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The Influence Of Taking High School Physics As [A] Junior On Act Science Scores

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THE INFLUENCE OF TAKING HIGH SCHOOL PHYSICS AS JUNIOR ON ACT SCIENCE SCORES

BY

BARTHOLOMEW T. FREY

THESIS

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I HEREBY RECOMMEND THAT THIS THESIS BE ACCEPTED AS

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Abstract

In recent years, policymakers, parents, and business leaders have expressed concern about the lack of student success on standardized tests in science. While the consensus is that the problem needs to be addressed, there is little agreement about how to achieve the increased test scores. This study examines the role of the specific science sequencing of biology, chemistry and physics completed by the junior year and increased ACT science test scores. This study compared the achievement of students who took physics as a junior with students who took physics as a senior on the ACT science test. This study continued by examining the increased ACT science test success of students in the top 25% of their graduating class who took physics by their junior year and those that did not.

Dedication

This thesis is dedicated to my father and mother, who epitomize selflessness and commitment to others.

Acknowledgements

As a professor, thesis chair, or mentor, the assistance of Dr. Steven Daniels has been immeasurable. Because of him, I was given insight that steered the thesis to what it was.

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This venture would not have been achievable without the contributions of my colleagues at Geneseo High School. Special recognition goes to Jon Obrecht, Fran Hirschfelder, and Alan Ringenberg. Their humor and dedication to student achievement have greatly contributed to this endeavor.

Finally, this project would not be possible without the real sacrifices of my parents, Rodney and Margaret Frey. This study and my success are the direct result of their undying dedication to their child's prosperity.

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Introduction

Historically, physics has been viewed as a difficult science course. People tend to have a polar opinion of the course. In fact two out of every three high school graduates in the United States did not take physics as a part of their academic preparation (Popkin, 2010).

At the same time, colleges and universities across the nation have experienced large increases in applications for admission. According to the Huffington Post (2011), this is evident even in prestigious universities and elite Ivy League schools that have seen the number of applications increase 3% to 32%. Therefore, common sense would suggest that admission into college is becoming more competitive for high school graduates.

Most colleges see grade point average, class rank, course rigor, and standardized test scores as useful factors for college admission and predictors of future academic success (Astin, 1971; Bloom & Peters, 1961; Conley, 2005; Hanford, 1991; Postman, 2000; Willingham, Lewis, Morgan, & Ramist, 1990; Zwick, 2002). Standardized test performance can even serve as a useful factor when it conflicts with the other factors such as grade point average and class rank (Donlon & Angoff, 1971). Standardized test performance could also serve to alert colleges when it is not consistent with other admission factors (Donlon & Angoff, 1971).

Thus, it would appear that success in the high school classroom coupled with standardized test scores are critical considerations for the high school graduate seeking admission into the most competitive colleges and universities. Hence, an aggressive course planning strategy to allow for success in the classroom and on standardized tests would be preferred. If statistical evidence existed to suggest a specific course sequence could yield greater performance on standardized tests, then that would enable more students to become better candidates for college.

Recent legislation and state education policy in Illinois place the evaluation of a school solely on standardized test performance of the students. So, another benefit from increased performance on test scores is that the school appears in a better light by those in the general public and policymakers. Therefore, if a course sequence resulted in improved test scores, schools should view this as important to implement for students.

Geneseo High School is a grade 9-12 public high school with an enrollment of approximately 900 students located in rural western Illinois. It enrolls almost 97% white students with the other 3% comprised of various ethnic minorities (Illinois State Board of Education, 2010). Almost 18% of the Geneseo High School students come from low income households and the school has a less than 1% dropout rate (Illinois State Board of Education, 2010).

Like all other high schools in the state, Geneseo High School is evaluated by its students' success on the Prairie State Achievement Examination or PSAE for short. The PSAE is composed of two tests over two days of testing. The first day of the PSAE is the ACT (Illinois State Board of Education, 2011). It includes subject assessment in English, reading, writing, math, and science. Day two of testing includes "an ISBE-developed science assessment, and two WorkKeys assessments (Applied Mathematics and Reading for Information)" (Illinois State Board of Education, 2011).

