2007

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Recommended Citation

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Executive Summary

Students in the schools of Central Appalachia continuously score lower in mathematics and science at all K-12 levels than their state's average scores. This education achievement gap is currently being addressed by the Appalachian Math and Science Partnership (AMSP). The AMSP is a professional development program whose goal is to increase the academic achievement of students in mathematics and science by enhancing the content knowledge and teaching skills of classroom teachers. There is a growing body of research that shows improving teacher knowledge and teaching skills is essential to raising student achievement.

The purpose of this study is to determine if the AMSP had an effect on the mathematics and science educational achievement gaps that exist in Central Appalachia. This study looks at 1,171 Kentucky public schools over six years for a total of 5,086 observations. Alternative schools and schools that did not report the necessary data to the Kentucky Department of Education were not included in the study. Two fixed effects regression models were employed, one with school's math academic index score as the dependent variable and the other with the school's science academic index score as the dependent variable.

Results of the analysis show that the AMSP has no statistically significant effect on a school's math academic index score or a school's science academic index score.

Issue Statement

The educational achievement gap in the Central Appalachian region, which includes Eastern Kentucky and the bordering Tennessee and Virginia school districts, must be addressed or it will continue to grow. A major achievement gap exists in the

areas of science and mathematics. The graduation requirements for these school districts overall indicate a lack of rigor in both science and mathematics programs. Few students in the Central Appalachian region score at the proficiency level or above in mathematics and/or science as defined by the assessment standards developed in each state. Analysis of the assessment data consistently reveals lower performance at all K-12 levels for central Appalachian students when compared to the state averages and/or students from more affluent regions of the states. Enrollment in higher level mathematics courses, including Algebra II and calculus, is less than one-third the enrollment in lower level mathematics. Introductory science courses have more than three times the enrollment of higher-level courses such as chemistry and physics. Although 25 of the central Appalachian school districts report offering some type of AP or dual credit program, enrollment in these programs is non-existent in many schools.

A major cause of this achievement gap may be that teachers in Central Appalachia are less prepared to teach math and science than teachers in other areas. Demand for teachers often exceeds supply, especially in low performing schools such as those in Central Appalachia. These school districts report a major problem with attracting and maintaining a staff of highly qualified mathematics and science teachers. Data from the Kentucky Department of Education in 1998 indicates that one-third of the middle school mathematics teachers lack the necessary mathematics and certification to teach middle school content (Clements and Hartangwicz, 1998). These numbers increase dramatically in rural Appalachian school districts, lacking ready access to institutions offering both undergraduate and graduate programs in science and mathematics education.

The provision of schooling is largely determined and financed by the government. This is especially true in an area like the Central Appalachian region, where access to alternative schooling, like private schools, is not an option because of the cost. The per capita income of residents in the central Appalachian region is well below the national average. According to a report by the Appalachian Regional Commission, using 2000 census data, more than one in five residents of central Appalachia (22.1 percent) were poor in 1999, compared with one in eight residents of both northern and southern Appalachia (12.8 percent each). Also, poverty in Kentucky's and Virginia's Appalachian sections was noticeably higher than in the rest of their respective states. A staggering 24.4 percent of the Bluegrass State's Appalachian residents were poor, compared to 12.4 percent elsewhere in the state. The poverty rate in the Old Dominion was 15.7 percent inside Appalachia and just 9 percent outside the region. The Appalachian region in Kentucky also contains four of the nation's poorest 25 counties, including Owsley, Clay, Martin, and Magoffin counties, all with poverty rates above 36 percent. The achievement gap in Central Appalachia is a government failure, but government provision of schooling is justified because as the economic data show there would be an access to education issue if it were not publicly provided.

Improving the quality of education has been and will most likely always be an issue of great concern. This can be proved by the extensive literature on educational research. As a result of much of this research, many reforms have taken place in schools. Some of these reforms include charter and voucher schools, lowering class size, state and national assessment tests, and No Child Left Behind. Research has also been conducted

regarding teacher quality. Notably, states have adopted different policies regarding teacher education, licensing, hiring, and professional development.

