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Physics, chemistry, and algebra are gatekeeper courses to technical careers in any

students, on the other hand, tend not to participate in the upper level courses at all (Tyson et al, 2007). In recent years, female and minority students have made strides toward closing the physics attainment gap with the advent of specialized high school academies. However, in general education high schools, the same opportunities for success may not be readily available (Conger, Long, & Iatarola, 2009). Providing female and minority students with an engaging physics program that provides a practical application of scientific concepts may increase the overall participation of both underrepresented groups in high school.

The 21st century skills of communication, problem solving, and critical thinking are essential components in educating students to become citizens who are prepared to contribute to society. High school courses that foster these skills benefit students throughout college and into the workplace (Carlgren, 2013). Juuti and Lavonen (2016) found that pedagogical practices such as scientific investigation and the social construction of knowledge influenced student interest in pursuing physics and enabled student success during the completion of physics coursework.

The EP program provides students in general education high schools and specialized academies with an avenue to success through a physics curriculum grounded in 21st century skills. Through the implementation of pedagogical practices that foster student interest and success, the EP curriculum may be one avenue to fostering interest and appreciation of STEM subjects in high school and beyond.[1]

This study took place at the conclusion of the second year of EP implementation. We employed a mixed-method design (Leedy & Ormrod, 2010), using quantitative techniques to investigate teacher outcomes to measure physics PCK, use of instructional strategies to advance

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[1] In the full conference paper, we will provide examples of lessons and activities.

physics learning, and confidence in teaching physics. We also employed a quantitative, within-group design to examine changes in student interest in STEM careers and enrollment and achievement. We applied qualitative techniques to analyze responses to open-ended survey items on the teacher questionnaire to help explain the changes observed.

Data for this study are drawn from 46 high schools in ten school districts across one mid-Atlantic state. Participating schools typically have only one physics teacher who offers several sections of physics each year. Data from the 2017-2018 school year served as a baseline measure for student outcomes, with the 2018-2019 school year being year one and 2019-2020 being year two. In year one, the project served 1,990 students, 41% of whom identified as femwo1dsih (p)-4 (9 (8-2 (s))4 (s four content-the help they need in the areas where they struggle the most with physics (57.7%). Teachers also responded that EP increased their students' learning (88.5%). Teachers explained that the EP curriculum was advantageous because the "equipment facilitates inquiry," and that the resources allow for "exploration with minimal information" provided. One teacher noted that "the simulations allow for students to observe and experience in real time without the time to set up, design, and conduct an experiment," adding that they are now able to explore "simulations that we could never accomplish in a high school physics class" until now. Teachers found the resources to be adaptable and integrated, promoting easier understanding of physics concepts among students.

However, when asked about their experiences teaching physics during the COVID-19 school closures, we observed statistically significant decreases for the instructional s lcures 4

An examination of enrollment and achievement data in year one indicated promising results, with the year two findings revealing exceptional progress. Figure 1 illustrates the reduction in the percentage of students not earning credits from baseline through year two. The non-passing rate fell from 3.6% to 1.9%, with the percentage of female students not earning credit dropping below one percent by year two, and the percentage of minority students not earning credit declining from 9% at baseline to 2.6% in year two. These reductions are even more meaningful when combined with the increases in enrollment. From baseline through year two, we observed an 80% increase in physics enrollment among all students. Female and minority students accounted for much of this, with female enrollment in physics increasing by 211% and minority students experiencing a 308% increase by year two (Figure 2). These findings indicate that considerably more underrepresented students were being exposed to rigorous physics content *and* that larger percentages were succeeding in the challenging course.

This study describes the results of a multi-district, regional effort to increase teacher knowledge and student participation in physics. The curriculum and its associated PD improved student outcomes, particularly for historically underrepresented students. Despite unprecedented interruptions due to COVID-19, overall pass rates remained strong. However, our findings indicated an emerging need for teacher support once schools shifted to a virtual instruction model. This need is currently being addressed through an enhanced focus on strategies for teaching physics in a distance format, and plans are being made to trace the impact of the shift on teachers and students during the upcoming school year.