To prove instructional adequacy, Geneseo High School must show improvement each year in the PSAE to conform with state and federal mandates. This includes individual subject area evaluation in English, reading, math and science. Therefore, it is possible to achieve adequate progress in science alone. According to the Illinois State Board of Education (ISBE), Geneseo has had its percentages of students meeting or exceeding the appropriate standards in PSAE reported from the 2001-2002 academic year to the

2009-2010 academic year. According to the yearly school report card from the ISBE (2011), the percentages meeting and exceeding in science were as follows: 60.8%(2001-2002), 64.0%(2002-2003), 60.3%(2003-2004), 60.3%(2004-2005), 63.3%(2005-2006), 58.6%(2006-2007), 69.1%(2007-2008), 67.5%(2008-2009), and 76.4%(2009-2010). According to SchoolDigger.com (2010), the 76.4% meeting and exceeding in science on the PSAE ranked Geneseo High School in the top 5% of Illinois high schools.

The percentages of students meeting and exceeding standards in PSAE in the last three academic years showed significant improvement. This kind of improvement garnered investigation as to the cause(s). The first hypothesis was that this was a residual effect of improvement in other subject areas. This was dismissed because the first six years of PSAE testing from academic year 2001-2002 through 2006-2007 showed no distinguishable difference between the other subject area performances and the science performance. Only in the last three years have all subject areas trended together with science showing the highest percentages in each year.

The next investigation was to look at the numbers of students taking the advanced science track of biology, chemistry, and physics respectively in the first three years of high school (we will call this the advanced science course sequence). During the academic year 2006-2007, significant effort was put in to encouraging students entering high school to embrace the advanced science course sequencing. In 2007-2008 10.5% of students had completed the advanced science tract by the completion of their junior year, 18.5% in 2008-2009, 2009-2010 had 24.8% and 22.4% in 2010-2011. According to the ACT (2010), only 10% off all students who took the ACT during the 2009-2010 school year had completed the advanced science course sequence nationally, while 21% completed it in Illinois.

In order to draw conclusions about course sequencing and test score performance, proper statistical study would need to be used with PSAE data of previous years. That way a positive comparison between advanced science sequence involvement and increased ACT scores could be investigated. Thus, students, parents, school administration, and the school board could be properly educated about the findings and the impact on student achievement.

Literature Review

For years the ACT (2010) has reported comparisons between science course sequencing and ACT averages nationally and by individual states. According to the ACT (2010), six categories were used to match science course sequencing with average ACT scores for each category. This data was based on student self-reporting of grades and course sequencing (Baird, 1976; Maxey & Ormsby, 1971; Sawyer, Laing, & Houston, 1988). The six categories included:

Biology, Chemistry, Physics

General Science, Biology, Chemistry, Physics

General Science, Biology, Chemistry

Other Combinations of 3 Years of Science

Less Than 3 Years of Natural Science

No Natural Science/Grade Information Reported

From 2002 to 2010 nationally, the ACT reported through yearly reports that the science test average ranged from 23.0 to 23.7 for the students who self-reported taking biology, chemistry and physics as a science sequence. The self-reported series of general science, biology, chemistry, and physics had a yearly science test average ranging from 22.2 to 22.5 on the ACT science test. The self-reported progression of general science, biology, and chemistry had a year average from 20.1 to 20.2 on the ACT science test. Students who took three years science, but in a unique sequence according to ACT scored a yearly average ranging from 19.7 to 20.6 on the ACT science test. The group of students who self-reported less than 3 years of natural science saw a yearly mean that ranged from 18.3 to 19.1 on the ACT science test. The group that failed to self-report and put into the category of no natural science/grade information reported had a yearly average that ranged from 17.4 to 20.9 on the ACT science test.