Background

This educational achievement gap in Central Appalachia has been recognized and addressed. Two Professional Development projects aimed at increasing student achievement in mathematics and science in Appalachia have existed. These projects include the Appalachian Math and Science Partnership (AMSP) and the Appalachian Rural Systematic Initiative (ARSI).

Appalachian Math and Science Partnership

Math and Science Partnerships developed from the No Child Left Behind Act and is intended to increase the academic achievement of students in mathematics and science by enhancing the content knowledge and teaching skills of classroom teachers. Awards are given on a competitive basis. The Appalachian Math and Science Partnership received a five year grant of $22.5 million from the National Science Foundation (NSF). AMSP is a partnership among 38 Central and Eastern Kentucky school districts, 9 Tennessee school districts, and 5 Western Virginia school districts, the Kentucky Science and Technology Corporation, and 10 higher education institutions located in these three states. AMSP seeks to demonstrate improved student achievement in mathematics and science in the Central Appalachian region through the support of partnerships that unite the efforts of teachers, administrators, guidance counselors, and parents in local schools with administrators and faculty at area colleges and universities. AMSP's goals are to eliminate the "achievement gap" in science, mathematics, and technology in the Central Appalachian region and to build an integrated elementary,

secondary and higher education system to ensure the selection, development, and career-long support of a high-quality mathematics and science teacher workforce. AMSP, which began in the 2002-2003 school year, provides Professional Development teacher training to teachers of Mathematics and Science.

Appalachian Rural Systemic Initiative

Prior to AMSP, the Appalachian Rural Systemic Initiative (ARSI) existed. It was originally a five-year, National Science Foundation (NSF) funded effort to improve science and mathematics education in some of the poorest rural counties in the country. The initiative began in the 1995-1996 school year and was scheduled to run through the 1999-2000 school year, but received an additional five year extension. ARSI's targeted area included 66 counties in Kentucky, Tennessee, Virginia, West Virginia, Ohio, and North Carolina. Sixteen Counties in Kentucky participated.

ARSI provided Professional Development to math and science teachers in these districts that focused on basic teaching skills and teaching methods. ARSI provided teachers the opportunity to participate in local "state-of-the-art" workshops that focused on improving students' problem-solving skills through different teaching strategies. ARSI also used the idea of collaborative Professional Development. Local teachers, who demonstrated excellence in mathematics and science and had earned the respect of their peers, were identified to serve as ARSI Teacher Partners. ARSI provided support for part-time release from the classroom to allow Teacher Partners to plan and implement research-based instructional practices in their classrooms, provide hands-on learning opportunities for their students, serve as mentors with other teachers in their school and district, and provide valuable resources for their colleagues.

Research Question

Has the AMSP had an effect on the mathematics and science educational achievement gaps that exist in Central Appalachia? Little evaluation has been done regarding the effects of the AMSP on its participating schools. The AMSP is currently in its fifth and final year of the grant. As the grant comes to an end, it is of great importance to evaluate the partnership in order to see if its goals have been achieved and if any other results can be credited to the partnership.

Literature Review

According to the Executive Director and Deputy Executive Director of the National Staff Development Council, Dennis Sparks and Stephanie Hirsh, there is a growing body of research that shows improving teacher knowledge and teaching skills is essential to raising student performance. This is especially pertinent in Central Appalachia where the typical teacher is not well prepared. They believe staff professional development can produce immediate gains in teacher quality because it can be applied to the millions of teachers already in schools. It is conceivable that because teachers have considerable interaction with students, their knowledge and actions will affect the quality of student learning. Sparks and Hirsh argue that ultimately improvements in schools come down to how well teachers understand the standards and instructional techniques to reach all students. They suggest that if states want teachers to improve student achievement, they must give teachers the tools, support, and training to change their practice. They conclude that in order to improve education, our nation must first improve the ongoing professional development it provides its teachers and create a national plan for helping teachers fulfill their untapped potential (Hirsh and Sparks).

