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Preparing 8th Grade Students to Excel in Physical Science: HandsOn Physics (HOP)!

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Abstract: This study describes a program that the University of Alabama at Birmingham (UAB) carried out in partnership with Birmingham City Schools (BCS) to test an educational intervention, i.e., Hands-On Physics (HOP), among 8th grade students in predominantly minority schools. It also evaluated teachers' demographics and educational backgrounds. The students conducted four physics experiments during a three day period. They performed better on post- tests. The actual and the percent gains in knowledge for each school were essentially equal for the schools that had passing versus failing grades in annual state assessment (20.4±5.6/49.0±5.6%, 20.4±2.7/48.4±8.3%, respectively). Most students (53%) stated that they were comfortable with science, 88% indicated that they were planning to enter higher education, and 86% agreed that higher education was very important for their future. The students' major perceived obstacles to higher education were education cost and low grades. The teachers were primarily between 40-59 years old (60%), female (80%) and African-American (93%), and 87% majored in biology (93%). Forty percent had a bachelor's degree and 60% had a master's degree. They reported that they needed more support teaching physics and reported that a lack of materials and time were the main obstacles to provide the highest quality science educational experiences.

INTRODUCTION

Due to the 21st century's rapidly developing technology-dominated economy students who are well-trained in science, technology, engineering and mathematics (STEM) are in high demand (Alden and Taylor-Kale, 2018; De Silver, 2014); however, much of the U.S. population is not receiving STEM education that engages them early and provides them with the education needed to enter into STEM careers (Hrabowski III, 2018; Overton, 2017; Ufnar and Shepherd, 2018; Wang and Degol, 2017; Wang, 2013). The lack of adequate resources is especially acute in traditionally minority and rural schools (Smedley et al., 2001). The U.S. Census Bureau expects that by 2050 over 50% of the US population will be minority, but projections indicate that if nothing changes, minorities will remain greatly underrepresented in STEM higher education and careers (Bidwell, 2015; Museus et al., 2011; Rogers and Sun, 2018). Historically, only 5% of underrepresented individuals are in STEM occupations (National Science Foundation, 2015b). Early introduction of students to potential STEM education and potential careers increases students' interest in these areas (Tai et al., 2006). However, Maltese and Tai reported that middle school students are not aware of STEM careers (Maltese and Tai, 2011). The lack of opportunities in STEM including the number of under-qualified teachers, weak funding, poor resourcing, low expectations, and the limitation of advanced level courses amplifies the lack of underrepresent students in the STEM career pipeline (Museus et al., 2011). Therefore, there is an urgent need for innovative, hands-on STEM educational opportunities that excite and educate young underrepresent minority students in STEM careers (Avilés, 2012).

This project targeted students in a medium sized (~25,000 students) urban school system in which 95% of all students are African-American, and most students qualify for a free or reduced lunch program. Many of these students will become first-generation college students; however, the majority of them are unlikely to attend a 4-year college, and instead, will initially choose to attend a community college to learn a trade. The University of Alabama at Birmingham (UAB) Center for Community OutReach Development (CORD) has been a major partner of the Birmingham City Schools (BCS) in STEM education for over 20 years. The ultimate goals of this current collaboration were to increase student interest in, skills for, and understanding of physics, and thus to excite them about STEM careers and help them pursue advanced STEM education. CORD provides extensive teacher professional development and then partners with the teachers to engage K-12 students in STEM learning to help the students, teachers, and parents understand the opportunities STEM careers can offer. Several formal and informal CORD programs provide engaging STEM training to all students in the Birmingham area schools, and physics education for 8th grade students, targeting a major Alabama science standards focus area in which improvement is needed.

"HandsOn!" provides interactive lab experiences designed to expose students to a wide breadth of STEM fields including engineering, computer science, physics, and biology. These programs are designed for formal classroom sessions in grades 6-8. "HandsOn!" is a 3-day, in-class laboratory experience, emphasizing inquiry-based instruction. According to Piburn and Baker (1993), students preferred group work, hands-on activities, and in-depth discussions. Many studies demonstrate that students learn best when they take an active role in the learning and practice what they have learned (Shamsudin et al., 2013). Additionally, hands-on, inquiry based methods improve student attitudes towards science, enhance interest and curiosity in the subject taught, generally improve reading and math and encourage exploration of STEM careers (Shamsudin et al., 2013). Oakes also stated that active learning and group work increase persistence in continuing studies beyond high school (Oakes, 1990). This study assesses one "HandsOn!" program that focuses on the development of students understanding and interest in physics.