In Illinois similar values were obtained. From 2004 to 2010, the ACT reported that Illinois test takers on the ACT science test average ranged from 23.3 to 23.9 for the students who self-reported taking biology, chemistry and physics as a science sequence. The self-reported series of general science, biology, chemistry, and physics had a yearly science test average ranging from 21.5 to 21.9 on the ACT science test. The self-reported progression of general science, biology, and chemistry had a year average from 19.2 to 19.8 on the ACT science test. The group identified as other combinations of 3 years of natural science scored a yearly average ranging from 18.6 to 18.9 on the ACT science test. The group of students who self-reported less than 3 years of natural science saw a yearly mean that ranged from 18.0 to 18.9 on the ACT science test. The group that failed to self-report and put into the category of no natural science/grade information reported had a yearly average that ranged from 17.5 to 20.1 on the ACT science test.

While the scores appear to suggest biology, chemistry, and physics as the superior sequence for maximum performance on the ACT science test, the issue of self-reporting may be cause for suspicion of validity. However, studies have validated the strong correlation of self-reported courses and the actual courses that students took (Baird, 1976; Maxey & Ormsby, 1971; Sawyer, Laing, & Houston, 1988).

Therefore the only roadblocks to incorporating the ACT's data for the purpose of science course sequencing rested in the statistical validity of ACT's data and the effect self-selection had on the findings. The goal of this study was to investigate, through statistical comparison of equivalent a priori test groups, the superior science sequence as reported by the ACT. Also, the study intended to address the concerns of self-selection and statistical significance.

Method

Participants

To investigate previous findings, four sample groups were used with the following classifications: students who took physics as a junior, students who took physics as a senior, students in the top 25% of their class who took physics as a junior, and students in the top 25% who did not take physics as a junior. This allowed for some comparisons as the first group would be the college bound "advanced science course sequence" and the second group would be the college bound regular science course sequence. Also, the third and fourth groups were developed in case there was a self-selection that the top students in the school took the "advanced science course sequence". The third and fourth groups were based on class ranking and so were nominally equivalently academically talented students. The sample group of students who took physics as a junior consisted of 56 males and 56 females from academic year 2007-2008 through academic year 2009-2010. The sample group of students who took physics as a senior consisted of 56 males and 14 females from academic year 2007-2008 through academic year 2009-2010. The sample group of students in the top 25% of their class who took physics as a junior consisted of 38 males and 55 females from academic year

2008-2009 through academic year 2010-2011. The sample of students in the top 25% who did not take physics as a junior comprised of 25 males and 35 females from academic year 2008-2009 through academic year 2010-2011.

Measures

Norm-referenced standardized tests provided the measure of student performance. Student scores were evaluated on the ACT science tests taken in late April of their junior year or in their senior year. According to the ACT website, act.org, the ACT science test scores range from 1-36 in a 40 question multiple choice format for 35 minutes. (2011) The precursor to the ACT in the College and Career Readiness System is the PLAN test. (ACT, 2011) The PLAN test was administered in the students' sophomore year prior to any enrollment into physics. PLAN science scores range from 1-32 in a 30 question, multiple choice format test that students are given 25 minutes to complete (ACT, 2011). The use of PLAN science scores was used to establish statistically comparable groups between students that took physics as a junior and those students that did not take physics as a junior. Thus, the correlation of physics enrollment and ACT science score performance could be studied while simultaneously addressing the issue of self-selection.

Procedure

The investigation was conducted in May and June 2011. Three distinct statistical comparisons were utilized in this project. ACT Science scores were obtained and grouped in the following categories: students who took physics as a junior, students who took physics as a senior, students in the top 25% who took physics as a junior, and students in the top 25% who did not take physics as a junior. In each study, the ACT science scores of a group who took physics as a junior were compared to the ACT science scores of a group that did not take physics as a junior.

Inclusion in the top 25% was determined by the final ranking upon graduation for the graduating classes of 2011 and prior. For data affiliated with the graduating class of 2012, the class ranking was determined upon the completion of the 2010-2011 academic year.