The Public Education Network states that "quality teachers are the single greatest determinant of student achievement" and that "teacher education, ability, and experience account for more variation in student achievement than all other factors" (Teacher Professional Development). A study of 900 Texas school districts conducted by Ronald Ferguson of Harvard University found that teacher expertise, measured by teacher education, licensing examination scores, and experience, explained 40 percent of the difference in student achievement in reading and mathematics. Another study conducted in New York City found that differences in teacher qualifications accounted for 90 percent of the variation in student achievement in reading and mathematics (Armour-Thomas, *et al*, 1989).

Since good teachers have considerable impact on student achievement, improving teachers' skills and knowledge may be one of the most important investments that can be made in education. The National School Boards Foundation believes that investment in teacher learning is, "the primary policy lever that school boards have to raise student achievement" (National School Boards Foundation). For this reason many studies have been conducted regarding improving teachers' skills and knowledge through professional development.

A 1998 study, using 4th grade math CLAS scores and teacher surveys, by David Cohen and Heather Hill at the University of Michigan found a relationship between teacher preparation in curriculum workshops and scores on California's state assessment, even when controlling for teachers' past learning. They found that teachers whose professional development learning focused directly on the curriculum they would be teaching were the ones who adopted the practices taught and that these teachers embraced

new curriculum materials when they were supported by training about the new state required student assessment. The study also showed that students of teachers who participated in this kind of curriculum-focused professional development did well on assessments (Cohen and Hill, 1998).

Another study, conducted by Michael Garet et al, surveyed a nationally representative sample of teachers who participated in the Eisenhower Professional Development Program, which focused on mathematics and science, in the late 1990's. The study found that teachers were more likely to alter their classroom practices, gain greater subject knowledge, and improve teaching skills when their professional development was directly linked to their daily teaching experiences and, similarly to the Cohen and Hill study, aligned with curriculum and assessments (Garet, et al, 2001).

A study on improving student achievement at high-poverty urban middle schools in Philadelphia conducted by the Center for Social Organization of Schools at John Hopkins University developed a teacher-support model that included a common science curriculum based on NSF-supported materials commercially available, ongoing teacher professional development built around day-to-day lessons, and regular in-class support of teachers by expert peer coaches. The study uses a nonequivalent group design to evaluate if the teacher-support model improves science achievement. The design includes three treatment schools paired with three matched control schools. Matching of the treatment and control schools was done on the basis of school characteristics including, minority composition, poverty level, and average student test scores prior to the implementation of the model. The same group of students was then followed from the end of fourth grade through seventh grade in 1998-2001. Standardized science test

scores were collected from these students in the spring of fourth grade, before the three treatment schools implemented the program, and again in the spring of seventh grade. Due to the mobility of students in schools, the exact exposure time of each student in the treatment school was measured. This allowed the program's effectiveness to be judged by the amount of time a student was exposed. In addition to the treatment schools being compared to the control schools, they were also compared to the 23 other district middle schools serving high poverty and high minority populations. The three treatment schools gained about 3.5 scaled points more on the standardized science test for each year of exposure in comparison to the matched control schools and 2 scaled points more than the 23 other district middle schools. The analysis also shows that exposure to the program increases the chances of rising from Below Basic science proficiency to Above and decreases the chances of falling from Above Basic science proficiency to Below (Ruby, 2006).

Methodology

This study uses an education production function to analyze the effect of the AMSP on student achievement. An education production function must include certain variables in order for the model to be accurately estimated.