MATERIALS AND METHODS

The subjects included 969 (460 M/509 F) [first day] – 811 (420 M/391 F) [third day] 8th grade students and 15 teachers (3 M/12 F) in the BCS district. The difference in the number of students at session 1 versus 3 reflects slightly higher than typical absentee rates at these schools. All interventions were conducted in the student's normal classrooms, and all protocol elements were reviewed and approved by the UAB Institutional Review Board (IRB).

During each school intervention, a CORD team (led by a Ph.D. scientist, and including a graduate student facilitator and the classroom teacher) guided students to understand basic principle(s) that was/were aligned with their physics curriculum. First, the students filled out a short pre-test that included both content and career items (Supplemental Table 1). Next, the CORD leader provided a 10-minute explanation of the research/experience to be covered and the first principles of science that were involved. The students then carried out the assigned experiments with their team, including a facilitator (the teacher served as a facilitator). The use of the teacher as a facilitator provided professional development for the teacher. Following the 3-day experience, the students completed a short post-survey to assess their advancement in skills and content knowledge, and their change in interest in science careers. All data are reported as mean+/- standard error. Pre-tests' and post-tests' science questions were compared for each school using post hoc Tukey test.

"HandsOn!" Physics (HOP). The main objective of HOP was to provide 8th grade physical science/physics students with hands-on activities to strengthen their conceptual understanding of physics and simultaneously strengthen their critical and analytical thinking and their understanding of STEM career opportunities available to them (Bice, 2015). To achieve this goal, CORD's physics/engineering science team worked with Alabama Science in Motion (ASIM, one of CORD's extramurally funded STEM facilitation programs for all high schools in Alabama) to identify activities that align with the Alabama Course of Study's (ACOS) 8th grade physical science standards. The sessions covered the energy concepts found in ACOS Standards 13, 14 and 16, all of which involve the conservation of energy, energy transformations, and applications of energy to everyday life. These activities aligned to Next Generation Science Standards elements MS-PS3-1, MS-PS3-2, MS-PS-4, MS-PS-5 (NGSS Lead States, 2013a, 2013b, 2013c, 2013d) and were identified by our teachers as areas in which they sought assistance in helping students gain skills.

Pre- and post-tests were given to the students (Supplemental Table 1). Six out of ten questions were about physical science/energy concept knowledge. The remainder (four questions) were related to the students' future education plans/interest in STEM education/careers and were adapted from the U.S Department of Education-Middle School Survey (Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP), 2017)

The activities. Four hands-on activities were completed in three class periods. Students worked in small groups of 3-5 students for each activity. The first activity primarily focused on calculating potential energy. A board, an adjustable easel, and three balls of varied weight were given to the students, who were then instructed to set up the experiment (Figure 1) (Mihut and Zabawa, 2006). Students created a ramp and explored the effect of the board's height on energy, the effect

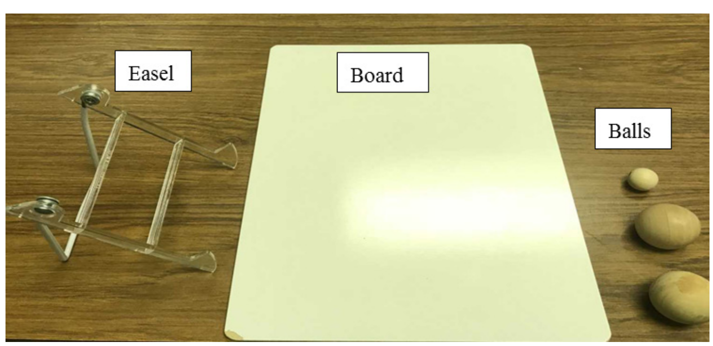

Figure 1. Experiment 1 explored potential, kinetic and total energy modeling. The students built a ramp by using an easel and a board. In this activity, the students calculated potential, kinetic and total energy at the top, middle and bottom of the ramp for varying weights, and the effect of height and mass on energy and conservation of energy.

of an object's mass on the potential and kinetic energy, transformation of energy, and conservation of energy.