To address the issue of bias, ACT and PLAN scores were obtained from students who had completed at least their junior year before the creation of the study. The specific restriction eliminated the propagation of bias to sway academically achieving students into the course and prevent the admission of lower performing students. Also, while the PLAN test was only administered once during the student's sophomore year, the ACT could have been taken multiple times by students in their junior and senior years. In those cases, the best ACT science score was used for analysis. Historical data from the 2007-2008 academic year through 2010-2011 academic year were employed.

The first study compared ACT science scores from students who took physics as a junior to ACT science scores from students who took physics as a senior. For this investigation, student ACT science score data was used from the graduating classes of 2009 through 2011. In the event that a student was missing an ACT science score, the student was eliminated from the comparison. Every student in each group had an ACT science score on record.

The second investigation compared ACT science scores from only students who were in the top 25% of their class. According to Faulkner (2002), class rank has been a strong predictor of student success in college for the University of Texas at Austin. The comparison of only the top 25% addressed the issue of self-selection within the groups. By the restriction of class rank, similar academic achievement was compared. Students who were in the top 25% of their class and took physics as a junior were compared with students who were in the top 25% of their class and did not take physics during their junior year. For this investigation, student ACT science score data was used from the graduating classes of 2010 through 2012. In the event that a student was missing an ACT science score, the student was eliminated from the comparison. Three students evaluated in the group that did not take physics as a junior were missing an ACT science score, so their partial scores were dismissed from study. There were no missing scores from the group who took physics as a junior.

The third study included the same groups as the second investigation. PLAN science scores were utilized to establish comparative groups between the students who did take physics during their junior year and the students who did not take physics during their junior year. Then, the corresponding ACT science scores were evaluated to expose a difference between the two groups.

Four students evaluated in the group that did not take physics as a junior were missing either a PLAN or an ACT science score, so they were not included in the study. There were no missing scores from the group who took physics as a junior.

Initial investigation of PLAN science scores proved to be different from the outset for the two groups, so three levels of adjustment to the scores were implemented. In the first sequence, the PLAN science scores of 16-19 were eliminated from consideration along with the corresponding

ACT science scores for the group that did not take physics as a junior. Those data sets were then tested against the data sets obtained from the group that did take physics as a junior for congruency. The resulting ACT science score groupings were evaluated for difference. The goal of this step was to significantly reduce the effect of the lower achieving students in the students who did not take physics as a junior group.

Next, the PLAN science scores of 24-31 along with the matching ACT science scores were removed from evaluation from the group that took physics as junior. The PLAN science data remaining were then tested against the original PLAN science data from the group that did not take physics as a junior for compatibility. Once likeness among PLAN science scores was established, ACT science scores were evaluated for distinction. The intent of this step was to eliminate the effect of the higher achieving students in the students who took physics as a junior group.

Finally, the PLAN science scores of 16-19 along with the corresponding ACT science scores were eliminated from consideration along with the corresponding ACT science scores for the group that did not take physics as a junior. Also, the PLAN science scores of 29-31 along with the matching ACT science scores were removed from evaluation from the group that took physics as junior. The PLAN science data remaining for the group that did not take physics as a junior were then tested against the remaining PLAN science data from the group that did take physics as a junior for compatibility. Once likeness among PLAN science scores was established, ACT science scores were evaluated for distinction.

Research Hypotheses

Two research hypotheses were postulated.

Hypothesis 1. Taking physics as a junior will result in a higher ACT science score than taking physics as a senior.

Hypothesis 2. Students in the top 25% who took physics as a junior will score better on the ACT science test than students in the top 25% who did not take physics in their junior year.

Results

Table 1 shows the data from the group who took physics as a junior and the data from the group who took physics as a senior. A two-tailed, unpaired-samples t-test was conducted to compare the ACT science scores of the students who took physics as a junior (M=27.4, SD=3.85, N=112) and the ACT science scores of the students who took physics as a senior (M=24.9, SD=4.00, N=70). The results for the students who took physics as a junior were determined to be significantly different from the students who took physics as a senior; $t(180)=4.20$, $p < .001$, 95% CI [1.3, 3.7]. These results suggested that students who chose to take physics as a junior experienced a better ACT science test score than those students who chose to take physics as a senior.