The Education Production Function

$$A_t = h\ (\ R_t,\ F_t,\ P_t,\ A_{t-1}\ )$$

Where: A_t is student achievement
R_t is school resources
F_t is family resources
P_t is peer effects
A_{t-1} is a lag year student achievement of the same students

Data

All Kentucky public elementary and secondary schools were selected for the study. Tennessee and Virginia schools were not included due to the difficulty in comparing standardized test scores of the other states. Data were collected from the Kentucky Department of Education, Appalachian Math and Science Partnership, and Dr. Eugenia Toma of the Martin School of Public Policy and Administration at the University of Kentucky. The data collected for this study are for six school years, from 2000-2001 through 2005-2006. The 2000-2001 school year is dropped from the data set in order to be used as the baseline for 2001-2002. This study only uses data from these six school years because the objective is to analyze the effects of the AMSP on student achievement. ARSI is also included as an independent variable in order to control for any "trickle down" effects it may have in its participating schools.

Dependent Variables

The dependent variable used in the regression model analyzing student achievement in math is the mathematics academic index score for a given school and the dependent variable used in the regression model analyzing student achievement in science is the science academic index score for a given school. These academic index scores are weighted scores based on the Commonwealth Accountability Testing System (CATS). CATS is comprised of two types of assessments administered to students, the Kentucky Core Content Test (KCCT) and the Comprehensive Test of Basic Skills, Fifth Edition (CTBS/5). Students are divided into four categories: novice, apprentice, proficient, or distinguished, based on their performances on each of the assessments that

cover core content (LRC Research Report # 328, 2005). Table 1 shows how the scores

are calculated for each school.

Table 1: Academic Index Formula

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0 * percent Novice non-performance + 13 * percent Novice medium + 26 * percent

Novice high + 40 * percent Apprentice low + 60 * percent Apprentice medium + 80 *

percent Apprentice high + 100 * percent Proficient + 140 * percent Distinguished = a

school's academic index score.

Independent Variables

The independent variables used in both regressions are the schools

involvement in AMSP, the schools involvement in ARSI, the student to teacher ratio in

each school, the average years of experience for the teachers of each school, the amount

of spending for instruction by each school, the percent of students eligible for free or

reduced lunch in each school, the percentage of Black, Hispanic, Asian, and other race in

each school, the school year from which data were collected, a dummy variable for

missing data, and a lag score variable. Table 2 shows the mean and standard deviation of

each variable used in the analysis.

Table 2: Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
oaacode	7310	286519.2	161956	1010	650100
sch_year	7311	2.00E+07	16914.35	2.00E+07	2.01E+07
ave_years_exp	7311	9.353796	5.345153	0	26
spending	7310	4263.26	2602.314	0	59994
stratio	7306	12.6945	6.957347	0	29
maai	6831	69.35916	15.05889	13	126.262
scai	6866	77.9226	14.95346	31.3998	137.648
fr_per	6341	41.75869	27.06081	0	126.1724
etw_p	6217	56.19203	43.60783	0.1200407	100
etb_p	6217	6.021527	12.4266	0	100
eth_p	6217	0.6489884	1.570149	0	38.5
eta_p	6217	0.3745615	1.066593	0	27
eto_p	6216	1.00658	18.11414	0	1422
amsp	7137	0.0117697	0.1078553	0	1
arsi	7137	0.0371304	0.1890947	0	1
maailag	5783	67.79634	14.48362	13	126.262
scailag	5811	76.95551	14.68898	31.3998	137.648
miss_teacher	7311	0.2117357	0.4085665	0	1

The regression model analyzing math scores uses the previous year's math academic index score as the lag variable and the regression model analyzing science scores uses the previous year's science academic index score as the lag variable. Participation in AMSP and participation in ARSI are included as dummy variables. The NSF defines school participation in either project as having at least thirty percent of the school's total teachers participating in at least thirty hours.

Free and reduced lunch data are not available for the 2004-2005 school year because the Kentucky Department of Education determined it was not reliable information. An estimation of the percent of students eligible for free or reduced lunch in each school in 2004-2005 was used in the model. The estimation is the average of the percent of students eligible for free or reduced lunch in each school in the 2003-2004

school year and the 2005-2006 school year. This is a good estimation because the free and reduced lunch data are fairly consistent over time.