In the second experiment (usually also completed on day 1), the students followed a protocol to build a basic model rubber band car using Lego parts (Technically Learning, 2009) (Lego System A/S, Billund, Denmark; Figure 2). The primary goal of the exercise was to help the students understand how to calculate the speed of a car based on an understanding of kinetic energy. They were required to measure the mass of the car, the distance and time of the car's movement to calculate the kinetic energy. Another goal was to allow the students to define energy transformation by observing the rubbers band's transfer of potential energy to kinetic energy. After they calculated the kinetic energy, they were able to calculate the potential energy of the rubber band by using the transformation of the energy rule.

Figure 2. Experiment 2 consisted of building an initial rubber band Lego car using the parts shown in 2A. 2B shows the fully assembled basic Lego car.

For the third experiment, students were instructed to use what they learned in experiments 1 and 2 to create a faster car using an assortment of parts (including different sized rubber bands, Lego parts, and wheels). Each group designed their own rubber band car model with the alternative parts, and they examined if alternative parts affected how far/fast their car traveled. This allowed the students to investigate how the elasticity of the rubber band, bigger wheels, bigger parts, or more weight affected the velocity of the car. Students calculated the kinetic energy of their designed car and decided which part/parts had more effect on kinetic energy and speed of the car. At the end of the session, they raced their cars to see which model worked better. The desire to win motivated the student groups to improve their decision-making, critical thinking and engineering design skills (Figure 3).

Experiment 4 utilized energy conversion kits purchased from Arbor Scientific (Ann Arbor, MI). Figure 4 shows varied types of energy conversions. The purpose of this experiment was to help the students understand that energy exists in many forms. Students connected a pair of leads from the solar cell to an LED and faced the solar cell toward the sun or bright light source in the room. The students learned that to turn light energy into electricity, the solar cell absorbs light into a semiconductor, and converts light energy to electrical energy that runs the apparatus being used (Figure 4A). Students also attached a crank generator to a motor (Figure 4B) and observed that when the student cranks the generator faster, the motor provides more energy to the fan and the fan spins faster, thus demonstrating the conversion of mechanical energy into electrical energy, and back into mechanical energy (running the fan). The generator and the buzzer were also attached in this experiment (Figure 4C), thus demonstrating the conversion of mechanical energy into sound en-

Figure 3. Experiment 3: The two figures display two different rubber band cars built using the alternative parts (more gears, bigger wheels, rubber bands with different elasticity, etc.). These are examples that were designed and built by the students.