Table 2 shows the data from the students in the top 25% who took physics as a junior and the data from the students in the top 25% who did not take physics as a junior. A two-tailed, unpaired-samples t-test was conducted to compare the ACT science scores of the students in the top 25% who took physics as a junior and the ACT science scores of the students in the top 25% who did not take physics as a junior. There was a significant difference in the students in the top 25% who took physics as a junior

(M=27.7, SD=3.42, N=93) and the ACT science scores of the students in the top 25% who did not take physics as a junior (M=24.5, SD=4.02, N=60) conditions; $t(151) = 5.27$, $p < .001$, 95% CI [2.0, 4.4]. These results suggest that taking physics as a junior resulted in higher ACT scores than not taking physics as a junior for the academically gifted students in the top 25%.

Table 3 shows the PLAN science and corresponding ACT science data from the students in the top 25% who took physics as a junior and the from the students in the top 25% who did not take physics as a junior. The PLAN science scores of 16-19 from the students in the top 25% who did not take physics as a junior were ignored and compared to the PLAN science scores of the students in the top 25% who took physics as a junior. A two-tailed, unpaired-samples t-test was conducted to compare the PLAN science scores of each group. No significant difference was determined in the group that took physics as a junior (M=23.1, SD=3.35, n=93) and the group that did not take physics as a junior (M=22.5, SD=2.88, n=41); $t(132) = .996$, $p = .321$.

The corresponding ACT data was then compared using a two-tailed, unpaired-samples t-test. There was a significant difference in the ACT scores of the students who took physics as a junior (M=27.7, SD=3.72, n=93) and the ACT scores of the students who did not take physics as a junior (M=25.7, SD=3.77, n=41); $t(132) = 2.86$, $p = .005$, 95% CI [.6, 3.4]. These results point to a correlation between taking physics as a junior and improved ACT science test performance even for the students in the top 25% of their class.

Next, the PLAN science scores of 24-31 from the students in the top 25% who took physics as a junior were ignored and compared to the PLAN science scores of the students in the top 25% who did not take physics as a junior. A two-tailed, unpaired-samples t-test was conducted to compare the PLAN science scores of each group. No significant difference was determined in the group that took physics as a junior (M=20.9, SD=1.46, n=59) and the group that did not take physics as a junior (M=21.0, SD=3.36, n=59); $t(116) = .210$, $p = .834$.

The corresponding ACT data was then compared using a two-tailed, unpaired-samples t-test. There was a significant difference in the ACT scores of the students who took physics as a junior (M=26.3, SD=2.89, n=59) and the ACT scores of the students who did not take physics as a junior (M=24.5, SD=4.05, n=59); $t(116) = 2.78$, $p = .006$, 95% CI [.5, 3.1]. The implications from these results further suggest the correlation between increased ACT science test performance and the enrollment in physics as a junior for the academic elite.

Finally, PLAN science scores of 16-19 from the students in the top 25% who did not take physics as a junior and the PLAN science scores of 29-31 from the students in the top 25% who took physics as a junior were ignored. The remaining data from both groups were compared using a two-tailed, unpaired-samples t-test to compare the lowest PLAN science scores of students in the top 25% who took physics as a junior and the highest PLAN science scores of the top 25% students who did not take physics as a junior. There was no significant difference between the PLAN science scores of the remaining students who took physics as a junior (M=22.3, SD=2.51, n=83) and the PLAN science scores of the remaining students who did not take physics as a junior (M=22.5, SD=2.88, n=41); $t(122) = .397$, $p = .692$.

The corresponding ACT data was then compared using a two-tailed, unpaired-samples t-test. There was a significant difference in the ACT scores of the students who took physics as a junior (M=27.2, SD=3.40, n=83) and the ACT scores of the students who did not take physics as a junior (M=25.7, SD=3.77, n=41); $t(122) = 2.23$, $p = .028$, 95% CI [.2, 2.8]. These results additionally suggest the correlation between physics taken as a junior and increased ACT science test scores for even the best students in the school.