The student to teacher ratio in each school, the average years of experience for the teachers of each school, and the amount of spending for instruction by each school is not available for the 2005-2006 school year because this information is still being organized by the Kentucky Department of Education. In order to control for these missing data a dummy variable was created. The dummy variable enables observations from the 2005-2006 school year to remain in the model, as well as other observations that are missing these data for other reasons such as data collection error. Three hundred thirty-four observations not from the 2005-2006 school year are missing these data for other reasons. Even though the data for these variables is not known, the dummy variable makes it possible to see, on average, controlling for the other variables, how the math and science academic index scores for a school are affected when these data are missing.

Fixed Effects Specification

This study applied a fixed effects regression model to analyze the effect of the AMSP on student achievement. The estimates of coefficients derived from regression may be subject to omitted variable bias, a problem that arises when there is some unknown variable or variables that cannot be controlled for that affect the dependent variable. With panel data, it is possible to control for some types of omitted variables even without observing them, by observing changes in the dependent variable over time. Fixed effects regression models control for omitted variables that differ between cases but are constant over time. The data was analyzed using STATA v.9.

Two different regressions were performed, one for math scores and one for science scores. The same independent variables were used in both regressions, except in the case of the lag variable.

$$\text{Academicindexscore}_{it} = \beta_0 + \beta_1 \text{amsp}_{it} + \beta_2 \text{arsi}_{it} + \beta_3 \text{ave\_yrs\_exp}_{it} + \beta_4 \text{stratio}_{it} + \beta_5 \text{spending}_{it} + \beta_6 \text{fr\_per}_{it} + \beta_7 \text{lag}_{it} + \beta_8 \text{etb\_p}_{it} + \beta_9 \text{eth\_p}_{it} + \beta_{10} \text{eta\_p}_{it} + \beta_{11} \text{eto\_p}_{it} + \beta_{12} \text{sch\_year}_{it} + \beta_{13} \text{miss\_teacher}_{it} + \alpha_{it} + \varepsilon_{it}$$

where: $\text{Academicindexscore}_{it}$ is academic index score from school i
amsp_{it} is a dummy variable denoting if the school was involved with AMSP
arsi_{it} is a dummy variable denoting if the school was involved with ARSI
ave_yrs_exp_{it} is the teachers' average years of experience from school i
stratio_{it} is the student to teacher ratio from school i
spending_{it} is the amount of spending per student from school i
fr_per_{it} is the percentage of students eligible for free or reduced lunch from school i
lag_{it} is the previous year's academic index score in math or science from school i
etb_p_{it} is the percentage of Black students from school i
eth_p_{it} is the percentage of Hispanic students from school i
eta_p_{it} is the percentage of Asian students from school i
eto_p_{it} is the percentage of students of another race from school i
sch_year_{it} is the school year from which data were collected from school i
miss_teacher_{it} is a dummy variable denoting that the student to teacher ratio, teachers' average years of experience, and the amount of spending per student from school i are missing
α_{it} is the fixed effect for school i
ε_{it} is a random variable that is the error term for school i

Results of Analysis

The results of the fixed effects regression with the math academic index score for a given school as the independent variable are shown in Table 3. Asterisks denote those coefficients that are statistically significant.