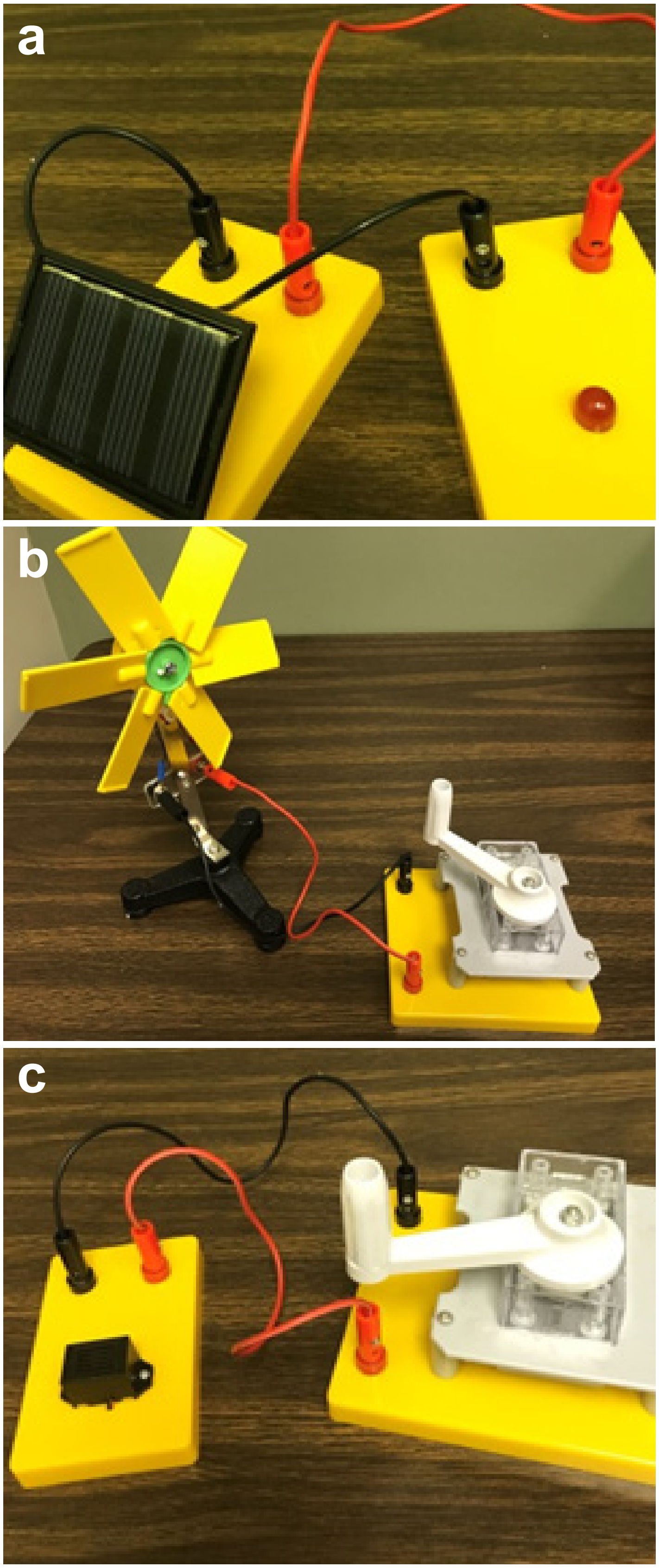

Figure 4. Experiment 4 explored energy conversion. (4A) shows the solar cell connected to the LED. (4B) shows the crank generator, motor, and fan, and (4C)shows the crank generator connected to the buzzer. Using this hands-on activity, the students observed how energy can be transferred from one form to another form.

ergy (Energy Conversion Kit, 2010).

At each visited school, the CORD team worked with 3-5 students per group (6 to 8 groups), and the group worked as a team. The initial cost of Experiment 1 was between $56-$70/class and Experiment 2 was $90-$120/class set, depending on the number of groups. For Experiment 3, the extra parts were obtained from Experiment 2, thus, there was not an additional cost for Experiment 3. Only one kit was purchased for Experiment 4 and used as a class activity, with a total cost for all the activities of between $225- $269. The same experimental kits were used throughout the year, and replacement supplies were less than $100 for the year.

After the hands-on activities, post-tests were given to the students. The post-test questions were the same as the pre-test questions. Also, a survey was given to each teacher to learn more about each teacher's educational background and to provide feedback to improve the program (Javier, 2014) (Supplemental Material).

Statistical analysis. Pre-/post student data were evaluated by analysis of variance (ANOVA) followed by post hoc Tukey t-test correction to determine the source of a main effect (SPSS, Chicago, IL). The significance criterion for all experiments was $p < 0.05$. All data are reported in the Results section as mean ± standard error.

RESULTS

Student Surveys

a) Science questions results (Questions 1-6)

This HOP education protocol was conducted during the 2016-17 school year and completed by 8th grade students at 15 BCS (five were K-8 schools and ten were grades 6-8). The State's Annual Report Card and the US Department of Education tracking records both indicated that in math and science two of the 15 schools were relatively high performing (A/B), three were at the "passing" level (C/D) and ten were in the failing (F) category.

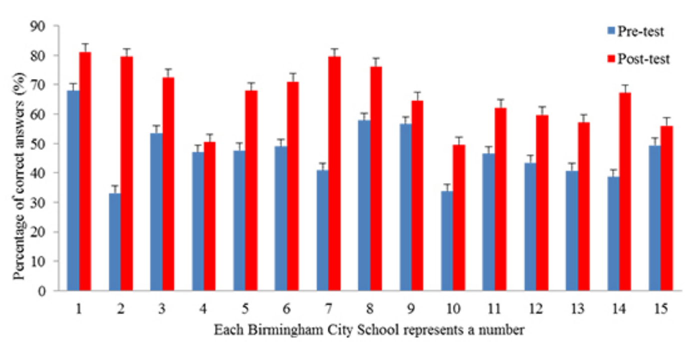

Figure 5. This bar graph displays the results of the pre-test (given at the beginning of the first class) and post-test (given at the end of the third class period). Schools are ranked from highest (1) to lowest (15) performing schools according to the State assessment in math and science.