Table 1

ACT Scores by Junior and Senior Physics Enrollment

(2007-2008 through 2009-2010 Academic Years)

Physics As A Junior

19	23	25	26	27	29	30	32
19	23	25	26	27	29	30	32
20	23	25	26	27	29	30	33
21	23	25	26	27	29	30	33
21	24	25	27	28	29	30	34
21	24	25	27	28	29	30	34
22	24	25	27	28	29	30	35
22	24	25	27	28	29	30	35
22	24	25	27	28	29	30	35
22	24	25	27	28	29	30	35
22	25	26	27	28	29	31	35
23	25	26	27	29	30	31	36
23	25	26	27	29	30	31	36
23	25	26	27	29	30	31	36

Physics As A Senior

8	21	23	24	25	26	27	30
20	21	23	24	25	26	27	30
20	21	23	24	25	26	27	31
20	22	23	24	25	26	27	33
20	22	23	24	25	26	28	35
21	22	24	25	25	26	28	35
21	23	24	25	25	26	28	35
21	23	24	25	25	26	29	
21	23	24	25	26	26	29	

Table 2

Top 25% Students ACT Scores by Physics Enrollment

(2008-2009 through 2010-2011 Academic Years)

Physics As A Junior

20	24	25	26	28	29	30	34
21	24	25	26	28	29	30	34
22	24	25	27	28	29	30	35
22	24	25	27	28	29	31	35
22	24	25	27	28	29	31	35
23	24	25	27	28	29	31	35
23	24	26	27	28	29	32	36
23	24	26	27	28	29	32	36
23	25	26	27	28	30	32	36
23	25	26	27	28	30	33	
24	25	26	27	28	30	33	
24	25	26	27	29	30	33	

Without Physics As A Junior

13	21	23	23	25	26	27	33
18	21	23	23	25	26	27	35
18	22	23	24	25	26	27	35
19	22	23	24	25	26	27	35
20	22	23	24	25	26	27	
20	22	23	24	25	26	28	
20	22	23	24	25	26	29	
21	22	23	25	25	27	32	

Table 3

Top 25% Students PLAN and Corresponding ACT Scores by Physics Enrollment (2008-2009 through 2010-2011 Academic Years)

Without Physics As A Junior

PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT
16	22	18	22	20	21	20	26	22	23	25	24
16	18	18	26	20	20	20	25	22	27	25	25
16	20	18	22	20	25	20	25	23	35	25	33
16	13	18	21	20	23	21	26	23	25	25	25
17	23	19	26	20	22	21	21	23	26	27	25
17	19	19	23	20	25	21	27	23	29	27	35
17	23	19	23	20	23	21	28	23	20	28	27
18	22	19	23	20	23	21	22	24	35	29	27
18	18	20	26	20	25	22	24	25	24	31	32
18	27	20	24	20	23	22	27	25	24		

Physics As A Junior

PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT	PLAN	ACT
18	22	20	24	21	24	22	29	24	34	27	30
18	24	20	26	21	21	23	28	25	36	28	33
19	24	20	23	21	30	23	24	25	32	28	27
19	25	20	27	22	29	23	28	25	28	29	25
19	22	20	23	22	26	23	28	25	27	29	28
19	29	20	25	22	31	23	25	25	24	29	29
19	26	20	24	22	26	23	26	25	26	29	35
19	30	21	26	22	25	23	30	25	29	29	36
19	23	21	28	22	28	23	28	25	27	29	27
19	25	21	24	22	29	23	27	25	28	31	29
19	20	21	30	22	24	23	25	26	32	31	35
19	22	21	33	22	27	24	29	26	32	31	36
20	30	21	25	22	27	24	34	27	35	31	35
20	27	21	24	22	30	24	27	27	26		
20	25	21	29	22	33	24	31	27	23		
20	23	21	28	22	28	24	25	27	31		

Discussion

The comparison of the students who took physics as a junior fared better in every statistical evaluation within the study. The implication that physics taken in the junior year showed significant benefit in ACT science score performance was corroborated in each t-test. In all of the t-tests comparing ACT scores, the $p < 0.05$, suggested a high level of significance.