Table 3: Fixed-Effects Regression for Math Academic Index Score

Maai	Coefficient	t-statistic	P-value
Sch_year	.0003561***	25.61	0.000
Ave_years_exp	.1463936*	1.79	0.073
Spending	-.0000197	-0.17	0.869
Stratio	-.3340711***	-3.71	0.000
Fr_per	-.1113017***	-8.83	0.000
Etb_p	-.0036808	-0.22	0.824
Eth_p	.3276665***	3.17	0.002
Eta_p	.353776**	2.29	0.022
Eto_p	-.0067424	-1.14	0.253
Amsp	-1.130401	-1.08	0.280
Arsi	-.3590882	-0.29	0.775
Maailag	-.0313947*	-1.89	0.059
Miss_teacher	-8.519316***	-3.99	0.000
Constant	-7051.424***	-25.39	0.000

Observations 5085
Corr(u_i, xb) 0.0245
Rho   .7319771
***p<.01
**p<.05
*p<.1

       The model shows that the coefficient AMSP is not significant at any level. This indicates that participating with AMSP has no effect on a school's math academic index score. Since a school's math academic index score tells us how a school performs in mathematics on the CATS assessment this can be translated to mean that participating with AMSP has no effect on student achievement in mathematics.

       Other independent variables are statistically significant in this model. School year, student to teacher ratio, the percent of students eligible for free or reduced lunch, the percent of Hispanic students, and missing teacher demographics and spending are significant at the .01 level. The percent of Asian students is significant at the .05 level. Teachers' average year's experience and a school's previous year's math academic index score are significant at the .1 level.

Math academic index scores are affected positively by the school year, teachers' average years of experience, the percent of Hispanic students, and the percent of Asian students. On average, a school's math academic index score increased by .0003561 points each school year. On average, a school's math academic index score increased by .146 points for each year increase in teachers' average years of experience. The math academic index score for a school increased by .328 points, on average, for every percent increase in Hispanic students at a school. The math academic index score for a school increased by .354 points, on average, for every percent increase in Asian students at a school.

Math academic index scores are affected negatively by the student to teacher ratio, the percent of students eligible for free or reduced lunch, the previous year's math academic index score, and missing teacher demographics and spending. For every point increase in a school's student to teacher ratio, on average, the math academic index score decreased by .334 points. On average, the math academic index score for a school decreased by .111 points for every percent increase in students eligible for free or reduced lunch at a school. The math academic index score for a school, on average, decreased by .0314 points for every point increase in the school's previous year's math academic index score. On average, the math academic index score for a school decreased by 8.52 points when data regarding teacher demographics and spending are missing.

The correlation between the independent variables and omitted variables are significant, but small at .1336. The model also shows that 73 percent of the variation in the schools' math academic index scores is due to fixed effects in the schools.

The results of the fixed effects regression with the science academic score for a given school as the independent variable are shown in Table 4. Asterisks denote those coefficients that are statistically significant.

Table 4: Fixed-Effects Regression for Science Academic Index Score

Scai	Coefficient	t-statistic	P-value
Sch_year	.0003329***	27.04	0.000
Ave_years_exp	.2152496***	2.96	0.003
Spending	.0002332**	2.20	0.028
Stratio	-.4817873***	-5.99	0.000
Fr_per	-.0508749***	-4.54	0.000
Etb_p	.0167352	1.14	0.256
Eth_p	.2905823***	3.15	0.002
Eta_p	.1551517	1.13	0.260
Eto_p	-.0091119*	-1.73	0.083
Amsp	1.341773	1.44	0.150
Arsi	2.314436**	2.07	0.039
Scailag	.0530588***	3.31	0.001
Miss_teacher	-9.293455***	-4.87	0.000
Constant	-6586.763***	-26.80	0.000

Observations   5086
Corr(u_i, xb) 0.1407
Rho   .78177186
***$p<.01$
**$p<.05$
*$p<.1$

The model shows that the coefficient AMSP is not significant at the .1 level or below. This indicates that participating with AMSP has no effect on a school's science academic index score. Since a school's science academic index score tells us how a school performs in science on the CATS assessment this can be translated to mean that participating with AMSP has no effect on student achievement in science. It must be noted, however, that AMSP is significant at the .15 level. At this level this indicates, on average, participating with AMSP increased a school's science academic index score by 1.34 points. .