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Table 1

Comparison of teacher responses on survey subscales from pre-training to end of year 2

Teacher Survey Subscale	Pre-PD *m (SD)*	End of Yr 2 *m (SD)*	*t*	*df*	*p*

Table 3

Pre- to post-course comparison of means for STEM career interest

	Science subscale			Technology subscale			Engineering subscale			Mathematics subscale		
	Pre	Post	*t*	Pre	Post	*t*	Pre	Post	*t*	Pre	Post	*t*
Year One												
All students	41.4	41.4	0.20	44.0	44.2	-.35	38.7	39.4	-1.2	41.4	41.2	.50
Females	41.2	40.5	1.01	42.1	41.7	.53	35.6	35.4	.29	40.8	40.4	.61
Students of color	40.7	40.9	-.30	43.6	44.0	-.63	37.2	39.3	-2.5*	40.5	41.1	-.88
Year Two												
All students	41.5	42.2	-1.3	43.4	43.4	0.10	39.0	38.3	0.79	40.7	40.8	-.03
Females	41.3	43.5	-2.6*	41.4	42.3	-1.1	35.4	35.6	-.09	40.1	39.5	0.68
Students of color	40.6	41.1	-.53	43.0	43.6	-.54	39.3	38.3	0.75	40.4	40.5	-.01

*Statistically significant at *p*>.05

Table 4

Mean between-group differences on STEM-CIS subscales from pre- to post-course

	Science		Technology		Engineering		Mathematics	
	Mean difference		Mean difference		Mean difference		Mean difference	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Year One								
Male vs female students	0.3	1.27	3.57	3.92	5.71	6.53	1.32	1.39
Non-minority vs students of color	1.36	0.88	0.75	0.31	2.62	0.04	1.62	0.13
Year Two								
Male vs female students	0.33	-1.53	3.47	2.44	5.93	5.66	1.09	3.52
Non-minority vs students of color	1.51	1.72	0.72	-0.34	-0.67	-0.04	0.58	0.51

Figure 1

Percentage of students not earning physics credit

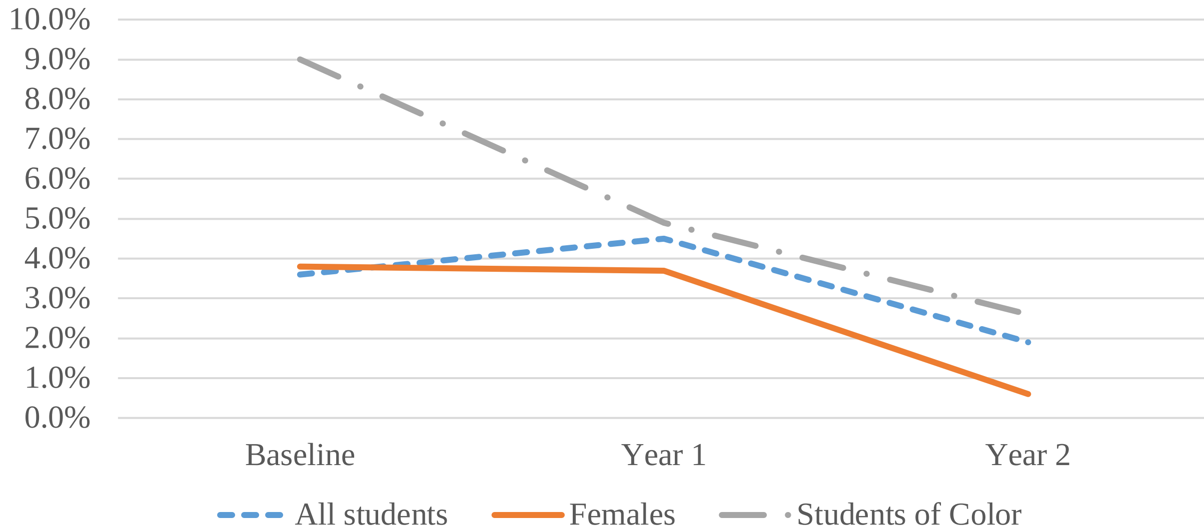

Figure 2

Student enrollment in physics since introduction of Essential Physics curriculum