Students were asked to complete a pre-test given at the beginning of the first class and a post-test given at the end of the third class period (Figure 5). Each school was numbered based on the order of the 2016-17 Alabama State Education Report card (Alabama State Department of Education Report Card, 2018). Schools 1 and 2 received an A/B on their report cards, schools 3-6 had C/D report cards and 7-15 had F report cards for 8th grade math and science. In general, the data demonstrate that the students in all schools experienced a positive gain in their subject matter knowledge from the 3-day intervention. Specifically, there is a significant difference between pre-test and post-test results ($p<0.05$), except for school number 4. The highest pre-test (68%) and post-test (81%) results were obtained from the same school, which was the highest performing on both State and Federal grade reports. In contrast, students from school number 2 (very close to school 1 in Federal and State grade reports) had the lowest pre-test performance (33%), but had the highest gain, % gain, and the second best post-test results. The least improved students were at school number 4 (a C level school) with a 3% gain (47%-50%). School number 10 (49%) had the lowest post-test performance, but they had a 43% gain between pre- and post-test. The average score for the pre-test was 47% and the average score of the post-test was 67%. On average, the percentage of correct answers increased by 20% between the pre- and post-tests.

We had expected that students from the high performing schools would have the highest pre- and post-test results. Thus, we divided the schools into high, moderate and poorly performing schools. The pretest results were not different between the high and moderate school and were only slightly better in the high compared to poor performing schools. We further assessed the results by comparing the data of the schools that had a State/Federal passing grade in math and science versus schools that had a failing grade in math and science. The comparison demonstrated that the actual and the percent gains were essentially identical in these two groups (20.4 ± 5.6/49.0 ± 5.6% [passing schools], 20.4 ± 2.7/48.4 ± 8.3% [failing schools]). Together, this suggests that the intervention was beneficial in both high and low performing schools.

b) Students' future education plans

The students felt comfortable with their science knowledge both before and after the intervention. Initially, 47% agreed that they were comfortable with science, and this percentage slightly increased to 53% on following the intervention. There were also decreases in the number of "Neutral" responses (reduced from 45% to 41%) and "Disagree" responses (reduced from 7% to 5%) suggesting a slight improvement in the students' perceived science knowledge (Figure 6).

A majority of the students (88%) were planning to continue their education after high school through a certificate program, an associates degree, a bachelor's degree, and/or a graduate degree (Figure 7A). Pre- and post- tests results were relatively close to each other, and most respondents thought they would eventually attain a bachelor's degree (pre-44.39%, post-47.13%) or higher. Only 11% of the students reported that they had not yet decided.

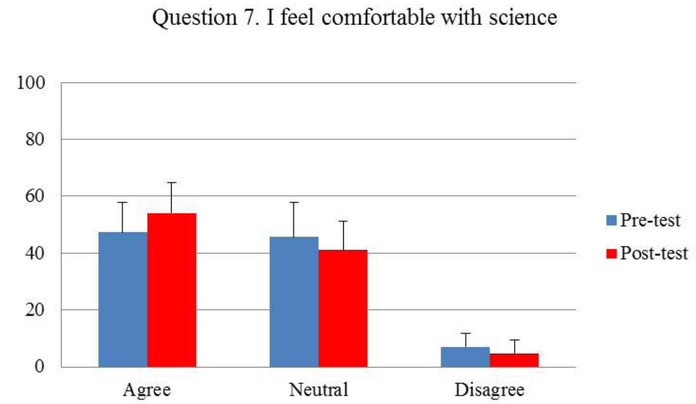

Figure 6. The cumulative student responses indicating their feeling of comfort with science.

The students were also asked what they perceived as the main obstacles to them attaining a college education (Figure 7B). The results showed that cost (31%) and their class grades (30%) were the main reasons the students questioned their ability to continue on to higher education. Some students reported that a need for them to work (10%) might be an obstacle, while a few were not interested in college education (7%). About 19% of the students stated that they had some other reasons for not considering college attendance. On both the pre- and post-test, approximately 86% of the students agreed that getting an education after high school is very important (Figure 7C).