The first comparison of the ACT science scores of students who took physics as a junior and the ACT science scores of students who took physics as a senior attempted to resolve the benefit of taking the course earlier than later. The ACT has shown that students who took the sequence of biology, chemistry, and physics performed better on the ACT science test than the students who took the general science, biology, chemistry, and physics preparation (ACT, 2002-2010). This study confirmed the increased performance identified initially by the ACT based on course sequence.

However, it can be argued that such an occurrence could be the result of self-selection. Reason would suggest that the best students would take the most challenging courses. To address this concern, the second and third components of the investigation were implemented.

The top 25% of the 2010, 2011, and 2012 graduating classes were used to compare assumed identical groups. This strategy also attempted to address the role of test taking ability on ACT science test achievement. The goal of these parts was to create a deficient free group or an advantaged group of students who did not take physics as a junior. The third part attempted to strengthen the group who did not take physics as a junior as PLAN scores of 16-19 were dropped. Simultaneously, the group who did take physics as a junior were weakened as PLAN scores of 29-31 were excluded.

In essence, the better scores of the group without physics were compared with the lesser scores of group with physics as a junior. The t-test showed significant difference even in the extreme comparison. These two adjustments provided compelling consideration that self-selection was at worst minimized, and at best, eliminated entirely. In reality, the data does show a strong correlation between taking physics as a junior and doing better on the ACT. While this does not demonstrate a causal relationship between physics and strong ACT scores, it does point to some advantage that those students who take this route must have.

This study employed three distinct groups that differed in the aspect of physics course participation. Academic backgrounds and abilities were addressed so that the focus could point toward the benefit of taking physics as a junior. That design allowed the study's results to be more compelling. However, the sample groups were not chosen at random, and the scope of the study was very narrow as other high schools were not considered for participation. The data only went back as far as four years, and in some cases, three years. Resource and time considerations prevented the study from being more exhaustive.

In this study, the students who took physics were taught by the same instructor. The study did not address the role the educator had in the development of the appropriate skills to perform better on the ACT science test. Therefore, the study cannot be used to create causation that merely taking physics as a junior will result in increased ACT science scores. Certainly, the skill of the instructor and the design of the course would be need to be studied as well. The study did confirm that under similar conditions as listed in the investigation, a strong correlation existed between students who took physics as a junior in their high school science preparation and increased ACT science test scores.

Therefore, the appropriate continuation of this research would be to include a broader scope of high school inclusion. Also, a deeper historical study within the schools may provide further insight to the significance of physics course sequencing on ACT science test score performance.

Instructor involvement into the performance on the ACT science test may also be fruitful experimentation. The distinction between the person instructing the course and the merit of the course is necessary to consider. The goal of the study was to expose the merit of taking physics during the junior year on ACT science test performance. The elimination of outside factors would significantly solidify the merits of the course.

Conclusions

Students understand the importance of a good test score on a standardized test such as the ACT. The benefits of preferred consideration for admission certainly make any advantage in ACT test performance attractive. The apparent benefits of taking physics as junior, preceded by taking biology and chemistry, increased performance on the ACT science test.

This benefit was observed especially by the top students within a graduating class. Traditionally, the best students within a graduating class also have the highest standardized test scores, so this group tends to have less opportunity for significant improvement. Therefore, any noticeable improvement within this group through course sequencing is remarkable and cause for course planning consideration. While the case has not been closed on the prospect of taking physics to increase ACT science test scores, the results of this study were compelling and encouraging.

The gain of increased student performance on standardized tests will also benefit schools and teachers. Recent legislation at the state and federal levels put a higher reliance on student performance on standardized tests in evaluating the success or failure of the school and teacher. Therefore, any evidentiary support to increased student achievement can benefit the teacher and school as well.

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