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Additional variables are statistically significant. School year, teachers'
average years of experience, student to teacher ratio, the percent of students eligible for
free or reduced lunch, the percent of Hispanic students, last year's science academic
index score, and missing teacher demographics and spending are significant at the .01
level. Spending and participation in ARSI are significant at the .05 level. The percent of
students of another race in a school is significant at the .1 level.

Science academic index scores are affected positively by the increase in
school year, teachers' average years of experience, spending per school, the percent of
Hispanic students, participating in ARSI, and the previous year's science academic index
score. On average, a school's science academic index score increased by .0003329 points
each school year. On average, a school's science academic index score increased by .215
points for every year increase in teachers' average years of experience in a school. A
school's science academic index score increased by .0002332 points, on average, for
every dollar increase in spending by a school. On average, for every percent increase in
Hispanic students, a school's science academic index score increased by .291 points.
Participation in ARSI, on average, increased a school's science academic index score by
2.31 points. A school's science academic index score increased by .053 points, on
average, for every point increase in a school's previous year's science academic index
score.

A school's science academic index score is negatively affected by an increase
in the student to teacher ratio, the percent of students eligible of free or reduced lunch, the
percent of students of another race, and when data are missing about teacher
demographics and spending. For every point increase in a school's student to teacher

ratio, on average, a school's science academic index score decreased by .482 points. On average, a school's science academic index score decreased by .051 points for every percent in increase in students eligible for free or reduced lunch at a school. A school's science academic index score decreased by .009, on average, for every percent increase in students of another race. If data are missing regarding teacher demographics and spending, on average, a school's science academic index score decreased by 9.29 points.

The correlation between the independent variables and omitted variables are significant, but small at .1407. The model also shows that 78 percent of the variation in the schools' math academic index scores is due to fixed effects in the schools.

Conclusion

While this study finds AMSP to have no effect on increasing student achievement, it would be rash to assume AMSP has achieved nothing. It is quite possible AMSP will have an effect on student achievement in the future. It must be noted that the data available and used in this analysis was only for three complete years and one year without teacher demographics and spending for which AMSP has been in existence. It is very likely that the effects of AMSP have not had time to fully take affect in these four years. The initial stages of any project, especially a project of this magnitude, can be slow. This hypothesis is supported by the effects this study found ARSI participation to have. Participation in ARSI was found to increase schools' science academic index scores by 2.31 points, even though it began in 1995 and ended after the 2004-2005 school year. Further research should be conducted on its effect. This study should be done again after all 5 years of the project have been completed and again a few years later to see if any affects have taken place.

It is also possible that AMSP is currently having an effect but it is not showing up at the school level. It would be beneficial to do this study at the classroom level with measures of the level of engagement of teachers. At this level, it would be possible to compare participating teachers with non-participating teachers within a school and between schools. This study would give a stronger conclusion as to the effects of AMSP on student achievement.

Based on the fact that this analysis was conducted with data complete for only three years and at the school level as opposed to the classroom level, it is not reasonable to conclude that the type of professional development that AMSP is employing has no effect on student achievement in mathematics and science. I agree with the National School Board Foundation which, as stated in the Literature Review, believes investment in teachers' skills and knowledge, through professional development, is the best policy tool that any school board or district has. This is true because with the high demand for teachers, especially in low performing schools, it is not practical to place higher barriers to entry, like higher degree requirements or better GPA's, into the education field. If this were done there is a great possibility that some schools would not have enough teachers. Professional Development is the greatest control schools have on the quality of their teachers, who, based on much research, have an enormous impact on student achievement.

Policy Recommendations

The education achievement gap in Central Appalachia, especially in the areas of mathematics and science must be immediately addressed successfully in order to prevent further enlargement of this gap. Based on past research and realistic limitations on

policies that can be enacted in school systems, the most advantageous policy than can be

adopted in Central Appalachia in order to reduce the educational achievement gap is

requiring teachers to attend professional development courses that teach subject content

knowledge and basic teaching skills.

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