Teachers' survey. Fifteen BCS teachers were included in this study. A majority of the teachers were between 40-59 years old (60%), female (80%) and African-American (93%). One-third of the teachers was nearing retirement in the next 10 years. The vast majority (13) held a secondary science teaching certificate, while 2 held a temporary teaching license. Of the 15, six had only a bachelor's degree, eight held a master's degree and one had a doctoral degree. Most of them had a biology major (93%), but were certified for secondary education in General Sciences, and thus eligible to teach any area of science. One-third of the teachers had taught for five or fewer years, and half of them had ten or more years of experience teaching science. They reported that they needed more support teaching physics (50%) and chemistry (40%). Additionally, they agreed that lack of materials and time (47%, 67%, respectively) were the main obstacles to effectively teaching science in their school.

Some typical teacher comments were:

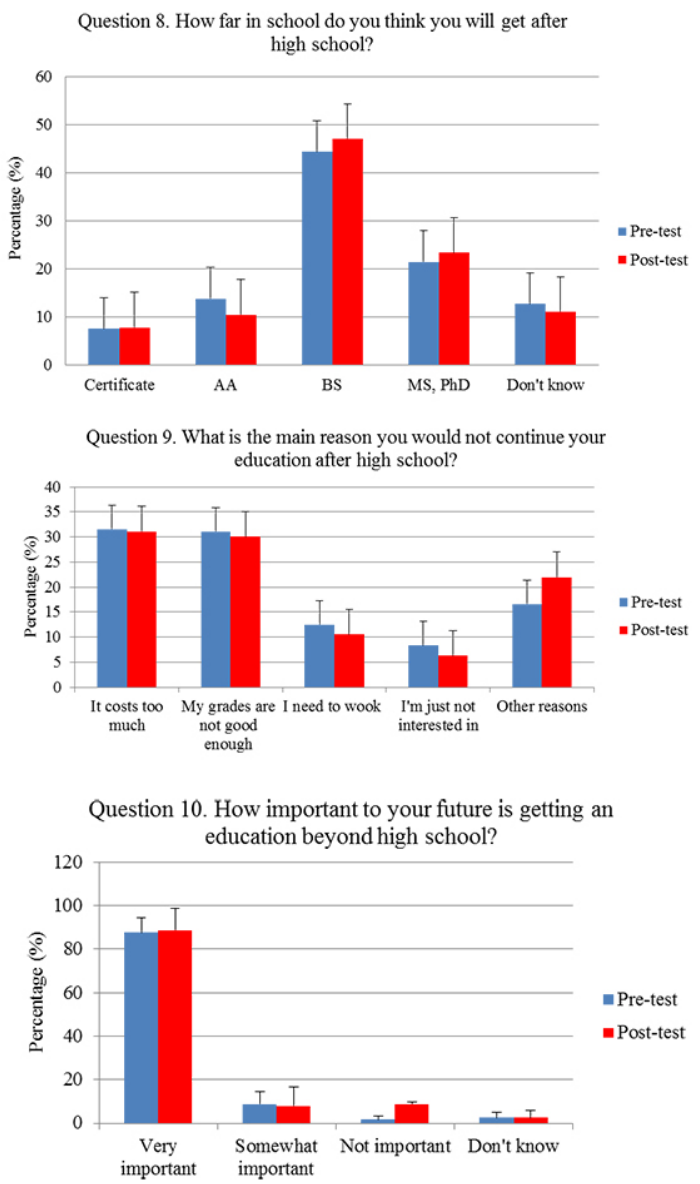

Figure 7. Most students indicated that they believed that they would eventually receive a BS or higher (7A). The students also believed that the greatest impediments to gaining a higher education degree were poor grades and a lack of funds (7B). Over 80% of the students believed that getting a higher education degree was very important to their future (7C).

"I truly enjoyed you coming out and working with my class. My students enjoyed you a lot and learned so much. When we do get to Energy next semester, they will have already been introduced to it.

"It would be great if you all could teach a little Chemistry as well since that's what we start off with the 1st semester. But anyway, thanks for coming and again, we truly enjoyed you and learned a lot."

"Great program. Collaborate more with us!"

"The students enjoyed learning from someone else."

