training that occurred during this program were a compilation of instructive and interactive sessions that covered material on computer and internet basics. The program extension resulted in a marked increase in participants that attended the instruction on a regular basis.

While the month of August marked a new session of the computer training camp, a majority of the students from the prior session continued to attend and participate in the instructions. Due to the mixture of new and old participants, the Zion Baptist team members split the seniors into two separate groups. The newer members and previous participants that may have struggled in grasping the material previously would participate in the instructional sessions during the first part of the day. The older members, as well as

any of the more advanced newer members would interact with the computers and continue the activities that they had been working on previously. Several of the instructional sessions were repeated due to the irregular entrance of newer participants at the beginning of the programs extended session. Repetition of the instructional subject matter was also necessary because of the nature of the participants and the session occurrence. The program staff and seniors met for two hours consecutively twice a week. The space in between the meetings increased the occurrence of the lack of retention of subject matter that the seniors had been introduced to during the previous instructional sessions. Constant repetition of information previously taught and affirmation when the seniors completed a task successfully was necessary to boost confidence in computer operation.

### *B. Preparation and Materials*

In preparation for the program, the Zion Baptist Outreach team assembled manila folders that contained information to be given to the students at the beginning of the session. The Outreach Team created a lesson plan and for the training camp that covered various topics. The Zion Baptist Outreach team also created presentations and planned in-class demonstrations for each session. The folders included a glossary of terms, a basic lesson plan and handouts from the National Institute on Aging, printed color copies of each PowerPoint, and other material on the benefits of understanding computers. The students also received a flash drive, a PiMERS folder, a name tag, and a PiMERS ink pen [8] [9]. These packets were meant to be supplementary to the actual presentation and a guide for in class workshops.

### *C. Instructional and Interactive Sessions*

The computer and internet basics presentation was broken up into two parts; part one covered computer terms while part two covered internet terms. During the computer terms instructional session, the participants learned about some of the different types of computers that they may interact with on a regular basis, the different operating systems that are installed on those devices and how those systems affect the user's interaction with the device. The seniors were also introduced to specific basic terminology and definitions concerning computer hardware such as the monitor, keyboard, computer processing unit, and computer mouse as well as an introduction to some of the software that would be covered during the course of the program. The internet basics presentation focused on information such as browsers, webpages, and search engines. During the interactive session associated with the computer and internet basics presentations, the participants practiced utilizing the computer mouse, the internet, and some of the built in software applications that were on the Macintosh computers provided. The students were provided with color printed handouts of each of the presentations at the beginning of the respective session.

The smartphone and tablet basics instructional session was a highly requested subject. A majority of the participants, especially from the second session utilized smartphones on a

daily basis or at the very least owned a tablet over possessing an updated computer. This instructional session covered the difference between smartphones and tablets and how to use them. The presentation reviewed the different components of these devices and how to utilize those functions efficiently, such as downloads, settings, and applications. The presentation also covered all of the basic inherent software features on a smart device regardless of the brand. This instructional session covered the disparities that have been found between Windows, Android, and Apple branded devices and their operating systems. The day prior to the smartphone and tablet basics presentations, the seniors were alerted to bring in their personal devices so that they could use their devices alongside the presentation. The following interactive session consisted of troubleshooting any problems that the seniors may have had prior to the program as well as clarifying any part of the instructional session that may have been unclear. The students were provided with a color printed handout of the presentation at the beginning of the session.

The email basics instructional session covered some of the many advantages electronic mail possesses over traditional mail. The instructional session introduced several of the different email servers that exist such as Gmail by Google, Hotmail, Yahoo! Mail, Microsoft Outlook and MSN. The presentation also detailed how to create a Google email account (or Gmail) and the different features of the Gmail inbox [10]. The instructional session concluded with information on how to create, send, and delete an email and how to log out of a Google account. After the end of the instructional session, the instructors assisted the seniors, who did not previously have an email account, with creating their own email accounts and with troubleshooting any problems the seniors, that already had accounts, may have had with their email accounts prior to the instructional session.

The Microsoft PowerPoint presentation was an amalgamation of an interactive session and an instructional session. During this time, the instructors demonstrated how to make a presentation in the class, utilizing the projector and laptop that Zion Baptist Church had provided for the program. The instruction covered basic features in Powerpoint, such as navigation, slide animation, and presentation themes. The presentation also covered some of the more advanced features Powerpoint offers users to enhance their presentations. These features include recording animations that the user draws on screen, compiling photos into a digital photo album, and the presenter view which allows the presenter to see their notes and the next slide. All of these features greatly interested the seniors. Additionally, one of the instructors gave their own "About Me" Powerpoint presentation as an example of the type of presentation one can give. During this presentation, the instructors addressed tips, tricks and general rules that the seniors should follow when creating a presentation for business or otherwise- such as not overcrowding the slides and choosing an unobtrusive background that will not distract the audience. Following the instructional session, the seniors created their own about me Powerpoint presentations.

The Microsoft Word interactive session took place strictly within the Zion Baptist Church computer lab. The main focus of this session was to familiarize the participants with typing on the keyboard and introducing them to the software's style ribbon—a consistent unifying aspect of all Microsoft Office software. During this session, the participants were instructed to use the Microsoft Word software to create a resume that was intended to inform others about certain aspects about themselves such as place of birth, former jobs, hobbies, and education.

The Microsoft Excel interactive session was conducted in a similar fashion to the Microsoft Word interactive session. The participants were introduced to the different features of the Microsoft Excel software, namely the style ribbon, and they were also shown how to navigate throughout the program. The participants were then tasked with creating a budget to practice inputting information and utilizing the software's equation commands to produce totals for their budget. The students were provided with an extensive handout on the different features and functions of Excel at the beginning of the interactive session.

#### D. Conclusion

At the conclusion of the program, the seniors were given a post survey to assess their competency with computers and computer software. When compared to the answers given by the preliminary survey, the post survey that the seniors were more confident as well as more independent when it came to using the computers and smartphones. The participants expressed that the program had proven beneficial and felt that the skills gained during the program would be utilized on a daily basis. Observations throughout the program showed that some repetition was required to maintain retention among the seniors. Program attendees displayed a larger threshold of comprehension of subject matter during the latter interactive sessions and preferred to use the instructional sessions to ask questions about the topics covered. The instructional sessions also served as periods for topic discussion among the participants, which facilitated retention. Overall, the PiMERS Senior Computer Training Camp at Zion Baptist Church fostered an interest in technology and technology training in the seniors who participated. The PiMERS Senior Computer Training Camp at Zion Baptist Church served as an outreach opportunity for senior citizens in the community to gain and improve upon basic computer skills. Through interactive and instructional sessions, participants gained the ability to comprehensibly use Microsoft Word, Microsoft Excel, and Microsoft PowerPoint. Participants also learned more about the features of the internet and smartphones.

### III. FUTURE WORK

For the future PiMERS Middle School Program, the adjustment of this program will include: a pre-program survey and post-program survey, as well as the implementation of the more rigorous level of the NXT LEGO® MINDSTORMS® robotics kit and program. It is suggested that for the further

development of the PiMERS Senior Computer Training Camp at Zion Baptist Church includes: an increase in the time allotted for sessions and an advancement from sessions two days a week to three. The Outreach team also requests an increase in computers for the computer lab as the daily amount of training camp participants exceeded the amount of computers available.

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