DISCUSSION

Minority and low-income students often attend relatively poorly STEM-resourced schools that have a rather low percentage of students who advance to STEM majors in college (Green et al., 2017; Martinez and Castellanos, 2018; Samuels, 2016; Wiggins et al., 2017). Often these students lack STEM professional role models in their families and communities (Bottia et al., 2018; Rendón, 2006). Minority school districts are also often forced to primarily focus on ensuring that every student passes state high school exit exams (primarily testing English and math), that standard test scores are at grade level or above, and that class discipline is maintained. This results in a decreasing focus on science education, which is often not a primary outcome that enters into the teacher's or school's annual assessment (students typically are required to take annual standardized assessments of math and reading, but only in a few grades are science, engineering or technology tested, and even then they often do not contribute to a schools overall grade from the district or state). Moreover, middle school students have very weak career awareness about STEM professions (Green et al., 2017; Maltese and Tai, 2011). Unless these students have their scientific interest sparked in the middle and early high school years, they are unlikely to have a great interest in, and skills for college science and engineering education or careers, despite the fact that these areas are some of the most important and profitable careers in the 21st Century.

There are many different science and engineering outreach programs for 8th graders, varying in time (a few hours, a week, semester long, etc.) (Jeffers et al., 2004; Sheridan et al., 2011). CORD's HOP program provides a progressive set of learning activities over a period of three days. Scientists agree that even short sessions can have a significant impact on students' motivation, as long as the sessions have active engagement (Roden et al., 2018). Many of the outreach activities take place at locations such as universities, in labs other than schools. In contrast, CORD's program has focused on immersing activities in schools and learning from teacher feedback as part of a formative assessment. Specifically, for this HOP outreach program, there was no need for the schools to be concerned about transportation, time, or funding for substitute teachers, since the program was carried out at the school and the teacher participation was with his/her regular class.

Our expectation was that schools measured as high-performing using the "Alabama State Annual Report Card" would score high on the pre-HOP exam. Report cards can be a good tool to help parents understand their student's educational progress and their educational potential given their schools grades (Friedman and David, 1995; Francis, 2006). We found the HOP pre-tests did not correlate with a school's relative rankings on the State evaluation. Nearly all BCS schools demonstrated improved student performance at the end of the 3-day period. The findings also indicated that the students preferred the third (competitive) experiment over others offered. Unfortunately, as was anticipated from previous work with BCS, the number of the students present on the first day of the intervention (pre-test day) did not match the number of the students on the third day (post-test day) for most of the schools. Some of the reasons included students' absences due to other school activities, weather conditions, illnesses, or skipping school. Another limitation of this study was that we were unable to follow the progress of each student from the pre- to post-test due to incomplete/unreadable identifiers entered by the students on the tests.

A majority of the students (53%) felt more comfortable with science after the HOP experience. Explaining science with hands-on activities and relating it to the real world examples might have had a positive impact on this. Unexpectedly, there was not a pattern between high and low performing schools relative to the interest and goals for higher education. The students were mainly planning to continue their education after high school. However, cost and grades were their main obstacles for seeking higher education.

Many factors affect a student's academic achievement, such as individual characteristics, family experiences, and school-related factors (Teachers Matter: Understanding Teachers' Impact on Student Achievement, 2012). However, teacher qualifications are one of the most important factors (Darling-Hammond, 2000; Teachers Matter: Understanding Teachers' Impact on Student Achievement, 2012). For example, teacher productivity increases with experience, which clearly affects student achievement (Harris and Sass, 2011). Teacher knowledge is also significantly related to student achievement (Hill et al., 2005). The HOP teacher surveys were anonymous, a drawback of this study. The main objective was to allow the teachers to provide feedback comfortably, rather than fearing administrative review of their responses. The teacher survey provided insights into teachers' education backgrounds and demographics. One of the important issues that the survey uncovered was the lack of substantial physics education among the teachers who were teaching chemistry and physics in grade 8. Education programs produce many teachers with biology foci, who then certify in general sciences by taking a relatively general test. Thus, they often have little formal physics education. In-service physics training of these teachers can greatly increase their ability to engage students and assist them in understanding the principles of physics and gaining physics skills. Given the general age of the teachers, the results suggest the need for recruitment and/or increased training in physics teachers.

There are several limitations associated with this study. First, there was no opportunity to follow up with the participating students' one-week or one-year post experience. Second, to be optimally effective, more focused teacher training is needed, so that the teacher can eventually take ownership of the intervention and run it with minimal external assistance. The HOP staff indicated that after the intervention, some teachers were not yet confident enough to continue these activities on their own. It will be important in the future to investigate the long term effects of programs like this on the trajectory of students both academically (gaining generalizable academic skills) and relative to their career paths.

CONCLUSIONS

The HOP 8th grade physics experience was inquiry-based, with activities designed to provide a meaningful learning experience (e.g., critical thinking, scientific discussions, etc.) for students, as well as professional development for their teachers. The student assessment results suggested that the program was successful in providing the educational objectives. The teacher survey indicated that the teachers greatly appreciated the physics outreach activity, which enhanced their ability to meet their course of studies objectives. In addition, these middle school students were already beginning to make plans for their future education. This finding implies that this type of intervention can positively impact middle school students' interest in science and the pursuit of STEM higher education and careers. Even though each session was only three days long, student and teacher feedback revealed that this partnership had a positive impact.

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Author Contributions

The manuscript was written through contributions of all authors. All authors have given approval to the final version of the manuscript.

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ABBREVIATIONS

BCS: Birmingham City Schools; CORD: Center for Community OutReach Development; HOP: HandsOn Physics; UAB: University of Alabama Birmingham;

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SUPPLEMENTAL MATERIAL

Table 1. *Pre- and Post-Test given to all students in the HOP study.*

Pre/Post Test
1. What is potential energy?
a. the energy of motion b. stored energy c. atomic energy
2. What is kinetic energy?
a. the energy of motion b. stored energy c. heat energy
3. Which of the following would be an example of kinetic energy?
a. a compressed spring b. a compressed spring kinetic energy c.a speeding car
4. When two cars traveling at the same speed have a head-on collision, the smaller car experiences more damage. What is a reasonable explanation for that fact?
a. The larger car has more potential energy than the smaller car does.
b. Mass has a greater effect on kinetic energy than speed does.
c. The larger car experiences more friction than the smaller car does.
d. The larger car has more kinetic energy than the smaller car does.
5. The rule that energy cannot be created or destroyed
a. magnetic potential energy
b. law of conservation of energy
c. kinetic energy
d. elastic potential energy
6. What is the energy unit?
a. Kilogram (kg) b. Newton (kg m / s2) c. Meter (m) d. Joule (kg m2 / s2)
7. I feel comfortable with science
a. Agree b. Neutral c. Disagree
8. How far in school do you think you will get after high school?
a. Certificate program (less than 2-year program) b. AA or Associates degree (2-year degree)
c. Bachelor's degree (4-5 year degree) d. Graduate degree (Ph.D., law, MD) e. Don't know
9. What is the main reason you would not continue your education after high school?
a. It costs too much or I cannot afford it c. I need or want to work
b. My grades are not good enough d. I'm just not interested
e. Some other reason. What reason?
10. How important to your future is getting an education beyond high school?
a. Very important b. Somewhat important c. Not important d. Don't know

Table 2. *Birmingham City School teachers were asked to complete questionnaire surveys following a CORD classroom activity. These responses were used to assess demographic and educational backgrounds of the teachers. Additionally, this information was used to revise the efforts of CORD in the classroom in order to best support the students and teachers.*

UAB-CORD Teacher Survey
1. How old are you? a) under 25 b) 25-29 c) 30-39 d) 40-49 e) 50-59 f) 60 or more
2. Are you female or male? a) Female b) Male
3. Which best describes you? a) White b) African American b)Hispanic c) Asian d)Other (specify) _______
4. What is the highest level of formal education you have completed? a) Did not complete secondary school b) Secondary school only c) Bachelor's degree or equivalent d) Master's degree e) PhD degree
5. While studying to obtain your bachelor's degree or equivalent, what was your major or main area of study? a) Mathematics b) Biology c) Physics d) Chemistry e) Education f) Mathematics Education g) Science Education h) Other ....
6. Do you have a teacher training certificate? a) Yes b) No
7. How many years have you been teaching? a) 0-2 years b)2-5 years c) 5-10 years d) 10-20 years e) More than 20 years
8. Do you feel comfortable in teaching science? a) Yes b) No
9. What barriers do you encounter when teaching science? a) Lack of content knowledge b) Materials c) Time d) Other
10. Which science area/areas do you need more support? a) Biology b) Chemistry c) Physics d) Environmental and Resource Issues e) Nature of Science and Scientific Inquiry Skills